HOW TO ACHIEVE Common Core With Tech:

{THE MATH STRAND}

[9] Grades [114] Standards

[20] Projects

ASK A TECH TEACHER

How to Achieve Common Core Standards with Tech

The Math Strand

9 Grades
114 Standards
20 Projects

By Ask a Tech Teacher©

2013

Visit the companion website at http://askatechteacher.com for more resources to teach K-12 technology

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Introduction

Technology has become synonymous with education reform. Like starter on a barbeque, squirt around enough iPads and digital tools and classes start to sizzle.

Everyone agrees it's a transformative tool, but there's little consensus on how to integrate it into a curriculum. Endless conversation. Spirited debate. An impressive number of pilot programs and great ideas all with decidedly mixed results.

That is, until Common Core State Standards arrived in classrooms across the country. Its rigorous approach to preparing students for college and career treats tech-in-ed as decided science. Of course teachers use it in classrooms, as one of many tools to deliver quality content to eager students.

Consider these tech-centric Standards spread throughout K-8 Common Core strands (truncated for brevity):

- *Expect students to demonstrate sufficient command of **keyboarding** to type a minimum of one page [two by fifth grade] in a single sitting*
- *Expect students to **evaluate different media** (e.g., print or digital …)*
- *Expect students to **gather relevant information** from print and digital sources*
- *Expect students to integrate and evaluate **information presented in diverse media** and formats*
- *Expect students to **interpret information** presented visually, orally, or quantitatively (e.g., … interactive elements on Web pages)*
- *Expect students to make **strategic use of digital media***
- *Expect students to use **glossaries or dictionaries, both print and digital** …*
- *Expect students to use information from **illustrations and words in print or digital** text*
- *Expect students to use a **variety of media** in communicating ideas*
- *Expect students to **use technology** and digital media strategically and capably*
- *Expect students to **use text features and search tools** (e.g., key words, sidebars, **hyperlinks**) to locate information*

> *Use of technology differentiates for student learning styles by providing an alternative method of achieving conceptual understanding, procedural skill and fluency, and applying this knowledge to authentic circumstances.*
>
> *—Common Core*

…and this Common Core note:

> ***New technologies** have broadened and expanded the role that speaking and listening play in acquiring and sharing knowledge and have tightened their link to other forms of communication. **Digital texts** confront students with the potential for continually updated content and dynamically changing combinations of words, graphics, images, **hyperlinks**, **and embedded** video and audio.*

The underlying theme can't be ignored: A 21st Century learner requires technologic proficiency. Proof enough is that Common Core summative assessments will be completed online—only possible if students use technology as comfortably as paper and pencil to demonstrate knowledge.

What's in the Common Core Tech Series?

OK. You're convinced, but how do you get tech into your classes? You don't have time for another subject in your already bloated curriculum?

You'll love this series—*How to Achieve Common Core With Tech*. Here, we show you easy-to-understand tech that can be used as a tool to accomplish the standards. The technology is always grade-appropriate, often intuitive, no more complicated to use than any other educational tool, like iPads or manipulatives.

Each volume addresses a separate Common Core strand:

- *Language*
- ***Math***
- *Reading*
- *Speaking-listening*
- *Writing*

You see how to use computers, websites, iPads, graphic art, infographics, web widgets and other tech tools to scaffold what you already teach, using tech to deliver Common Core's big ideas:

- *Provide practical strategies for students and teachers to publish and share*
- *Provide flexible learning paths*
- *Differentiate for varied student learning styles*
- *Share scalable projects that suit many classroom demands*
- *Increase rigor*
- *Make students accountable for their own learning*

> *Digital materials that are smaller than a course can be useful... adapted for clusters of standards or progressions within a cluster.*
>
> *—Common Core*

In this volume—*Math*—you'll find effective strategies to prepare students for rigorous math while covering 100+ **Common Core Standards in Literacy and Math.**

Big Idea of This Book

Common Core has refocused the teaching of math. No longer do you rush to present all material every year. Now, each grade focuses of specific topics, as part of a coherent strategy, with the application of rigor--

Focus
Coherence
Rigor

A triumvirate. Each year scaffolds on prior years with students expected to remember and use what they learn as math is linked to major topics within the grade level—less a stand-alone subject than a tool. The goal: Conceptual understanding, procedural skill and fluency, and application.

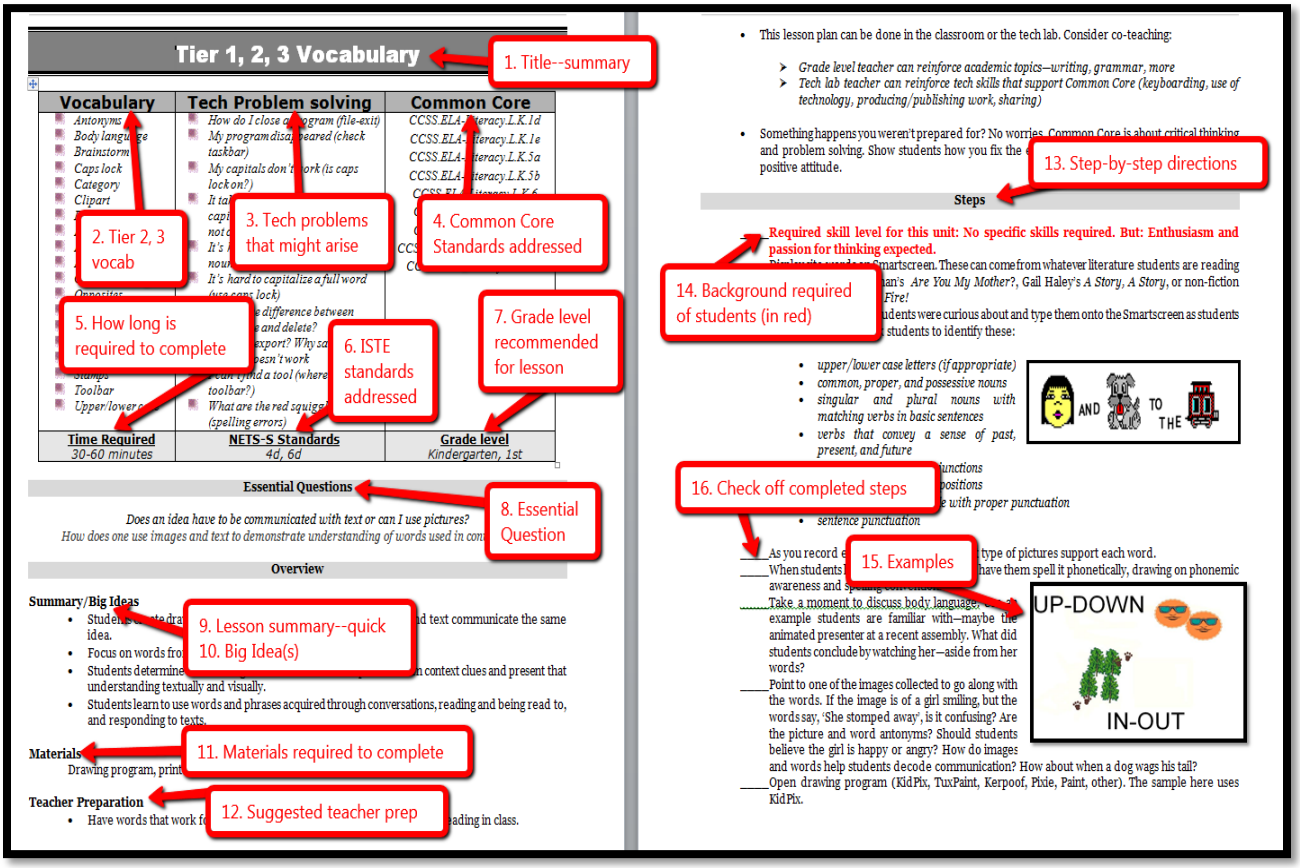
Use the twenty projects in this book to make that happen.

How the Book is Organized

Each lesson shows how to use technology to achieve Common Core Math Standards (*Figure 1)* as follows:

1. *Title—overview of what the project addresses*
2. *Vocabulary-academic/domain-specific used*
3. *Tech Problem solving—common tech problems faced when teaching lesson—and solutions*
4. *Common Core—standards addressed*
5. *Time Required—how long lesson will take to complete*
6. *NETS-S Standards—ISTE standards addressed*
7. *Grade level—recommended grades*
8. *Essential Question—what should student leave lesson understanding*
9. *Summary—what is accomplished*
10. *Big Idea—what student gets from time spent on this topic*
11. *Materials—software, hardware, equipment teacher should have available to complete lesson*
12. *Teacher preparation—how should teacher be prepared*
13. *Steps—step-by-step directions*
14. *Required skill level—what tech background should students have to accomplish stated goals*
15. *Examples—where relevant*
16. *Check off—track what's accomplished. Why? Some lessons take more than a class session*

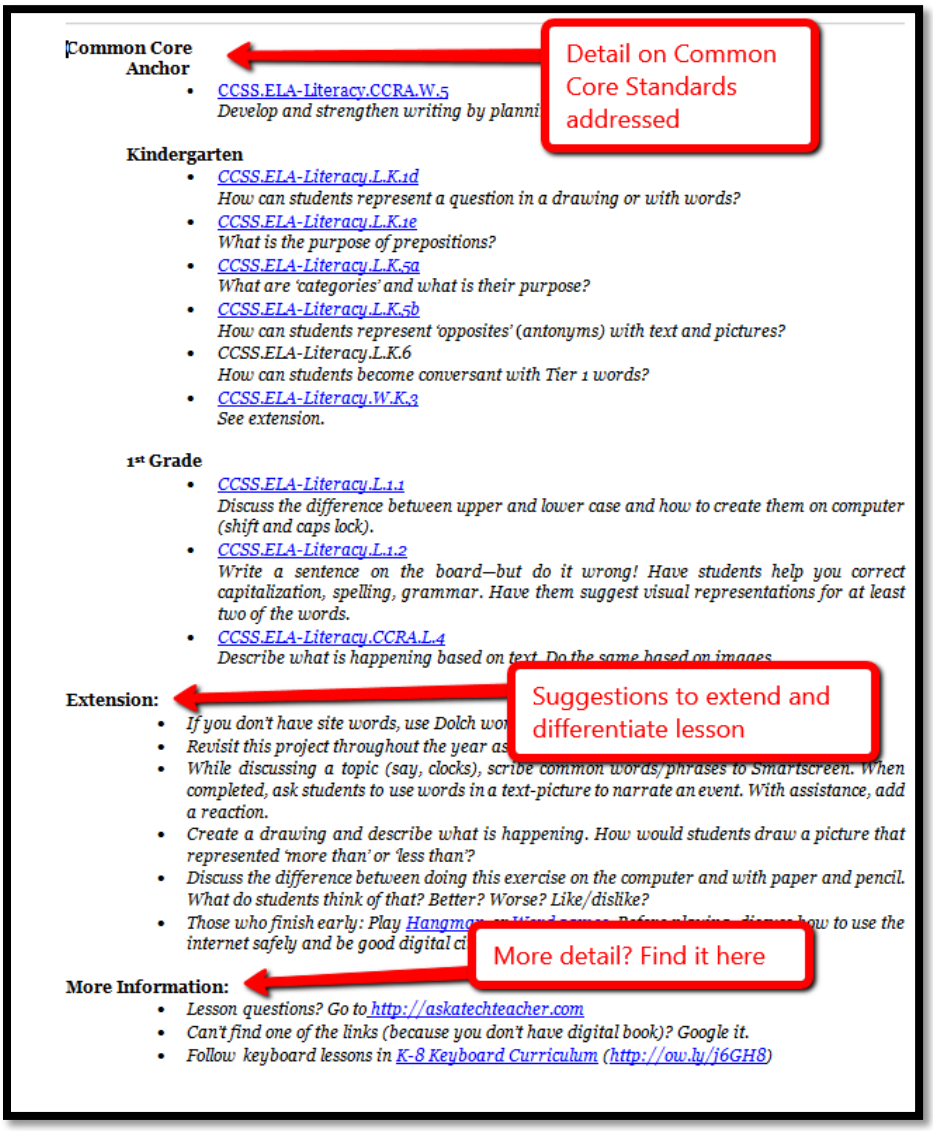
Figure 1



The next three are found at the end of each lesson (see *Figure 2*):

- *Common Core—detail of standards addressed*
- *Extension—suggestions on how to extend and differentiate lesson*
- *More information—where to go for additional help*

Figure 2



Who Needs This Book

You are the Tech Specialist, Coordinator for Instructional Technology, IT Coordinator, Technology Facilitator, Curriculum Specialist, Technology Director, or tech teacher—tasked with finding the right project for a classroom, an idea, a Standard. You have a limited budget, less digital tools, and the drive to do it right no matter the roadblocks.

Or you are the classroom teacher, a tech enthusiast with a goal—and this time you mean it—to integrate the wonders of technology into lessons. You've seen it work. Others in your PLN do it. And especially now, you want

technology to help meet standards like those listed earlier *(…use technology strategically and capably… …use digital resources…*). But too often, technology seems like a puzzle box added to your already overflowing educational toolbox.

How do you do it? With these projects, where tech meets Common Core.

Tips for Using This Book

When you unpack this tome, you likely will find many familiar strategies—but presented in Common Core ways. This means you aren't learning new programs, but new ways to scaffold comprehension and optimize learning.

Here are tips for using this ebook:

- Lessons are device-neutral. It doesn't matter if you're a Mac or PC school, with laptops or Chromebooks or desktops. The Big Ideas and Essential Questions are valid on any platform. Yes, you might have to make a few adjustments—but, you're a techie. No worries.
- Lessons can be done in the classroom or lab. Consider co-teaching:
    - *Grade level teacher reinforces academic topics*
    - *Tech teacher reinforces tech skills*
- Use 'Vocabulary' in each lesson as you teach. It supports Standards and students learn by your example.
- 'Tech Problem Solving' shares common geeky show-stoppers. Don't rush in to solve problems. Help students determine strategies that worked in the past. Focus on listed problems, but embrace all that come your way.
- All teachers share responsibility for student literacy. Use strategies to demystify math no matter where it appears—math, science, literature, other.
- Throughout lessons are instructions to '*pick which program works best*' and '*devise a plan to accomplish goals*'. It means exactly that: Differentiate instruction for your unique group. Be flexible, open-minded, and adventurous with choices.
- Common Core standards are a cumulative progression designed to enable students to meet college and career expectations. They build year-to-year, scaffolding on prior knowledge, developing depth:

> ***Standards for Mathematical Practice***
>
> *Mathematically proficient students consider available tools when solving a mathematical problem. When making mathematical models, they know that technology can enable them to visualize the results of varying assumptions, explore consequences, and compare predictions with data. Mathematically proficient students at various grade levels are able to identify relevant external mathematical resources and use them to pose or solve problems. They are able to use technological tools to explore and deepen their understanding of concepts.*
>
> *—Common Core*

Students advancing through the grades are expected to meet each year's grade-specific standards, retain or further develop skills and understandings mastered in preceding grades… (from Common Core)

- Most lessons in this book are for multiple grade levels. Pay attention to that as you implement the lesson.
- Lessons use free software and web-based tools where possible. If you can't access one, email us (info@structuredlearning.net) and a curriculum specialist will help you develop a work-around.
- Assessment isn't limited to traditional approaches (see Introductory section on 'Assessment'). Be creative. Materials in this book allow flexibility in meeting the needs of a range of students. The wide variety of assessments included in each lesson reflect that. Adjust as needed (maintaining core teaching principals), refine content and methodology, and pick the assessment approach suited to your needs. Remember why you assess: 1) to measure understanding, 2) to help students prepare for college and/or career.
- Consider a BYOD approach so students can use the device they are most comfortable with (if your IT folks and infrastructure support this approach). Because lessons cross content boundaries, learning is optimized by encouraging students to complete projects when convenient for their schedule.
- At every opportunity, use technology—to schedule projects, take a poll, read, time an activity. Expect students to devise tech alternatives to common activities.
- Questions? Don't know how to perform a required skill? Get answers from the companion website, AskaTechTeacher.com where you always find a teacher familiar with Structured Learning books. Let them know where you need help and they'll figure it out with you.

> *Digital materials offer substantial promise for conveying mathematics in new and vivid ways and customizing learning. In a digital or online format, diving deeper and reaching back and forth across the grades is easy and often useful.*
>
> *—Common Core*

Equipment Needs

Tech infrastructure and equipment needs vary tremendously from school-to-school. We've kept this list as basic as possible, with options to assist in meeting Common Core demands:

- *Digital camera (optional)*
- *Digital portfolios (online, GAFE, server)*
- *Headphones, speakers*
- *Internet access*
- *Microphone (optional)*
- *Permissions for online ed tools, student use*
- *Printer*
- *Productivity program (Office, GAFE, OO)*
- *Projector, optional Smartscreen, printer*
- *Student response system (Today's Meet, Socrative, Twitter, Padlet)*
- *Students computers*
- *Video camera (optional)*
- *Writing forums (blogs, wikis, websites, more)*

Assessment

Assessment is always challenging, isn't it? Finding evidence that students have learned what you taught, that they can apply knowledge to complex problems—how do you do this? Rubrics? Group projects? Posters? None sound worthy of the Common Core educational environ. You need authentic assessments that are measurable and student-centered, promote risk-taking by student and teacher alike, are inquiry-driven, and encourage students to take responsibility for his/her own learning.

Here's a general list included in this ebook with options that are scalable, age-appropriate and effective:

- **Anecdotal**
  Observe how students show learning. Are they engaged, making their best effort? Do they remember/apply skills taught prior weeks? Do they self-assess and make corrections as needed?
- **Transfer knowledge**
  Can students transfer learning to life? Do you hear fun stories from parents and teachers about how students used tech? Do students share how they 'helped mom use Google Maps …"
- **Teach others**
  There's a hierarchy of learning that goes like this:

  - ✓ *Student listens*
  - ✓ *Student believes*
  - ✓ *Student tries it*
  - ✓ *Student remembers it*
  - ✓ *Student shows others*
  - ✓ *Student teaches others*

  Authentic learning. That's rigor.

> *Digital materials that are smaller than a course can be useful. … adapted for clusters of standards or progressions within a cluster.*
>
> *—Common Core*

- **Verbalize**
  Can students use the right words? No umms, hand motions, giggles. Can they share knowledge in succinct, pithy sentences?
- **Portfolio**
  Do students collect work to a digital portfolio? Is it in the cloud where stakeholders can access it, never wondering what grade has been earned because they know?
- **Summarize knowledge**
  Can students use knowledge to create a magazine, a video, a how-to audio or screencast? 'Use' is important. Or does it sit in a mental file folder?
- **Oral presentations**
  This can be summative, formative, informational, formal, or informal. It can be a quick answer to classroom questions, solving a problem on the Smartscreen, teaching classmates to solve a problem during class, or preparing a multimedia presentation to share. It's more than assessment of learning. It judges speaking and listening skills—which, of course, are fundamental life skills.

In the end, choice of assessment depends upon teaching goals—and which works best for you.

Companion Website

Books are static. The challenge is to keep them current—especially in a field like technology where nothing remains the same for more than ten minutes. Common Core recognizes this:

Digital texts confront students with the potential for continually updated content…

To address this reality, we provide a companion website—Ask a Tech Teacher.com—that is always up-to-date, staffed by tech teachers using Structured Learning materials, and ready to answer your questions on lesson plans, tools, strategies, pedagogy. Drop by for a visit and find:

- *Free lesson plans*
- *Targeted websites*
- *Free Newsletters on tech tips and weekly websites*
- *Teacher resources*

- *Free training videos on tools used in lesson plans*
- *Great apps to include on iPads, digital devices*

Find not just help with projects, but your questions about technology in education. When should you start teaching keyboarding? How do you introduce computers to kindergarteners? What do you do when students know more than parents (or teachers)?

And more.

License

About the Publisher

Structured Learning IT Team *is the premier provider of technology instruction books and ebooks to education professionals including curricula, how-to guides, theme-based books, and one-of-a-kind online help—all to fulfill the tech demands of the 21st century classroom. Materials are classroom-tested, teacher-approved with easy-to-understand directions supported by online materials, websites, blogs, and wikis. Whether you are a new teacher wanting to do it right or a veteran educator looking for updated materials,* ***Structured Learning*** *and its team of technology teachers is here to assist*

About the Author

Ask a Tech Teacher *is a group of technology teachers who run an award-winning resource* ***blog*** *where they provide free materials, advice, lesson plans, pedagogic conversation, website reviews, and more to all who drop by. The free newsletters and website articles help thousands of teachers, homeschoolers, and those serious about finding the best way to maneuver the minefields of technology in education.*

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Common Core Standards Addressed

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CCSS.Math.Content.6.SP.B.5
CCSS Math/ Content 6-7.SP.B.4

1…Spreadsheets

Vocabulary	Tech Problem solving	Common Core
Cells *Columns* *Ctrl* *Excel* *Graph paper* *Grid lines* *Paint bucket* *Palette* *Rows* *Slideshows* *Spreadsheet* *Tools* *Toolbars*	*Screen froze (Is dialogue box open? Is program blinking on task bar?)* *Can't exit program (try Alt+F4)* *Capitals don't work (is caps lock on?)* *I can't find my slideshow (go to 'my computer'; drill down through folders; use 'search' on Start button)* *How do I know what to fill (where row and column meet)* *Can't find print (Ctrl+P)* *How do I get triangle sides to slant (They don't—think of blocky Minecraft figures)*	*CCSS.Math.Content.1.G.A.2* *CCSS.Math.Content.2.MD.A.1* *CCSS.Math.Content.2.G.A.1* *CCSS.Math.Content.2.G.A.2*
Time Required *45 minutes*	**NETS-S Standards** *3b, 6a*	**Grade** *1st, 2nd*

Essential Question

How do I find hidden information by using what I know?

Overview

Summary

Students follow directions to fill in spreadsheet and uncover a hidden drawing.

In this unit, 1st/2nd grade students review five Standards for Mathematical Procedures and up to 3 Common Core Math Standards, as well as spreadsheet basics to scaffold more rigorous use in later grades.

Big Ideas

I can decode information to find its true meaning

Materials

spreadsheet program, printer (if using this)

Teacher Preparation

- Have directions available individually for each student (so they keep the secret once picture is revealed). This can be downloaded to their digital device or distributed.

Steps

_____**Required skill level for this unit: Familiarity with following directions, using tools and toolbars, software**

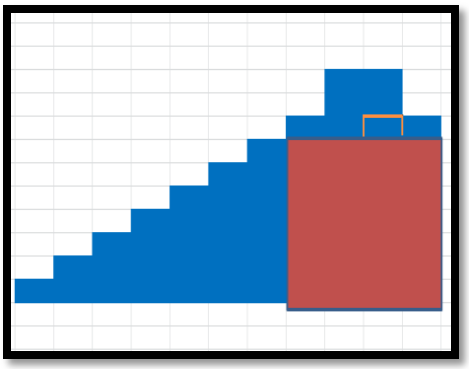
_____Spreadsheets are a time-proven method for understanding and solving problems and modeling data. A familiarity with spreadsheets should start as soon as students begin math, as a tool to be strategically used.

_____Let's back up: What does it mean to 'model' a concept, idea? What are some models students are aware of? What are comics a 'model' for? How did the performance play they did earlier this year (or last year) 'model' an idea? Discuss how important it is in modeling that it is done carefully, with precision. Each tool used must be exact and structured. In this way, anyone who sees the 'model' gets the message.

_____This lesson introduces spreadsheets (as a model) via art. It's easier in spreadsheets than on a blank sheet of paper because program grid lines simulate graph paper. Use whichever program your school uses—Excel, Google Spreadsheet, Open Office, Numbers, other.

_____Open spreadsheet program. Explain cells, rows, columns, tools and toolbars. Show students which tools they use for this project—paint bucket, color palette, and text.

Figure 3

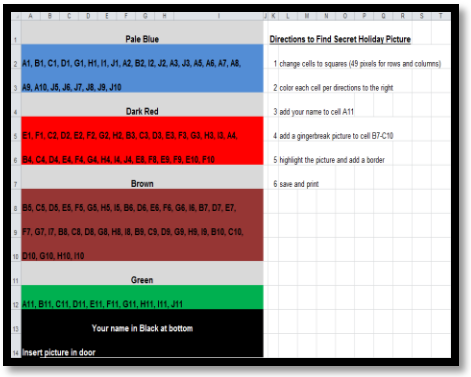


_____Ask what shape a cell is—a rectangle. Show students how to resize cells so they are all the same size. What is that called (a square)?

_____On Smartscreen, create a variety of shapes being discussed in class by filling cells with paint bucket; ask students what shape you've created. What are its attributes? How big is it—meaning: How many squares wide and tall? How does measuring in this way compare to other ways they've measured? Use text tool to record size. Count how many cells are in each shape and put that number to the side of the shape.

_____Have student work with partner to create a square, rectangle, triangle using paint bucket and color pallet. Does the triangle look blocky? Anyone play Minecraft?

Figure 4



_____Once shapes are created, have partners change one shape into another (see *Figure 3*). For example, morph rectangle you created into a triangle? Where would you add the extra pieces?

_____Now, show students how to find shapes using spreadsheet 'shapes' tool (*insert>shape* in Excel or *Insert>Drawing>shape* in Spreadsheet). Find quadrilaterals, pentagons, hexagons, and cubes. Have student groups insert as many as possible in five minutes (or whatever time frame you decide is appropriate). Label with text tool.

_____Next: Use drawing tool to partition shapes into other shapes. Measure sizes by counting cells across and down; place number to right of shape.

_____Now that students are comfortable, pass out directions for 'hidden picture' (*Figure 4* is a thumbnail; see full-size instructions at end of lesson). Let students work in pairs to uncover secret by filling squares with colors listed on directions (*Figure 5* shows completed picture). If students figure out what picture is, ask them to keep the secret.

_____Occasionally when students have difficulty doing what you are teaching, ask why. And listen. You may be surprised by the answer.

_____Throughout class, check for understanding. Expect student decisions to follow class rules.

_____Tech problems at beginning of lesson are the most common students will face. Expect students to be able to solve these with nominal assistance. Additionally, expect students to solve hardware problems as independently as possible:

- *Monitor problems—is power on*
- *Mouse problems—is there a light under mouse (which means it's getting power)?*
- *Sound problems—headphones plugged in? Student using correct headphones? Is sound on?*
- *Computer problems—power on? Correct log-in?*

_____As you teach, incorporate domain-specific vocabulary and expect students to do the same.
_____Show students how to print from spreadsheet program (if printing) and save to digital portfolios.
_____Remind students to transfer knowledge to class/home.
_____*A note: Every chance you get, use technology to facilitate teaching. Lead by example. Students will see you use tech quickly and facilely and follow your good example. They want to use tech. Don't discourage them!*

Figure 5

Common Core (truncated for brevity; refer to original Standards for exact wording)

Standards for Mathematical Practice

- CCSS.Math.Practice.MP4
  Model with mathematics
- CCSS.Math.Practice.MP5
  Use appropriate tools strategically. Common Core mentions 'spreadsheets' as a strategic tool mathematically proficient students consider when solving mathematical problem
- CCSS.Math.Practice.MP6
  Attend to precision; follow directions, resize cells
- CCSS.Math.Practice.MP7
  Look for and make use of structure
- CCSS.Math.Practice.MP8
  Look for and express regularity in repeated reasoning

1st Grade

- CCSS.Math.Content.1.G.A.2
  Compose two- or three-dimensional shapes to create a composite shape

2nd Grade

- CCSS.Math.Content.2.MD.A.1
  Measure the length of an object by using appropriate tools—in this case, grid and cells
- CCSS.Math.Content.2.G.A.1
  Recognize and draw shapes having specified attributes
- CCSS.Math.Content.2.G.A.2
  Partition rectangle into rows/columns of same-size squares and count to find total number

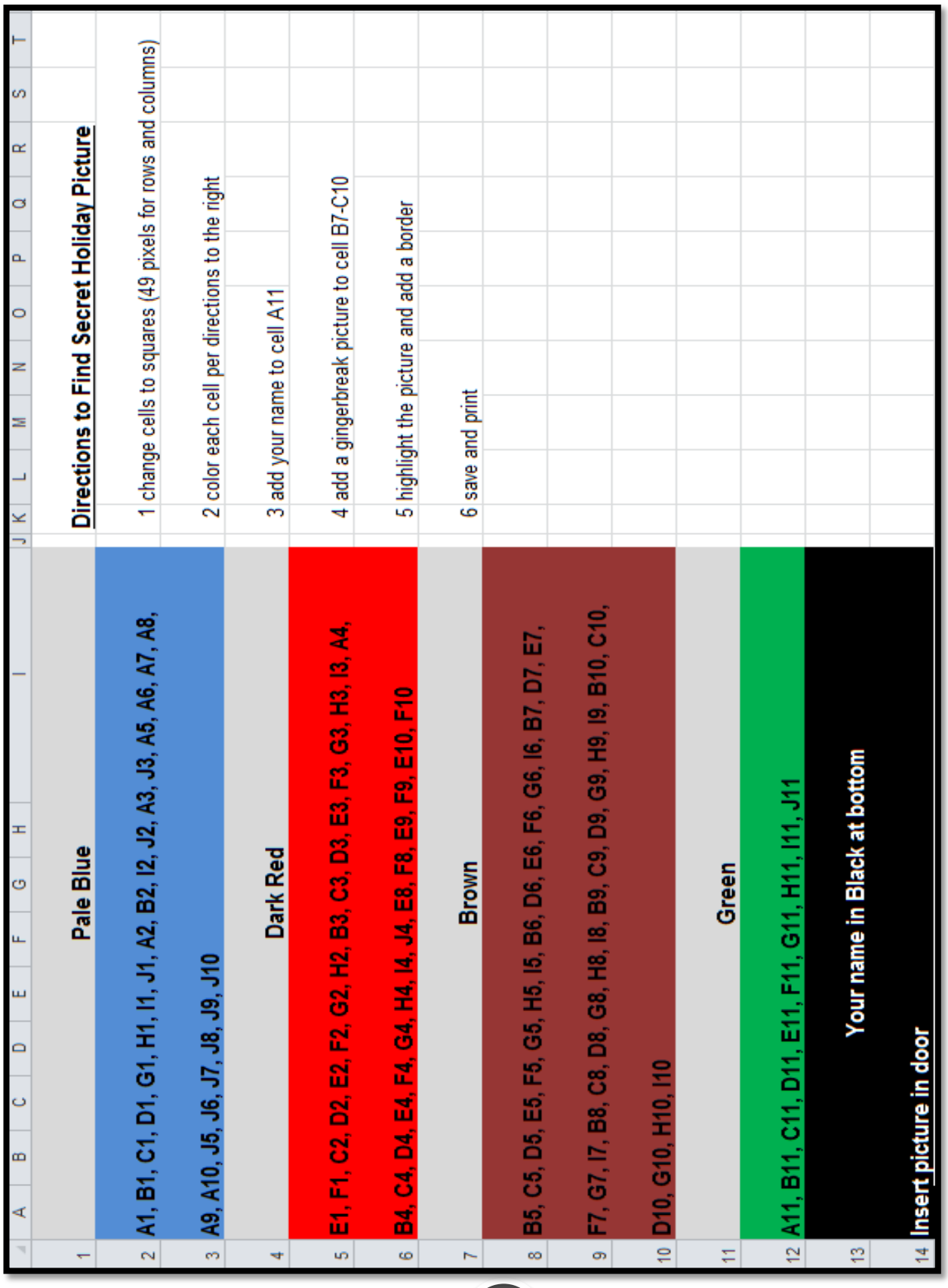
Extension:

- *Compare sizes of gingerbread men.*

More Information:

- *If using this for an assessment, see full list of assessment items by grade level at end of unit.*
- *Lesson questions? Go to Ask a Tech Teacher.*

Figure 6


Directions to Find Secret Holiday Picture
1 change cells to squares (49 pixels for rows and columns)
2 color each cell per directions to the right
3 add your name to cell A11
4 add a gingerbreak picture to cell B7-C10
5 highlight the picture and add a border
6 save and print
Pale Blue
A1, B1, C1, D1, G1, H1, I1, J1, A2, B2, I2, J2, A3, J3, A5, A6, A7, A8, A9, A10, J5, J6, J7, J8, J9, J10
Dark Red
E1, F1, C2, D2, E2, F2, G2, H2, B3, C3, D3, E3, F3, G3, H3, I3, A4, B4, C4, D4, E4, F4, G4, H4, I4, J4, E8, F8, E9, F9, E10, F10
Brown
B5, C5, D5, E5, F5, G5, H5, I5, B6, D6, E6, F6, G6, I6, B7, D7, E7, F7, G7, I7, B8, C8, D8, G8, H8, I8, B9, C9, D9, G9, H9, I9, B10, C10, D10, G10, H10, I10
Green
A11, B11, C11, D11, E11, F11, G11, H11, I11, J11
Your name in Black at bottom
Insert picture in door

Assessment
1st Grade

_____Was student able to resize cells from a rectangle to a square?
_____Did student work well with partner?
_____Did student join class discussion?
_____Did student create and label at least three shapes?
_____Did student recognize attributes of different shapes?
_____Did student measure length and width of at least three shapes?
_____Did student relate measuring with cells to other forms of measurement used in class?
_____Did student insert at least three shapes from spreadsheet collection?
_____Did student change one shape to another by adding to original form?
_____Did student label shapes with text tool?
_____Did student understand how spreadsheet program was a good strategic tool for this project?
_____Was student able to take/make helpful suggestions to/from peers?
_____Did student follow directions?
_____Did student complete project?
_____Did student recognize hidden picture?
_____Did student save/export to his/her digital portfolio?
_____Did student print correctly from spreadsheet program?
_____Did student respond positively to teacher suggestions?
_____Other_____
_____

Assessment
2nd Grade

_____Was student able to transfer knowledge from prior spreadsheet lessons as scaffolding for this lesson?

_____Was student able to resize cells from a rectangle to a square?

_____Did student work well with partner?

_____Did student join class discussion?

_____Did student create and label at least three shapes?

_____Did student recognize attributes of different shapes?

_____Did student measure length and width of at least three shapes?

_____Did student relate measuring with cells to other forms of measurement used in class?

_____Did student insert at least three shapes from spreadsheet collection?

_____Did student change one shape to another by adding colored blocks to original form?

_____Did student label shapes with text tool?

_____Did student understand how spreadsheet program was a good strategic tool for this project?

_____Was student able to take/make helpful suggestions to/from peers?

_____Did student follow directions?

_____Did student complete project?

_____Did student recognize hidden picture?

_____Did student save/export to his/her digital portfolio?

_____Did student print correctly from spreadsheet program (if doing this)?

_____Did student respond positively to teacher suggestions?

_____Other_____

_____

_____

2…Analyze Data—Formulas—Intro

Vocabulary	Tech Problem solving	Common Core
• *Associative* • *Cells* • *Columns* • *Commutative* • *Decimal place* • *Distributive* • *Excel* • *Formula* • *Function* • *Jing* • *Mental math* • *Place value* • *Right-aligned* • *Row* • *Snipping tool* • *Spreadsheet* • *Worksheet*	• *I can't find my document (where did you save it? Did you include your last name in file name?)* • *I entered data in wrong cell (drag-and-drop to correct spot)* • *My column is too small (double click between columns to resize)* • *Formula doesn't work (start with =)* • *My number didn't get added (was there text in cell?)* • *Formula doesn't multiply (use *)* • *Can't find file (where was it saved?)* • *Formula doesn't work (click formula)* • *All I get is ***** (widen column)* • *Where are decimals (cell formatting)* • *Where's Snipping Tool (Start button>search)*	*CCSS.Math.Content.3.OA.A.3* *CCSS.Math.Content.3.OA.B.5* *CCSS.Math.Content.4.OA.A.3* *CCSS.Math.Content.4.NBT.B.4*
Time Required *45 minutes*	**NETS-S Standards** *4a, 6a*	**Grade** *3rd-4th*

Essential Questions

How do I complete repetitive work quickly?
What are essential skills to analyze numbers?

Overview

Summary

Using spreadsheet formulas that students use daily, show how they are built, critical parts, and how they make the study of math efficient.

This lesson shows how technology contributes to coherence in math skills, as well as the steady progress toward fluent (accurate and reasonably fast) computation (*adapted from Common Core*).

By end of unit, 3rd/4th grade will review all eight Standards for Mathematical Procedures and up to 2OA, 1 NBT Common Core Math Standards, as well as spreadsheet formulas to scaffold more rigorous use in later grades.

Big Idea

Technology can complete repetitive actions more quickly than paper and pencil.

Materials

Spreadsheet program (Google Spreadsheet, Numbers, OO, Excel), four-function calculator (if appropriate to your school), screen shot program, backchannel program, student blogs

Teacher Preparation

- Have access to a screen shot program like Windows Snipping Tool or Jing.
- If students have blogs, have these set up.
- If you have a backchannel device (like Today's Meet, Socrative, or Twitter), have it available.
- This lesson plan can be done in the classroom or tech lab. Consider co-teaching:

  - *Grade level teacher can reinforce academic topics*
  - *Tech lab teacher can reinforce tech skills*

- Something happen you weren't prepared for? No worries. Common Core is about critical thinking and problem solving. Show students how you fix the emergency without a meltdown and with a positive attitude.

Steps

_____**Required skill level for this unit: Completion of one spreadsheet project.**

_____Spreadsheets are a proven approach to understanding/solving problems and modeling data; 'modeling' is a Common Core standard for Mathematical Practice that describes expertise educators seek to develop in students. An understanding of spreadsheets should start when students begin math concepts.

> …rigor in your school's math program defined by Common Core as [truncated]: *To help students meet expectations of the Standards, educators will need to pursue with equal intensity three aspects of rigor: (1) conceptual understanding, (2) procedural skill and fluency, and (3) applications.*
>
> *—Common Core*

_____Let's back up: What does it mean to 'model'? What models are students aware of? There's the physical 'model' students build with a parent of a ship or plane—what does a 'fashion model' communicate? What are other examples? What tools are used to model ideas? Music? Fiction stories? Poetry? How did the performance play students participated in earlier this year (or last year) 'model' an idea? Discuss how important it is to 'model' carefully, with precision. Each tool used must be exact. In this way, those who see the 'model' get the message.

_____This project introduces formulas as an approach to 'modeling' problems, commonly used to analyze relationships and draw conclusions. Students learn to build them, what their parts are, where to find them, how to trouble-shoot.

_____Before beginning, discuss this statement from Common Core—

Mathematically proficient students consider available tools when solving a mathematical problem. These tools might include pencil and paper, concrete models, ruler, protractor, calculator, ***spreadsheet****, computer algebra system, statistical package, or dynamic geometry software. Proficient students are sufficiently familiar with tools appropriate for their grade or course to make sound decisions about when each of these tools might be helpful.*

_____What is a spreadsheet? Why use it rather than word processing? Publisher? A presentation program like PowerPoint? What are its strengths for manipulating information?

_____Why are spreadsheets an appropriate math tool? What insight do they offer (for example, to double check answers)? Limitations (for example, might students rely on this tool rather than using it strategically when something 'doesn't look right')?

_____This lesson ties into pre-programming, logical thinking, critical thinking. Students apply familiar functions (adding, subtracting, multiplying, dividing) to whole numbers and decimal numbers (whichever they are working on it class).

_____Students build formulas composed of:

- *= (introduce formula)*
- ***Function** (add, subtract, multiply, divide)*
- ***Location** (cells function applied to)*
- ***( )** (to group numbers)*

_____The resulting formula will look something like either:

- *=b4+b5*
- *=Sum(b4:b5)*

> *Mathematically proficient students consider the available tools when solving a mathematical problem. These tools might include pencil and paper, concrete models, a ruler, a protractor, a calculator, a spreadsheet, a computer algebra system, a statistical package, or dynamic geometry software. Proficient students are sufficiently familiar with tools appropriate for their grade or course to make sound decisions about when each of these tools might be helpful.*
>
> *—Common Core*

_____How does this compare to other formulas discussed in class? What would be the 'unknown quantity' in these discussions (say, in Algebra, it is x)?

_____How does this compare to other methods for answering math problems, i.e., equations and arrays?

_____Formulas are a tool, much like a calculator, strategically used to analyze volumes of data, draw conclusions that would be difficult to comprehend without the assistance of automaticity. They do not supplant student responsibility for learning the process.

_____Before beginning, put backchannel device (Socrative, TodaysMeet, Padlet) onto Smartscreen. Show how to access it on student devices. As you demonstrate, address student concerns.

_____Open workbook and add a tab called 'Auto Math' (see *Figure 7*); change tab color.

_____A1—add title (Auto Math), font 36; merge-center A1-G1 (for older students); color with paint bucket.

_____A2—add student name.

_____A3—type 'Addition'; click row 3 to select entire row; use paint bucket to color. Or, select A3-G3 and color with paint bucket.

_____Add 'Total' next to answers; right-align cell.

_____Before inputting numbers, discuss place value. Show older students how to format cells for multiple decimal places.

_____Input data (not answers) into spreadsheet.

_____Add line beneath bottom row of data.

_____**Older students:** Reproduce *Figure 7* independently.

_____Cell beneath problem (and line) is for formula. Easiest way to create a formula is:

- *start with =*
- *select first cell with a mouse click*
- *input function—+,- /,**
- *select second cell*
- *push enter for answer*

_____Before entering formula (to calculate answer), have students try mental math. This can be done several ways:

- *Poll class for answer*
- *Race with spreadsheet—will student or program get answer first?*
- *Working in pairs, one student comes up with an answer while second student uses spreadsheet formula*

Figure 7

	A	B	C	D	E	F	G
1	AUTO MATH						
2	Your Name						
3	Addition						
4			99	144	720	1044	2583
5			33	12	20	132	357
6		*Total*	132	156			
7							
8	Subtraction						
9			35682	144	720	1044	2583
10			29876	12	20	132	357
11		*Total*	5806				
12							
13	Multiplication						
14			99	144	720	1044	2583
15			33	12	20	132	357
16			3267	1728			

_____Have students complete at least five problems.
_____Finish problems for other functions in similar fashion using:

- *+=add*
- *-=subtract*
- **=multiply*
- */=divide*

_____Have students look both for general methods and shortcuts. For example, copy formula *=b4+b5* and replace addition symbol with * for multiplication. Students understand that will work because they understand the importance of ***repeated reasoning***—how formula was constructed and meaning of parts.

_____When answer shows up, does it look correct: 1) eyeball answer to determine if logic and experience say it is accurate, 2) use mental math, 3) guess-and-check. ***In short: Students construct a viable argument, then critique reasoning.***

_____Share with students a teacher secret: We roughly know the answer before it comes up. If spreadsheet is not close to what we expect, we re-evaluate. Did we input the formula correctly? Did we point to the correct cells?

> *As they work to solve a problem, mathematically proficient students maintain oversight of the process, while attending to the details. They continually evaluate the reasonableness of their intermediate results.*
>
> *—Common Core*

As they work to solve a problem, mathematically proficient students maintain oversight of the process while attending to the details. They continually evaluate the reasonableness of their intermediate results (from Common Core).

_____If answer is wrong, show students how to troubleshoot:

- *Is function correct (+, -, *, /)?*
- *Is formula in right spot (or did student type answer rather than formula)?*
- *Does formula start with =?*
- *Is column wide enough (or is *** in answer cell instead of number)?*
- *Are cells being pointed to by formula all different?*

_____With a partner, replace some numbers and see spreadsheet recalculate.

_____With partner, explore **commutative property, associative property, and distributive property** by having spreadsheet calculate answers. For example:

- *Commutative property:* *Does A2*A3*A4 = A2*(A3*A4) = (A2*A3)*A4*
- *Associative property:* *Does A2*A3 = A3*A2*
- *Distributive property:* *Does A2*(A3+A4) = (A2*A3) + (A2*A4)*

_____When done, save to digital portfolio. Why don't you 'save' in Google Spreadsheets?

_____If using Google Spreadsheet, embed into student blog or class website and reflect on exercise using domain-specific language:

- *What problems did student run into and how did they persevere to solve them?*
- *How does this relate to other mathematical discussions?*

_____When student finishes blog entry, comment on another student's.

_____If spreadsheet won't embed, embed a screen shot using Snipping Tool, Jing or other program.

_____Continually throughout class, check for understanding. Expect students to solve problems and make decisions.

_____As you teach, incorporate domain-specific vocabulary and expect students to do the same.
_____Remind students to transfer knowledge to class or home.
_____Occasionally when students have difficulty doing what you are teaching, ask why. And listen. You may be surprised by the answer.
_____Problems listed at beginning of lesson are the most common students will face. Expect students to be able to solve these independent of assistance. Additionally, expect students to solve hardware issues:

- *Monitor problems—is power on*
- *Sound problems—are headphones plugged in? Is sound on?*
- *Computer problems—is power on? Is student logged in correctly?*

_____Tuck chairs under desk, headphones over tower; leave station as student found it.
_____*A note: Every chance you get, use technology to facilitate teaching. Lead by example. Students will see you use tech quickly and facilely and follow your good example. They want to use tech. Don't discourage them!*

Common Core (truncated for brevity; refer to original Standards for exact wording)

Standards for Mathematical Practice

- CCSS.Math.Practice.MP1
  Explain correspondence between equations and verbal descriptions; search for regularity
- CCSS.Math.Practice.MP2
  Reason abstractly and quantitatively
- CCSS.Math.Practice.MP3
  Construct viable arguments; critique reasoning of others
- CCSS.Math.Practice.MP4
  Model with mathematics
- CCSS.Math.Practice.MP5
  Use appropriate tools strategically
- CCSS.Math.Practice.MP6
  Attend to precision
- CCSS.Math.Practice.MP7
  Look for and make use of structure
- CCSS.Math.Practice.MP8
  Look for and express regularity in repeated reasoning

3rd Grade

- CCSS.Math.Content.3.OA.A.3
  Use multiplication and division to solve word problems by using drawings and equations with a symbol for the unknown number to represent problem
- CCSS.Math.Content.3.OA.B.5
  Apply properties of operations as strategies to multiply and divide. Examples: Commutative property, Associative property, Distributive property

4th Grade

- CCSS.Math.Content.4.OA.A.3
  Solve multistep problems using equations with a letter standing for unknown quantity
- CCSS.Math.Content.4.NBT.B.4

Fluently add and subtract multi-digit whole numbers using standard algorithm

Extension:

- *Format spreadsheet with colors, fonts. Visual learners love this.*
- *Format spreadsheet for decimal places.*
- *Have students use calculator built into computer or web-based one like these to verify spreadsheet answers. Be sensitive to whether your school allows calculators.*

More Information:

- *Lesson questions? Go to Ask a Tech Teacher.*
- *If using this for assessment, see full list of assessment items by grade level at end of unit.*

Assessment
3rd Grade

_____Did student join class discussion?

_____Was student able to transfer knowledge from prior spreadsheet lessons as scaffolding for this lesson?

_____Did student use workbook started on prior project (If available)? Were they able to locate and open that project?

_____Did student understand parts of a formula and how to deploy it?

_____Did student understand similarity between formula symbols and those from math class?

_____Did student formulas work? If not, could student troubleshoot them to correct?

_____Did spreadsheet formulas help students work faster or did they slow them down?

_____Did student double-check formulas via mental math, guess-and-check, calculator, or other method? Did student understand spreadsheets are technologic alternatives to other solutions?

_____Did student format spreadsheet as required?

_____Did student demonstrate use of commutative, distributive and associative properties (if using this)?

_____Was student able to take/make helpful suggestions to/from peers?

_____Did student follow directions?

_____Did student complete project?

_____Did student save/export to his/her digital portfolio? Was student able to embed spreadsheet or image into blog post? Did student post reflection to blog?

_____Did student worked well with partner?

_____Did student provide backchannel feedback?

Assessment
4th Grade

_____Did student join class discussion?

_____Was student able to transfer knowledge from prior spreadsheet lessons as scaffolding for this lesson?

_____Did student use workbook started on prior project (If available)? Were they able to locate and open that project?

_____Did student understand parts of a formula and how to deploy it?

_____Did student understand the similarity between formula symbols and those from math class?

_____Did student formulas work? If not, could student troubleshoot them to correct?

_____Did spreadsheet formulas help students work faster or did they slow them down?

_____Did student double-check formulas via mental math, guess-and-check, calculator, or other? Did student understand spreadsheets are tech alternatives to other solutions?

_____Did student format spreadsheet as required?

_____Did student demonstrate use of commutative, distributive and associative properties?

_____Was student able to take/make helpful suggestions to/from peers?

_____Did student follow directions?

_____Did student complete project?

_____Did student save/export to his/her digital portfolio? Was student able to embed spreadsheet or image into blog post? Did student post reflection to blog?

_____Did student worked well with partner?

_____Did student provide backchannel feedback?

3…Analyze Data—Formulas II

Vocabulary	Tech Problem solving	Common Core
• *Autosum* • *Average* • *Calculation* • *Cell address* • *Count* • *Data* • *Embed* • *Excel* • *Expressions* • *If-then* • *Max* • *Mean* • *Median* • *Mode* • *Running total* • *Simulations Roots* • *TODAY*	• *Can't find my doc/file (Start>search)* • *Formula doesn't work (start with =?)* • *One number didn't get added (did cell have text?)* • *How do I color tab? (right click)* • *What's a cell address?* • *How do I center (same tool as Word)* • *Computer doesn't work (check common problems)* • *Where's embed code (try 'share')* • *I don't know how to create formulas. Ask at http://askatechteacher.com.* • *Student didn't finish? That's OK.* • *It's slow moving around spreadsheet (use tab, Shift+tab, enter)* • *How do I turn data into information? (formulas, graphs, charts)*	*CCSS.Math.Content.4.OA.A.3* *CCSS.Math.Content.4.NBT.B.4* *CCSS.Math.Content.5.OA.A.1* *CCSS.Math.Content.5.OA.A.2*
Time Required *45 minutes*	**NETS-S Standards** *4b, 4c*	**Grade** *4th – 5th*

Essential Question

How do I evaluate data objectively in a way others will understand?

Overview

Summary

Students use formulas to calculate average (three types) on a test.

By the end of this lesson, 4th/5th grade students will review all eight Standards for Mathematical Procedures and up to 2 OA and 1 NBT Common Core Math Standards, as well as spreadsheet formulas to scaffold more rigorous use in later grades.

Big Ideas

- Students interpret data.
- Use the excitement of formulas to support math concepts.

Materials

Spreadsheet program (OO, Google Spreadsheet, Excel), four-function calculator (if appropriate to your school), screen shot program, backchannel program, student blogs

Teacher Preparation

- Have access to a screen shot program like Windows Snipping Tool or Jing.

- If students have blogs, have these set up.
- If you have access to a backchannel device (like Today's Meet, Socrative, Padlet, or Twitter), have available.
- This lesson plan can be done in the classroom or tech lab. Consider co-teaching:

    - *Grade level teacher can reinforce academic topics*
    - *Tech lab teacher can reinforce tech skills*

- Something happen you weren't prepared for? No worries. Common Core is about critical thinking. Show students how you fix the emergency without a meltdown and with a positive attitude.

Steps

_____**Required skill level for this unit: Familiarity with spreadsheet formulas.**

_____What does it mean to 'model' a concept? Students created a formula in the last lesson—a 'model'—for performing standard math functions. What are other examples? What tools are used to model ideas? Visual organizers? Infographics? Arrays? Pick some your student group has exposure to. Discuss how important it is that modeling is done carefully, with precision. Each tool used must be exact and structured so anyone who sees it gets the message.

_____Spreadsheets are a modeling tool, much like a calculator, to analyze volumes of data, and draw conclusions that would be difficult without automaticity. They do not supplant student responsibility for learning the process, rather extend their reach. Always confirm that students understand what they are doing before they do it.

_____Just as important are formulas—for analyzing relationships and drawing conclusions. This project delves into formulas—building them, knowing their parts, trouble-shooting.

_____Consider why students use both pencils and technology:

Mathematically proficient students consider available tools when solving a mathematical problem. These tools might include pencil and paper, concrete models, a ruler, a protractor, a calculator, a spreadsheet, a computer algebra system, a statistical package, or dynamic geometry software. Proficient students are sufficiently familiar with tools appropriate for their grade or course to make sound decisions about when each of these tools might be helpful.

To help students meet expectations of the Standards, educators need to pursue with equal intensity … rigor in major work of each grade: 1) conceptual understanding, 2) procedural skill and fluency, 3) applications.

—Common Core

_____This lesson assumes students have used formulas. Discuss where that has happened.

_____Open spreadsheet program (Google Spreadsheet, OO, Numbers, Excel). Why a spreadsheet? What can a spreadsheet do that a word processor (Google Docs, Pages, or MS Word) or a desktop publisher (Publisher) or presentation program (Google Presentations, iWorks, PowerPoint) can't (*Hint: Turn data into information*)?

_____Review spreadsheet layout (screen, tools, tabs, ribbons rows, columns, cells, worksheets, workbooks)—how similar it is to other programs? Expect students to remember what they learned in earlier spreadsheet lessons.

_____Before beginning, put backchannel device (Socrative, TodaysMeet, Padlet) onto Smartscreen to track student comments. Show how to access it on student devices.

_____Students will use test data (like a keyboarding speed quiz) to find class mean/median/mode (tie in with class discussion on 'averages'), minimum score, and maximum score. These formulas are standard and automated in most spreadsheet programs. Students will recreate spreadsheet in *Figure 8*. They can follow directions on right side or do together as a class. Students can work singly or in pairs, as you demonstrate on Smartscreen.

_____Rename worksheet (tab); color to preference.

_____A1—enter title (for example, *T2 Speed Quiz*).

_____A2—enter column headings (for example, *WPM* and *Grade*).

_____A3—enter data; Remind students: *Enter* moves down column; *tab* moves to next column; *Shift+tab* moves to previous column.

_____Remind students: Only enter numbers in cells—spreadsheet can't evaluate letters/symbols.

Figure 8

	A	B	C	D	E	F	G
1	**T2 SPEED QUIZ**						
2		**WPM**	**Grade**		**Teach this with each speed quiz:**		
3	1	22	9		*rename tab*	*font size*	
4	2	21	10		*recolor tab*	*fill*	
5	3	19	6		*enter data*	*merge cells*	
6	4	14	8		*average column*		
7	5	21	8		**Teach this with 3-week training**		
8	6	24	8		*add count, min, max, median, mode*		
9	7	29	10		*add label for WPM and Grade*		
10	8	28	10		*add labels for formulas*		
11	9	19	9		*click on cells and see the formula*		
12	10	21	10		*add separater line under data*		
13	11	15	8		*B/I rows 21-24*		
14	12	17	10		*F11 graph*		
15	13	16	10			*Who's the slowest*	
16	14	19	10			*Who's the fastest*	
17	15	20	10			*Who got the highest grade*	
18	16	18	10			*Who got the lowest grade*	
19	17	14	10		*Format Graph*		
20	18	20	10			*rt click--chart options*	
21	***average***	***19.83333***	***9.222222***			*explore chart options*	
22	***median***	***19.5***	***10***			*rt-click--chart type*	
23	***mode***	***21***	***10***			*change colors*	
24	***count***	***18***	***18***			*change background*	
25	***max***	***29***	***10***				
26	***min***	***14***	***6***				
27							

_____Discuss meaning of *mean, median, mode*.

_____Look both for general methods and shortcuts. For example, copy formula *=AVERAGE(b3:b20)* and replace *AVERAGE* with *MEDIAN* or *MODE*. Students understand that will work because they understand ***repeated reasoning***—how formula was constructed and meaning of parts.

_____When answer shows up, does it look correct? Use mental math, guess-and-check, logical reasoning, or whatever method works best in this situation to determine if answer is correct. This is a good habit to create—eyeball an answer to determine if logic and experience say it is correct. ***In short: Students construct a viable argument, then critique reasoning.***

_____Share with students a teacher secret: We roughly know the answer before it comes up. If not what we expect, we re-evaluate. Did we input formula correctly? Did we point to correct cell?

As they work to solve a problem, mathematically proficient students maintain oversight of the process while attending to the details. They continually evaluate the reasonableness of their intermediate results (from Common Core).

_____Discuss formula as it appears in cell. Why parentheses, brackets, or braces in expression? How do these help? How does this record calculations with numbers and interpret numerical expressions? Relate to class inquiry into numerical expressions, operations, algebraic thinking. What would be the 'unknown quantity' that students learned about in Algebra?

_____How does this compare to other methods of finding answers, i.e., equations or arrays?

_____Complete cell calculations for 'count', 'max', 'min' similarly. The spreadsheet makes these automatic calculations by clicking *Autosum* tool dropdown list and selecting formula.

_____Why are spreadsheets an appropriate math tool? When might students use them? What insight do they offer (for example, to double check answers)? What are their limitations (for example, could students rely on them exclusively)?

_____Save to digital portfolio. What's the difference between 'save', 'save-as'? If using Google Spreadsheet, embed into student blog or website and reflect using domain-specific language:

- *What problems arose and how did student persevere to solve them?*
- *Did student understand the regularity and trends in formula construction?*
- *When critiquing a formula (via mental math or other), did student discover errors?*

_____When student finishes blog entry, comment on another student's.

_____If spreadsheets can't be embedded, insert a screen shot with Window's Snipping Tool, Jing or another program.

_____As you teach, incorporate domain-specific vocabulary and expect students to do the same.

_____Remind students to transfer knowledge to class or home.

_____Occasionally when students have difficulty doing what you are teaching, ask why. And listen. You may be surprised by the answer.

_____The problems listed at beginning of lesson are the most common students will face. Expect students to be able to solve these independent of assistance. Additionally, expect students to solve hardware problems independently:

- *Monitor problems—is power on*
- *Sound problems—are headphones plugged in? Is sound on?*
- *Computer problems—is power on? Is student logged in correctly?*

_____*A note: Every chance you get, use technology to facilitate teaching. Lead by example. Students will see you use tech quickly and facilely and follow your good example. They want to use tech. Don't discourage them!*

Common Core (truncated for brevity; refer to original Standards for exact wording)

Standards for Mathematical Practice

- CCSS.Math.Practice.MP1
  Explain correspondences between equations, verbal descriptions, and search for trends
- CCSS.Math.Practice.MP2
  Reason abstractly and quantitatively
- CCSS.Math.Practice.MP3

Construct viable arguments; critique reasoning of others

- CCSS.Math.Practice.MP4
  Model with mathematics
- CCSS.Math.Practice.MP5
  Use appropriate tools strategically
- CCSS.Math.Practice.MP6
  Attend to precision
- CCSS.Math.Practice.MP7
  Look for and make use of structure—formulas, tables, spreadsheets
- CCSS.Math.Practice.MP8
  Look for and express regularity in repeated reasoning—formulas, auto

4th Grade

- CCSS.Math.Content.4.OA.A.3
  Solve multistep problems using the four operations, using equations with a letter standing for the unknown quantity—same formula-different function
- CCSS.Math.Content.4.NBT.B.4
  Fluently add and subtract multi-digit whole numbers using the standard algorithm—format cells for automaticity

5th Grade

- CCSS.Math.Content.5.OA.A.1
  Use parentheses, brackets, or braces in numerical expressions, and evaluate expressions with these symbols
- CCSS.Math.Content.5.OA.A.2
  Write simple expressions that record calculations with numbers, and interpret numerical expressions without evaluating them

Extension:

- *Do one set of numbers with decimal place, another rounding to next whole number. Evaluate difference between answers.*
- *Have students create formulas to complete math homework.*
- *Have students use mental math and then calculate with spreadsheet.*
- *Try other formulas that interest students (turning a cell red, an if-then hypothesis). Students love formulas.*
- *Teach students to use an online calculator like these to verify spreadsheet answers, or the one built into computer. Be sensitive to whether your school (or state) allows calculator use on tests.*
- *Play a game using a spreadsheet to track data. Preview Coffee Shop and Lemonade Stand.*

More Information:

- *Lesson questions? Go to Ask a Tech Teacher.*
- *If using this for assessment, see full list of assessment items by grade level at end of unit.*

Assessment
4th Grade

_____Did student join class discussion?

_____Was student able to transfer knowledge from prior spreadsheet lessons as scaffolding for this lesson?

_____Did student use workbook started on prior project (was s/he able to locate and open that project)?

_____Did student understand parts of a formula and how to deploy it?

_____Did student understand relationship between formulas and mathematical sentences?

_____Did student formulas work?

_____Did student double-check formula via mental math, guess-and-check, or other?

_____Was student able to troubleshoot formulas?

_____Did student understand use of parentheses, unknowns in formulas?

_____Did student troubleshoot hardware problems (if any)?

_____Did student format spreadsheet as required?

_____Was student able to take/make helpful suggestions to/from peers?

_____Did student follow directions?

_____Did student complete project?

_____Did student save/export to his/her digital portfolio?

_____Did student embed spreadsheet in blog?

_____Did student use screenshot to include spreadsheet in blog post (if necessary)?

_____Did student post reflection to blog? Did student comment on blog posts of classmates?

_____Did student use domain-specific language in his/her blog post and class conversation?

_____Did student work well with partner?

_____Did student provide backchannel feedback?

Assessment
5th Grade

_____Did student join class discussion?

_____Was student able to transfer knowledge from prior spreadsheet lessons as scaffolding for this lesson?

_____Did student use workbook started on prior project (was s/he able to locate and open project)?

_____Did student understand parts of a formula and how to deploy it?

_____Did student understand relationship between formulas and mathematical sentences?

_____Did student formulas work?

_____Did student double-check formulas via mental math, guess-and-check?

_____Was student able to troubleshoot formula?

_____Did student understand use of parentheses, unknowns in formula?

_____Did student troubleshoot hardware problems (if any)?

_____Did student format spreadsheet as required?

_____Was student able to take/make helpful suggestions to/from peers?

_____Did student follow directions?

_____Did student complete project?

_____Did student save/export to his/her digital portfolio?

_____Did student embed spreadsheet in blog or use screenshot to include spreadsheet in blog post (if necessary)?

_____Did student post reflection to blog? Comment on post of classmates?

_____Did student use domain-specific language in their blog post and class conversation?

_____Did student worked well with partner?

_____Did student provide backchannel feedback?

4…Create a Gradebook

Vocabulary	Tech Problem solving	Common Core
• *Absolute reference* • *Amortize* • *Discretionary* • *Format* • *Formula* • *Google Hangout* • *Hashtags* • *Open Office* • *Relative reference* • *Rounding* • *Screencast* • *Screenshare* • *Spreadsheet* • *Tweets* • *Word processing*	• *Formula doesn't work (start with =)* • *When I copy-paste formula, it grabs wrong cells (Consider relative or absolute references)* • *I can't figure it out (try Help, Google search, ask a neighbor)* • *This is impossible (use problem solving strategies)* • *Numbers are confusing (enhance spreadsheet with images, color)* • *Excel is confusing (watch videos)* • *Don't know what job or school I want (research; make a choice)* • *Gradebook differs from teacher grade (is it a rounding error?)*	*CCSS.ELA-Literacy.RST.6-8.3* *CCSS.ELA-Literacy.RST.6-8.4* *CCSS.ELA-Literacy.RST.6-8.7*
Time Required *90 minutes*	**NETS-S Standards** *4a, 6a*	**Grade** *Middle School*

Essential Question

How can I use technology to draw conclusions?

Overview

Summary

Students create a gradebook in their spreadsheet program to auto-calculate grades based on data entered. This is an authentic way to use tech tools for academic needs.

By the end of this unit, middle school students will review all eight Standards for Mathematical Procedures and three RST standards, as well as an authentic use of spreadsheet formulas.

Big Idea

Quantitative analysis helps in understanding, evaluating, and sharing ideas.

Materials

Internet, spreadsheet program (i.e., Open Office, Excel, Google Docs, Numbers), online calculator (if appropriate to your school), backchannel, screenshot program, student blogs (if using)

Teacher Preparation

- Have access to screen shot program like Windows Snipping Tool or Jing.
- If students have blogs, have these set up so students can use them to reflect.
- If you have access to a backchannel device (like Today's Meet, Socrative, Padlet, or Twitter), have available.

- This lesson plan can be done in the classroom or tech lab. Consider co-teaching:
  - *Grade level teacher can reinforce academic topics*
  - *Tech lab teacher can reinforce tech skills*

- Something happen you weren't prepared for? No worries. Common Core is about critical thinking and problem solving. Show students how you fix the emergency without a meltdown and with a positive attitude.

Steps

_____**Required skill level: working understanding of spreadsheets (Excel, Google Spreadsheet, OO, Numbers) including one project that involved formulas.**

_____How do students think teachers come up with grades? Discuss this. Come around to that teachers use formulas that objectively arrive at conclusions (although part of that formula might include subjective input). In short, teachers use a 'model' that provides a final grade.

_____What does it mean to 'model' grades? Teacher creates a formula that includes variables for tests, quizzes, projects, more. Discuss how important it is that these formulas work precisely. Why? (everyone wants students to get the grade they earned, not one awarded). The tools used must be exact and structured. In this way, anyone who sees the 'model' gets the same message.

_____Discuss why an automated program to calculate grades is better/worse than manually completing calculations. Which is more accurate? Faster? More reliable? Keep in mind the following from Common Core:

How to create a Gradebook:

- *set up a spreadsheet*
- *add a row for each class (at least five)*
- *add columns for projects*
- *add a 'total' column*
- *add an 'Average' column*
- *add formulas to update grade based on new scores*

Mathematically proficient students consider the available tools when solving a mathematical problem. These tools might include pencil and paper, concrete models, a ruler, a protractor, a calculator, a spreadsheet, a computer algebra system, a statistical package, or dynamic geometry software. Proficient students are sufficiently familiar with tools appropriate for their grade or course to make sound decisions about when each of these tools might be helpful.

_____Formulas are a student tool, much like a calculator. Their purpose is to analyze volumes of data, draw conclusions that would be difficult to comprehend without automaticity.

_____This lesson makes full use of formulas as a strategic tool for analyzing relationships and drawing conclusions so that when needed to construct viable arguments, students will be ready.

_____What is a spreadsheet? Name some spreadsheet programs (hint: Excel, Google Spreadsheet, Open Office, Numbers). Why is it important to be able to use them? Hint:

- *Communicate information and ideas effectively*
- *Present relationships between information and ideas clearly and efficiently*
- *Develop a coherent understanding of a topic or issue*

_____Discuss where students have used spreadsheets in the past.
_____Discuss how spreadsheets are uniquely qualified to attain these Common Core goals:

- *Make sense of problems and persevere in solving them*
- *Reason abstractly and quantitatively*
- *Construct viable arguments and critique reasoning of others*
- *Model with mathematics (i.e., a grade book)*
- *Use appropriate tools strategically*
- *Attend to precision*
- *Look for and make use of structure*
- *Look for and express regularity in repeated reasoning*

> *Mathematically proficient students start by explaining to themselves the meaning of a problem and looking for entry points to its solution. They analyze givens, constraints, relationships, and goals. They make conjectures about the form and meaning of the solution and plan a solution pathway rather than simply jumping into a solution attempt.*
>
> *—Common Core*

_____What tasks are suited to spreadsheets instead of word processing? Presentations?
_____Before beginning, put backchannel device onto Smartscreen. Show how to access it on student devices. If using Twitter, encourage students to post quick answers to classmate problems (if they know solution).
_____As you demonstrate lesson, pay attention to student comments and address their concerns.
_____Open spreadsheet program. Who wants to review (screen, tools, tabs, ribbons, rows, columns, cells, naming protocol for cells, worksheets, workbooks)? How about inserting data? Creating formulas? Expect students to remember from prior lessons. Questions?
_____Today, class will create a grading sheet that automatically updates scores. Formulas are critical to a dependable, credible, defensible calculation of grades. If spreadsheet says '98%'—and formulas are correct—that is a strong argument to present to a teacher. In fact, this is how teachers used to calculate grades before software arrived.
_____This is a self-directed lesson. Students work independently or in small groups. Use knowledge from prior spreadsheet training to intuit how to create chart. Additionally, here are videos that summarize skills:

- https://www.youtube.com/watch?v=YfytLuUUkvE
- https://www.youtube.com/watch?v=IfQT6Lb3-nU
- https://www.youtube.com/watch?v=227pNaTsixI
- https://www.youtube.com/watch?v=-SnBlC_1tSk

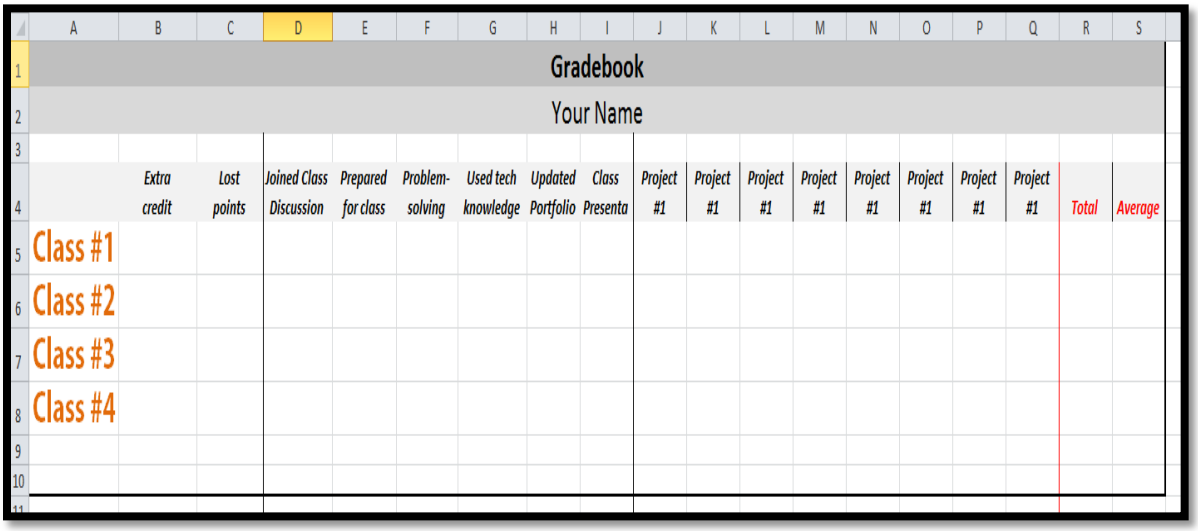
_____Watch one video as a group (they're not long), then ask: What should be changed to adapt instructions to class's particular needs?
_____Students independently:

- *set up a spreadsheet*
- *retitle a worksheet 'Grade book'*
- *add their name under title*

- *add a row label for each class they are taking (at least four)*
- *add column labels for graded projects*
- *add a 'total' column to extreme right*
- *add an 'Average' column to extreme right*
- *add formulas that calculate grade change based on new scores*

_____*Figure 9* is an example of a simple spreadsheet:

Figure 9



_____Let students create one formula, then explain it to a neighbor. What terms were used? Why? Does it work? Use domain-specific language and be able to define words partner does not understand. Be methodical and rigorous in the effort to make them work.

_____Have students manually calculate grade (with mental math or calculator—or both) as well as via Gradebook program. Do they match?

_____What if grade is weighted? Toss this around with students. How would they create a formula to weight the student grade?

_____Students can format spreadsheet to suit their needs (fonts, colors, sizes, fills, classes, borders).

_____When done, embed gradebook (if using Google Spreadsheets) into blog and reflect on the process using domain-specific and academic vocabulary (if not using Google Spreadsheets, embed screenshot).

_____Over time, add new grades to spreadsheet and watch final score recalculate. After several weeks, discuss whether this is a strategic tool for its purpose. Is there a better way to determine a final grade? Look both for general methods and shortcuts. Now that students have seen the formula work, is there any way to improve on it?

_____Updated spreadsheet will be submitted weekly via dropbox or shared via GAFE (Google Apps for Education).

_____Throughout class, expect students to make decisions that follow class rules

_____Remind students to transfer knowledge to class or home.

_____Problems listed at beginning of lesson are the most common students will face. Expect students to persevere in solving these without assistance. Additionally, expect students to solve hardware issues independently.

_____*A note: Every chance you get, use technology to facilitate teaching. Lead by example. Students will see you use tech quickly and facilely and follow your good example. They want to use tech. Don't discourage them!*

Common Core (truncated for brevity; refer to original Standards for exact wording)

Standards for Mathematical Practice

- CCSS.Math.Practice.MP1
  Make sense of problems and persevere in solving them
- CCSS.Math.Practice.MP2
  Reason abstractly and quantitatively
- CCSS.Math.Practice.MP3
  Construct viable arguments; critique reasoning of others
- CCSS.Math.Practice.MP4
  Model with mathematics
- CCSS.Math.Practice.MP5
  Use appropriate tools strategically
- CCSS.Math.Practice.MP6
  Attend to precision
- CCSS.Math.Practice.MP7
  Look for and make use of structure
- CCSS.Math.Practice.MP8
  Look for and express regularity in repeated reasoning

Middle School

- CCSS.ELA-Literacy.RST.6-8.3
  Follow precisely a multistep procedure when performing technical tasks
- CCSS.ELA-Literacy.RST.6-8.4
  Determine the meaning of symbols, key terms, and other domain-specific words and phrases as they are used in a specific scientific or technical context
- CCSS.ELA-Literacy.RST.6-8.7
  Integrate quantitative or technical information expressed in words in a text with a version of that information expressed visually

Extension:

- *Students can work in groups.*
- *If using Twitter for backchannel device, use #hashtags to categorize feedback.*

More Information:

- *Lesson questions? Go to Ask a Tech Teacher.*
- *For Excel basics, try these videos.*
- *A note: These links may change. You can find your own by searching "Excel grade books" in YouTube, SchoolTube, or similar.*
- *If using this for assessment, see full list of assessment items at end of unit.*

Assessment
Middle School

_____Could student transfer knowledge from prior lessons as scaffolding for this?

_____Did student understand parts of formula, as well as relationship between formula and mathematical sentences?

_____Did student formulas work?

_____Did student check formulas via mental math, guess-and-check, other? Was student able to troubleshoot formula problems?

_____Did student understand use of parentheses, symbols, unknowns in formulas?

_____Did student troubleshoot hardware problems (if any)?

_____Did student format spreadsheet as required?

_____Was student able to take/make helpful suggestions from/to peers?

_____Did student follow directions?

_____Did student work well with partner?

_____Did student join class discussion?

_____Could student follow a multi-step procedure? Could s/he use training videos to create gradebook?

_____Did student provide backchannel feedback?

_____Did student use screenshot or embed code to include spreadsheet in blog post (if necessary)?

_____Did student post reflection to blog?

_____Did student use domain-specific language in blog post and class conversation?

_____Did student complete project?

_____Did student save/export to his/her digital portfolio?

_____Did student email spreadsheet to teacher, or share via GAFE?

5…Spreadsheets—a Budget

Vocabulary	Tech Problem solving	Common Core
• *Absolute reference* • *Amortize* • *Discretionary* • *Format* • *Formula* • *Google Hangout* • *Hashtags* • *If-then* • *In the red* • *Relative reference* • *Screencast* • *Screenshare* • *Shortkey* • *Tweets*	• *Formula doesn't work (start with =)* • *When I copy-paste formula, it grabs wrong cells (Consider relative or absolute references)* • *I can't figure it out (try Help, Google search, ask a neighbor)* • *This is impossible (use problem solving strategies)* • *Numbers are confusing (enhance spreadsheet with images, color)* • *Excel is confusing (work along with videos)* • *I don't know what job or school I want (research and make a choice)* • *I spend less on restaurants (adjust)*	*CCSS.ELA-Literacy.RST.6-8.3* *CCSS.ELA-Literacy.RST.6-8.4* *CCSS.ELA-Literacy.RST.6-8.7*
Time Required *135 minutes*	**NETS-S Standards** *3c, 6a*	**Grade** *Middle School*

Essential Question

How can we use technology to draw conclusions?

Overview

Summary

Students use a spreadsheet to create a budget that reflects their expected income and expenses on their first job. They will calculate numbers both on a spreadsheet and with traditional tools like calculators (if appropriate to your school).

By the end of this unit, middle school students will review all eight Standards for Mathematical Procedures and three RST, as well an authentic use of a spreadsheet.

Big Idea

Quantitative analysis helps in understanding, evaluating, and sharing ideas.

Materials

Spreadsheet program (i.e., Open Office, Excel, Numbers, Google Docs), sites to evaluate jobs/vehicles/homes/schools, calculator (if appropriate to your school)

Teacher Preparation

- Have access to a screenshot program like Windows Snipping Tool or Jing.
- If students have blogs, have these set up.
- If you have access to a backchannel device (like Today's Meet, Padlet, Socrative, or Twitter), have that available.

- This lesson plan can be done in the classroom or tech lab. Consider co-teaching:
  - *Grade level teacher can reinforce academic topics*
  - *Tech lab teacher can reinforce tech skills*

- Something happen you weren't prepared for? No worries. Common Core is about critical thinking and problem solving. Show students how you fix the emergency without a meltdown and with a positive attitude.

Steps

_____**Required skill level for this unit: At least one project that used formulas.**

_____How do students think their parents come up with a family budget? Discuss. Come around to parents use formulas that include all factors, sort through variables, so they objectively arrive at conclusions (although part of that formula might include subjective input). In short, parents use a 'model' to get a final budget.

_____What does it mean to 'model' a budget? Parents create a formula that includes variables for income, expenses, emergencies, more. Discuss how important it is that these formulas work precisely, in a structured manner. Why? Tools used must be exact and structured. In this way, anyone who sees the 'model' gets the same message.

_____Discuss why an automated program to calculate a budget is better/worse than manually completing calculations. Which is more accurate? Faster? More reliable?

_____Formulas are a tool, much like a calculator. Their purpose is to analyze volumes of data, draw conclusions that would be difficult to comprehend without automaticity.

_____This lesson makes full use of spreadsheet formulas as a strategic tool to draw conclusions. It builds on simple formulas introduced in 3rd grade and assumes students are comfortable with them.

_____Discuss what students remember about spreadsheets. What are examples of how they use them?

_____What is a spreadsheet? Name some spreadsheet programs (hint: Excel, Numbers, Google Spreadsheet, Open Office). Why is it important to be able to use them? Prod students to include:

- *Communicate information and ideas effectively*
- *Present relationships between information and ideas clearly and efficiently*
- *Develop a coherent understanding of a topic*

> *Mathematically proficient students can apply the mathematics they know to solve problems arising in everyday life, society, and the workplace.*
>
> *—Common Core*

_____Discuss Common Core goals and how spreadsheets are uniquely qualified to attain them:

- *Make sense of problems and persevere in solving them*
- *Reason abstractly and quantitatively*
- *Construct viable arguments and critique reasoning of others*
- *Model with mathematics*
- *Use appropriate tools strategically*
- *Attend to precision*
- *Look for and make use of structure*

- *Look for and express regularity in repeated reasoning*

_____Discuss why automating a budget is better/worse than manually completing calculations. Which is more accurate? Faster? More reliable? Keep in mind the following (from Common Core):

Mathematically proficient students consider the available tools when solving a mathematical problem. These tools might include pencil and paper, concrete models, a ruler, a protractor, a calculator, a spreadsheet, a computer algebra system, a statistical package, or dynamic geometry software. Proficient students are sufficiently familiar with tools appropriate for their grade or course to make sound decisions about when each of these tools might be helpful.

_____What tasks are suited to spreadsheets instead of word processing? Presentations?
_____Before beginning, put backchannel device onto Smartscreen to track student comments. Show students how to access it on their devices. If using Twitter, encourage students to post quick answers to classmate problems (if they know the solution). As you demonstrate, pay attention to student comments and address their concerns.
_____Open spreadsheet program. Who wants to review layout for class? Inserting data? Creating formulas? Expect students to transfer knowledge from prior lessons. Any questions?
_____Create a budget for life after college (or high school). This will include:

- *Conclusions*
- *Data analysis*
- *Formatting*
- *Formulas*
- *Correct Grammar and spelling*
- *Headings*
- *Income and expense categories and sub-categories*
- *Personalized information*
- *Relative and absolute addresses (within formulas)*
- *Research*
- *Totals and subtotals*

Mathematically proficient students look closely to discern a pattern or structure.

—Common Core

_____Students will independently:

- *set up a spreadsheet*
- *add expense and income categories (see Figure 10)*
- *add initial data set:*
    - *career*
    - *annual income*
    - *years of education required*
    - *student loans (if any)*
    - *years to amortize student loan*
- *add columns for '% of Total Expenses' and '% of Total Income'*

- *add formulas where needed*

_____When completed, spreadsheet will calculate answers and student will verify answers with a redundant method (calculator, manually, mental math, online tool).

_____Students will discuss how they arrived at formulas in a blog post, Discussion Board, Google Doc that's shared, or another method of your choice that enables you to check their mental processes.

_____*Figure 10* is a sample uncompleted template:

Figure 10

	A	B	C	D	E
1	**MONTHLY BUDGET**				
2	*Your name*				
3			Data		
4	*Selected career*				
5	*Annual income*		$ -		
6	*Years of education*				
7	*Student loans total*				
8	*Amortize student loan over ___ years*				
10	**HOUSEHOLD**			**% of Total Expenses**	**% of Total Income**
11	Rent/Mortgage	$ -		#DIV/0!	#DIV/0!
12	Utilities (gas, electric, cable)	$ -		#DIV/0!	#DIV/0!
13	Insurance	$ -		#DIV/0!	#DIV/0!
14	Phones	$ -		#DIV/0!	#DIV/0!
15	Other Household Expenses	$ -		#DIV/0!	#DIV/0!
16	Student loan payment	$ -		#DIV/0!	#DIV/0!
17	TOTAL	$ -		#DIV/0!	#DIV/0!
18					
19	**FOOD**				
20	Groceries	$ -		#DIV/0!	#DIV/0!
21	Restaurants			#DIV/0!	#DIV/0!
22	TOTAL	$ -		#DIV/0!	#DIV/0!
23					
24	**Car**				
25	Car payment			#DIV/0!	#DIV/0!
26	Insurance			#DIV/0!	#DIV/0!
27	Gasoline			#DIV/0!	#DIV/0!
28	Maintenance and Repairs			#DIV/0!	#DIV/0!
29	TOTAL	$ -		#DIV/0!	#DIV/0!
30					
31	**RETIREMENT**				
32	Savings	$ -		#DIV/0!	#DIV/0!
33				#DIV/0!	#DIV/0!
34	**TOTAL EXPENSES**	$ -			
35					

_____**First**: **Student chooses a career**. Start by taking Holland Code Quiz and see what it recommends. There will be several choices. Follow links, read about careers, and record 1) job title, 2) annual income, and 3) years of education at top of spreadsheet.

_____**Second: Student selects a college**. Determine what it costs to attend. Use a State College if undecided. Multiply yearly cost by number of years required for selected job. For example, if 'Chaplain' (requires five years of college) and 'University of San Diego' were selected, multiply annual education cost at USD times five for a total. This number will be amortized over ten years (or whatever amortization number class agrees on). Divide by twelve (for monthly number) and plug answer into budget (in top section). For this exercise, consider college loan interest-free:

- *Students amortize total value of student loan over 10 years. That requires formulas in c8 and b16 (maybe more). Expect students to figure this out with minimal help.*

- *If that is too much of a monthly expense, re-evaluate college choice.*
- *If parents are paying for college, plug in only costs student will be responsible for.*

_____**Third: Student purchases/rents a home**. Plug costs of purchasing a home into spreadsheet. To do this, go to http://www.realtor.com/, enter zip code of desired location (use current zip as a default), and evaluate houses. Calculate monthly mortgage payment on http://realestate.yahoo.com/calculators/payment.html. When student plugs mortgage number into spreadsheet, *#DIV/O!* changes to a number (of course, student will have to have entered a formula in the right spots for that to happen). Consider:

- *Under '% of Total Income' and '% of Total Expenses', what does '#DIV/O!' mean?*
- *Where will student need to include formulas rather than data?*
- *Click cell D11 and discuss what formula =B11/B34 means (it divides number student mortgage cost by 'Total Expenses'). Have student determine other formulas by themselves.*
- *To come up with formula, student must know what EXACTLY they want to calculate.*
- *Budget experts recommend house payment should be no more than 28% of gross monthly income. If '% of Total Income' allocated to Rent/Mortgage exceeds that, choose a more affordable house.*
- *If student can't afford to buy, go to Apartments.com, find a unit in preferred zip code and plug rental rate into budget.*

_____**Fourth: Student chooses a car.** Evaluate choices on Autotrader and Carmax. Calculate monthly car payment and plug number into budget. Budget experts recommend car payment should not exceed 12% of gross monthly income. If car payment exceeds that, choose a more affordable car. Record numbers on spreadsheet.

_____**Fifth: Student calculates remainder of expenses**—utilities, phones, groceries, restaurants, insurance, gasoline, other household expenses, retirement. Double check calculations.

_____**Sixth: Divide Annual Income by 12—why? (**to get monthly income). This will enable student to evaluate whether they are in the 'black' or 'red' for month.

_____Stop when most students have completed at least one formula. Have each student explain formula to a neighbor. What terms did they use? Why? How did the student select the operators and terms they did? Does it work? Use domain-specific language and be ready to define words partner does not understand. Be ready to defend work. It's important to be methodical and rigorous in creating formulas.

_____Students manually calculate expenses (with mental math or calculator—or both) as well as via spreadsheet.

> *Mathematically proficient students consider the available tools when solving a mathematical problem. These tools might include pencil and paper, concrete models, a ruler, a protractor, a calculator, a spreadsheet, a computer algebra system, a statistical package, or dynamic geometry software. Proficient students are sufficiently familiar with tools appropriate for their grade or course to make sound decisions about when each of these tools might be helpful.*
>
> *—Common Core*

_____When calculating *% of Total Revenue*, two adaptations must be made to reflect reality. Any thoughts on what these are? How about:

- *Annual income must be divided by 12.*
- *Annual income is not the same as take-home pay. Discuss. This can be adjusted by multiplying income by 65% (to approximate the 35% that goes for taxes). Or, have students research how much money goes out in taxes. Use real pay stubs if available.*
- *A working formula might look like: =B11/(C5/12*0.65). Discuss what the dollar sign means, the parentheses, the .65.*

_____Format worksheet so *money* and *%* cells are reflected with *$* and *%*.
_____If student budget is in the red, adjust expenses to make it work.
_____Throughout class, check understanding. Expect students to make decisions that follow class rules.
_____Remind students to 'save early save often'—about every ten minutes.
_____*Figure 11* is a sample budget. Do you see any errors:

Figure 11

A39 =IF(B36>=B34, "Yes", "no")

	A	B	C	D	E
1	**MONTHLY BUDGET**				
2	*Your name*				
3			Data		
4	*Selected career*		Chaplain		
5	*Annual income*		$ 45,000.00		
6	*Years of education*		5		
7	*Student loans total*		$ 100,000.00		
8	*Amortize student loan over___ months*		120		
10	**HOUSEHOLD**			**% of Total Expenses**	**% of Total Income**
11	Rent/Mortgage	$ 400.00		18%	16%
12	Utilities (gas, electric, cable)	$ 75.00		3%	3%
13	Insurance	$ 25.00		1%	1%
14	Phones	$ 100.00		4%	4%
15	Other Household Expenses	$ 50.00		2%	2%
16	Student loan payment	$ 833.33		36%	34%
17	**TOTAL**	$ 1,483.33		65%	61%
19	**FOOD**				
20	Groceries	$ 100.00		4%	4%
21	Restaurants	$ 100.00		4%	4%
22	**TOTAL**	$ 200.00		9%	8%
24	**Car**				
25	Car payment	$ 200.00		9%	8%
26	Insurance	$ 100.00		4%	4%
27	Gasoline	$ 100.00		4%	4%
28	Maintenance and Repairs	$ 100.00		4%	4%
29	**TOTAL**	$ 500.00		22%	21%
31	**RETIREMENT**				
32	Savings	$ 100.00		4%	4%
33				0%	0%
34	**TOTAL EXPENSES**	$ 2,283.33			
36	**TOTAL INCOME**	$ 3,750.00			
38	**DISCRETIONARY INCOME**	**$ 1,466.67**			
39	Yes				

_____Problems? Persevere in solving them. One of the beautiful parts of technology is that it is so good at problem solving. Seek out ways that have worked in the past or find new ideas. Follow the videos suggested under 'More Information' step-by-step, carefully reproducing suggestions. Ask classmates for assistance before going to teacher. Set up a Twitter #hashtag that students can use for Tweets related to project, for example: *#budgethelp*.

_____When done, share spreadsheet with several classmates. What are their thoughts?

_____Submit completed spreadsheet via drop box or share via GAFE (Google Apps for Education)

_____Have students reflect on usefulness of spreadsheets for evaluating quantitative data in their blog or via tweets. Prod them toward answers aligned with Common Core:

- *Spreadsheets facilitate reasoning abstractly and quantitatively*
- *Spreadsheets facilitate construction of viable arguments*
- *Spreadsheets aid in making sense of problems and identifying a solution*
- *Spreadsheets allow for modeling problems*
- *Spreadsheets use repeated reasoning to solve problems*

> *Mathematically proficient students notice if calculations are repeated, and look both for general methods and for shortcuts.*
>
> *—Common Core*

_____Additionally, reflect on:

- *What did they think of the budget?*
- *Any surprises?*
- *How did a spreadsheet program make evaluative process simpler?*

_____When students write, remind them to consider*:*

- *target audience*
- *writing goal*
- *legal use of images*

_____As you teach, incorporate domain-specific vocabulary and expect students to do the same. Remind students to transfer knowledge to class or home.

_____Problems listed at beginning of lesson are the most common students will face. Expect students to solve these independent of assistance. Additionally, expect them to solve hardware problems:

_____*A note: Every chance you get, use technology to facilitate teaching. Lead by example. Students will see you use tech quickly and facilely and follow your good example. They want to use tech. Don't discourage them!*

Common Core (truncated for brevity; refer to original Standards for exact wording)

Standards for Mathematical Practice

- CCSS.Math.Practice.MP1
  Make sense of problems and persevere in solving them
- CCSS.Math.Practice.MP2
  Reason abstractly and quantitatively
- CCSS.Math.Practice.MP3
  Construct viable arguments; critique reasoning of others

- CCSS.Math.Practice.MP4
  Model with mathematics
- CCSS.Math.Practice.MP5
  Use appropriate tools strategically
- CCSS.Math.Practice.MP6
  Attend to precision
- CCSS.Math.Practice.MP7
  Look for and make use of structure
- CCSS.Math.Practice.MP8
  Look for and express regularity in repeated reasoning

Middle School

- CCSS.ELA-Literacy.RST.6-8.3
  Follow precisely a multistep procedure when performing technical tasks
- CCSS.ELA-Literacy.RST.6-8.4
  Determine the meaning of symbols, key terms, and other domain-specific words and phrases as they are used in a specific scientific or technical context
- CCSS.ELA-Literacy.RST.6-8.7
  Integrate quantitative or technical information expressed in words in a text with a version of that information expressed visually (e.g., a table)

Extension:

- *Set up an if-then formula:* ***If revenue exceeds expenses, then 'yes' appears in cell. If not, 'no' appears.*** *How would this be structured? Students can use Help, Google 'if-then formula', or trial-and-error. [Hint: =IF(B36>=B34, "Yes", "no")].*
- *Show students how to calculate interest on loans.*

More Information:

- *Watch this on cell references: https://www.youtube.com/watch?v=NmVMjQzseLA.*
- *Watch this on budgets: https://www.youtube.com/watch?v=twRRneQd8W0.*
- *For Excel basics, try these videos.*
- *Lesson questions? Go to Ask a Tech Teacher.*
- *If using this for an assessment, see full list of assessment items by grade level at end of unit.*

Assessment
Middle School

_____Did student join class discussion?

_____Could student transfer knowledge from prior lessons as scaffolding for this?

_____Could student follow a multi-step procedure? Could they use training videos to create budget?

_____Did student safely use the internet to research information for budget?

_____Did student understand parts of the formula, as well as relationship between formulas and mathematical sentences?

_____Did student formulas work?

_____Did student check formulas via mental math, guess-and-check?

_____Was student able to troubleshoot formula?

_____Did student understand the use of parentheses, symbols, and unknowns in formulas?

_____Did student troubleshoot hardware problems (if any)?

_____Did student format spreadsheet as required?

_____Was student able to take/make helpful suggestions from/to peers?

_____Did student follow directions?

_____Did student work well with partner?

_____Did student provide backchannel feedback?

_____Did student use screenshot or embed to include spreadsheet in blog post (if necessary)?

_____Did student post reflection to blog?

_____Did student use domain-specific language in blog post and class conversation?

_____Did student complete project?

_____Did student save/export to his/her digital portfolio?

_____Did student email spreadsheet to teacher, or share via GAFE?

6…Spreadsheets—Charts, Graphs

Vocabulary	Tech Problem solving	Common Core
• *Autosum* • *Cells* • *Columns* • *Context* • *Data* • *Embed* • *Excel* • *F11* • *Format* • *Formula* • *Graph* • *Headings* • *Legend* • *Rows* • *Spreadsheet* • *Table* • *Workbook* • *Worksheet* • *X axis* • *Y axis*	• *Computer doesn't work (check common problems)* • *I can't find file (did you save to your digital portfolio?)* • *I can't find folder (are you logged in correctly?)* • *Screen froze (dialogue box open?)* • *Graph has empty column (you selected empty column)* • *Graph is empty (highlight data before pushing F11)* • *Graph looks funny (highlight only data and labels)* • *Making charts is confusing (F11)* • *Chart isn't clear (use 'chart' toolbar to change type, add titles, colors, whatever makes it clearer)* • *I changed data in table. Will graph change? (It automatically recharts)* • *What's the difference between save and 'save-as'?*	*CCSS.Math.Content.2.MD.A.4* *CCSS.Math.Content.2.MD.D.10* *CCSS.Math.Content.3.MD.B.3* *CCSS.Math.Content.4.MD.A.1* *CCSS.Math.Content.4.MD.B.4* *CCSS.Math.Content.5.MD.B.2*
Time Required *45 minutes*	**NETS-S Standards** *3b, 4c*	**Grade** *2-5*

Essential Questions

How do I turn data into information?
How do I visually display a data set?
How do I make data interesting and still allow viewers to draw their own conclusions?

Overview

Summary

Students poll classmates on an authentic subject and present results two ways: 1) a table, and 2) a chart. Which method do students prefer and what are the differences?

Students use lesson as part of overall steady progress toward fluent (accurate and reasonably fast) computation (*from Common Core*).

By the end of this unit, 2nd-5th grade students will review all eight Standards for Mathematical Procedures and up to two MD Common Core Math Standards, as well as the creation of charts and graphs to better articulate mathematical information.

Big Ideas

- Students turn data into information.
- Highlighting data can point toward prescribed conclusions.

Materials

Spreadsheet program, student blogs, backchannel device, screenshot program

Teacher Preparation

- If students have blogs, have these set up so students can use them to reflect.
- If you have access to a backchannel device (like Today's Meet, Socrative, Padlet), have that available for organic feedback.
- Have access to a screenshot program like Windows Snipping Tool or Jing.
- This lesson plan can be done in the classroom or tech lab. Consider co-teaching:
  - *Grade level teacher can reinforce academic topics*
  - *Tech lab teacher can reinforce tech skills*
- Something happen you weren't prepared for? No worries. Common Core is about critical thinking. Show students how you fix the emergency without a meltdown and with a positive attitude.

Steps

_____**Required skill level: Familiarity with spreadsheet program including at least one project.**

_____Let's back up: What does it mean to 'model' a concept? What are some models students are aware of? There's the physical 'model' students may have built of a plane or car—what does a fashion model communicate? How about models in some of the online games students play? What are other examples? What tools are used to model ideas? Music? Poetry? How did the video they created earlier this year (or last year) 'model' an idea? Discuss how important it is in modeling that it is done carefully, with precision. Each tool used must be exact and structured. In this way, anyone who sees the 'model' gets the message.

> *Mathematically proficient students can apply the mathematics they know to solve problems arising in everyday life, society, and the workplace.*
>
> *—Common Core*

_____Spreadsheets are a time-proven method of solving problems and modeling data—and 'modeling' is one of Common Core's Standards for Mathematical Practice that describe expertise educators seek to develop in students. An understanding of spreadsheets should start when students begin math concepts, as a strategic used when appropriate to task.

_____Spreadsheets, like a calculator, make it possible to analyze volumes of data, draw conclusions that would be difficult to comprehend without automaticity.

_____What is a spreadsheet? Name some spreadsheet programs (hint: Excel, Google Spreadsheet, Open Office, Numbers). Why use them? Prod students to include:

- *Communicate information and ideas effectively*
- *Present relationships between information and ideas efficiently*
- *Develop a coherent understanding of a topic*

_____Discuss where students have used spreadsheets from prior years. What projects would students use spreadsheets for rather than word processing or a presentation program? Why?
_____Discuss how spreadsheets uniquely attain Common Core goals:

- *Make sense of problems and persevere in solving them*
- *Reason abstractly, quantitatively*
- *Construct viable arguments; critique reasoning of others*
- *Model with mathematics*
- *Use appropriate tools strategically*
- *Attend to precision*
- *Look for and make use of structure*
- *Look for and express regularity in repeated reasoning*

_____Discuss the following (from Common Core):

Mathematically proficient students consider the available tools when solving a mathematical problem. These tools might include pencil and paper, concrete models, a ruler, a protractor, a ***calculator****... Proficient students are sufficiently familiar with tools appropriate for their grade or course to make sound decisions about when each of these tools might be helpful.*

_____Before beginning, put backchannel device onto Smartscreen so it will track student comments as you work. Show students how to access it on their devices. This may be limited to older students. As you demonstrate, pay attention to comments so you address student concerns.
_____What is a chart (*Figure 12*)? A graph *(Figure 13*)? What's the difference between the two? How does each analyze data?
_____Show examples of both. Be careful, though: Second grade focuses on a single-unit scale to represent a data set with up to four categories. Fifth grade will be more sophisticated.
_____Which tells students more: *Figure 12 or 13?* Which is better at 'making sense' of data? Why?

Figure 12

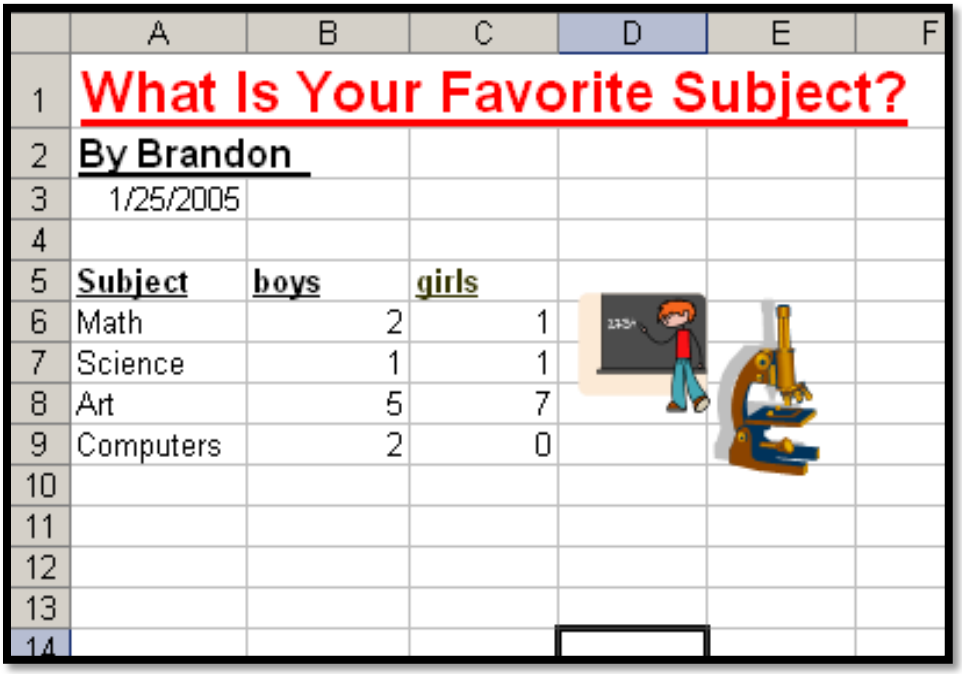
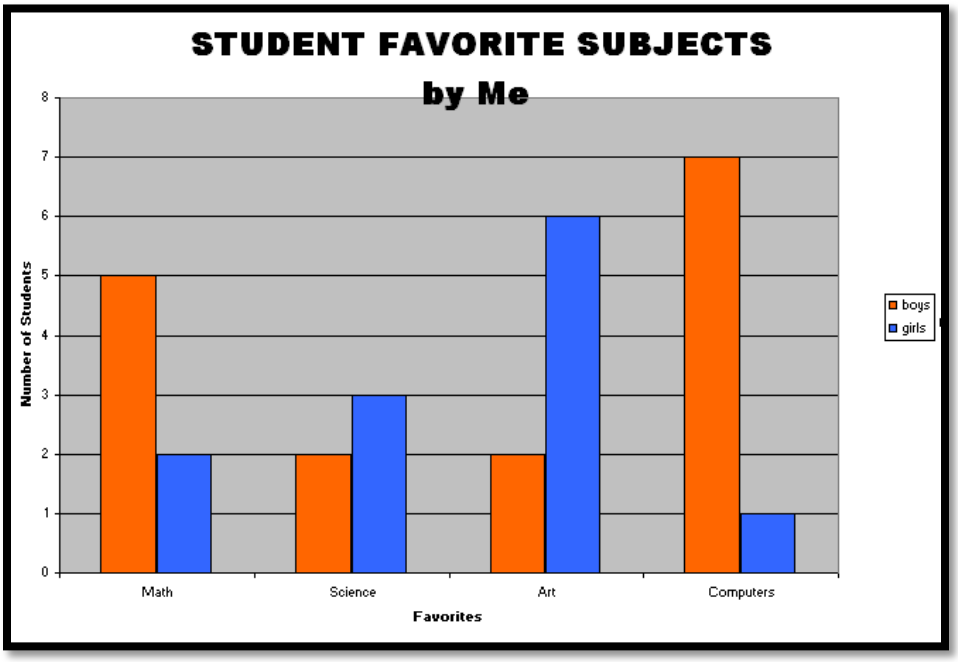


Figure 13



_____Open spreadsheet program on Smartscreen. Explain (older students: have them review) basics—columns, rows, cells, how cells named. Take questions.

_____Today, class will collect data to create a table and a chart and evaluate which is more useful.

_____Have students open spreadsheet program (keep all spreadsheet projects in the same workbook by adding new tabs). Rename 'sheet 1' to subject being analyzed; change color.

_____Add table name (i.e., *What is Your Favorite Subject?*), student name, date, column headings (*subject, boys, girls*), categories *(math, science, art, computers*). Students should do this as independently as possible especially if this is review. Use it as a formative assessment if you like.

_____Take a classroom poll and turn it into a graph that fits your class learning requirements. **4th and 5th grade**—include fractions. Suggestion: Collect data for a science experiment.

_____See 'Instructions' on the right side of Figure 14? **Older students:** Complete steps up to 'Survey Class…' **Youngers:** Do each step as a group. Students can work in pairs if you wish.

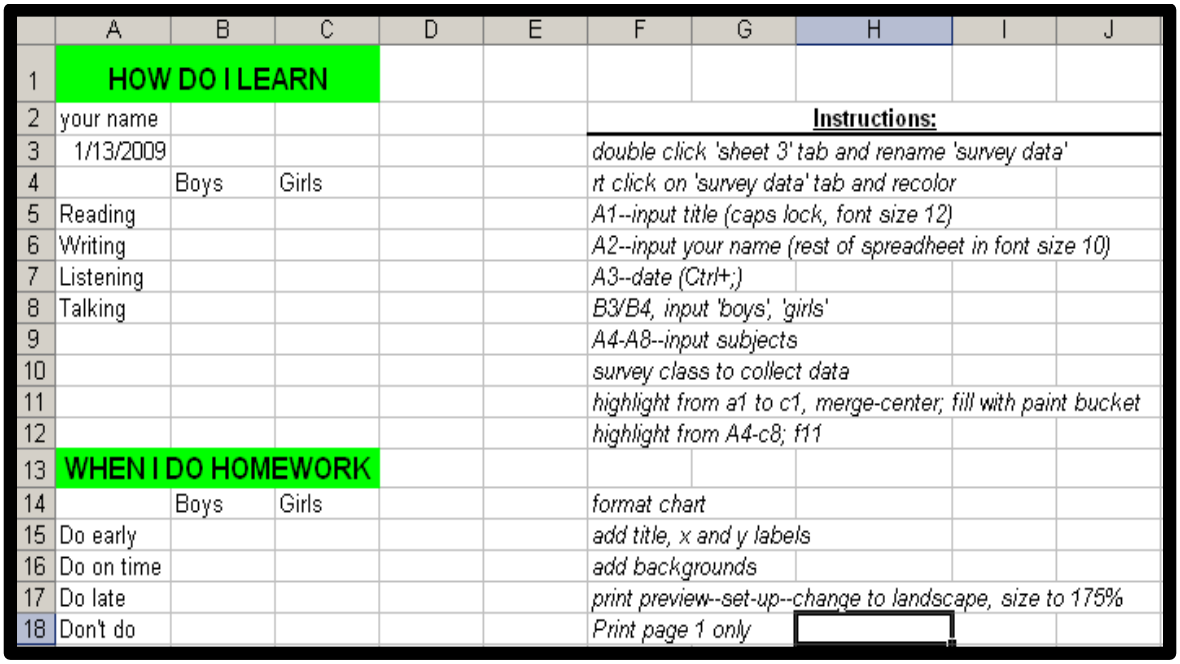
_____When you reach 'Survey Class…' under 'Instructions': Collect data by a show of hands. Only one vote per student and no one can change their vote (well, you may choose to allow this, but it makes the process complicated).

> *…variety in formats and types of representations—graphs, drawings, images, and tables in addition to text—can relieve some of the language demands that English language learners face when they have to show understanding in math…*
>
> *—Common Core*

_____Occasionally when students have difficulty doing what you are teaching, ask why. And listen. You may be surprised by the answer.

_____As you teach, incorporate domain-specific vocabulary and expect students to do the same.

Figure 14



	A	B	C	D	E	F	G	H	I	J
1	HOW DO I LEARN									
2	your name					Instructions:				
3	1/13/2009					double click 'sheet 3' tab and rename 'survey data'				
4		Boys	Girls			rt click on 'survey data' tab and recolor				
5	Reading					A1--input title (caps lock, font size 12)				
6	Writing					A2--input your name (rest of spreadheet in font size 10)				
7	Listening					A3--date (Ctrl+;)				
8	Talking					B3/B4, input 'boys', 'girls'				
9						A4-A8--input subjects				
10						survey class to collect data				
11						highlight from a1 to c1, merge-center; fill with paint bucket				
12						highlight from A4-c8; f11				
13	WHEN I DO HOMEWORK									
14		Boys	Girls			format chart				
15	Do early					add title, x and y labels				
16	Do on time					add backgrounds				
17	Do late					print preview--set-up--change to landscape, size to 175%				
18	Don't do					Print page 1 only				

_____Demonstrate how to highlight data. In *Figure 14*, that would include a4 to c8 (all labels, titles and data) and push *F11* to graph. It will turn table into a chart similar to *Figure 15*. There will be no title or formatting, but resulting bars will interpret data. Depending upon age group, this may be new material or review. With **olders**, use chart creation as a formative assessment of skills students should know.

_____Notice chart opened on a new worksheet; rename tab 'subjects chart'.

_____Take a moment to study graph. Ask students to share what they see (which questions your students can answer will depend upon age group):

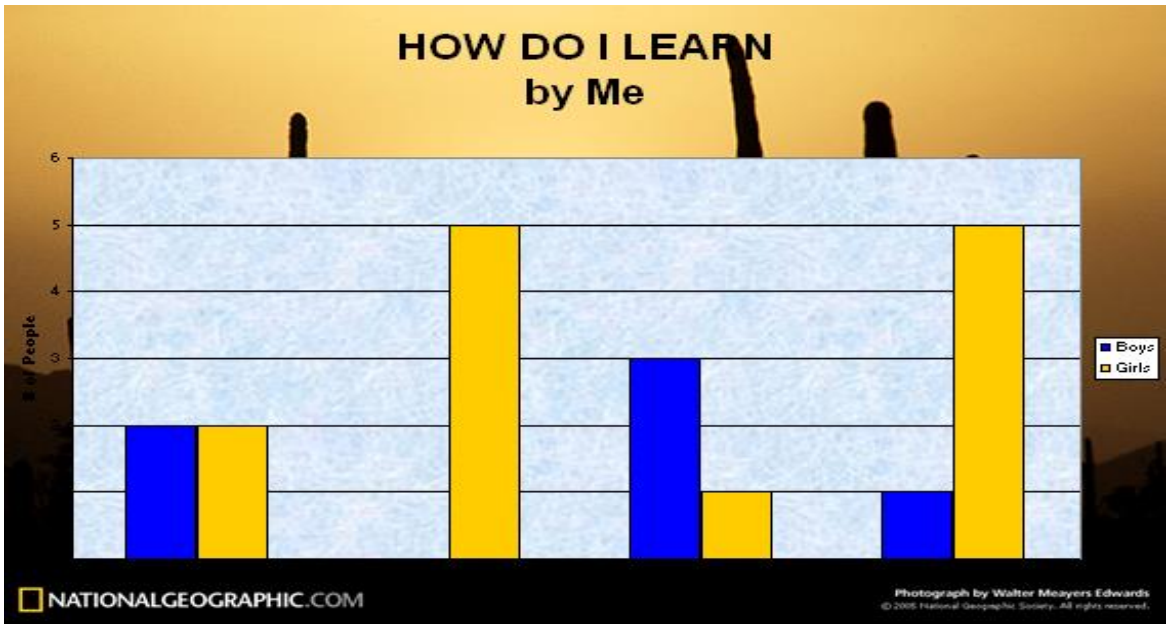
- *What does x axis represent? Do students understand that term?*
- *How about y axis?*
- *Notice legend on right side—how does that tie into bars?*
- *What's the favorite way to learn? Least favorite?*
- *Which approach did girls like best?*
- *If girls 'writing' results were redistributed equally among other three choices, which would be the favorite?*
- *By what percent did girls like writing more than boys liked talking?*
- *How many more people learn by reading than listening? What percent?*
- *How many less people learn by talking than writing? What percent?*
- *Which approach do the most boys like? Girls? By what percent?*

_____Throughout class, check for understanding via backchannel device. Expect students to solve problems as they maneuver through lessons and make decisions that follow class rules.

_____**2nd Graders**—discuss measuring bars in *Figure 15* to determine how much bigger one group is than another. Use left side numbers as a unit of measurement while bottom shows categories.

_____**4th/5th Graders:** Note what *Figure 15* left-side 'measurement' scale is. Km? Cm? Minutes? Be able to convert measurements (say, 66 minutes) into a larger unit (say 1.1 hours).

Figure 15



_____What's the difference between how a chart and table represent data? Which is clearer? How about interpretation of data? Is there a danger in allowing chart to interpret data for us—that we won't draw our own conclusions?

_____Demonstrate how to re-form graph as a line graph, a 3D graph, other options. Are these clearer or more confusing? Which is best for this data?

_____Demonstrate how to format chart area, add title, add labels to x and y axis, change background colors, resize title to 26, add student name after title, format plot area. Remind students to pay attention to clarity of chart (for example, in *Figure 15,* it's difficult/impossible to read categories on x axis and measurement on y axis. Student should change the background).

_____Problems listed at beginning of lesson are the most common students will face. Expect students to solve these independent of assistance. Additionally, expect them to solve hardware problems:

- *Monitor problems—is power on*
- *Mouse problems—is there a light on underside of mouse?*
- *Sound problems—are headphones plugged in? Is sound on?*
- *Computer problems—is power on? Is student logged in correctly?*

_____Remind students to transfer knowledge to class or home.

_____Save to digital portfolio. If using Google Spreadsheet, embed into student blog or class website (or use a screenshot) and reflect using domain-specific vocabulary:

- *What problems did student run into and how did s/he persevere to solve them?*
- *How does the table relate to the chart? Which is clearer? Is this a good tool for sharing results of a discussion?*

_____When student finishes blog entry, comment on another student's.
_____*A note: Every chance you get, use technology to facilitate teaching. Lead by example. Students will see you use tech quickly and facilely and follow your good example. They want to use tech. Don't discourage them!*

Common Core (truncated for brevity; refer to original Standards for exact wording)

Standards for Mathematical Practice

- CCSS.Math.Practice.MP1
  Make sense of problems and persevere in solving them—make data representation clear
- CCSS.Math.Practice.MP2
  Reason abstractly and quantitatively—on both chart and graph
- CCSS.Math.Practice.MP3
  Construct viable arguments; critique reasoning of others—via blogs
- CCSS.Math.Practice.MP4
  Model with mathematics—with chart and graph
- CCSS.Math.Practice.MP5
  Use appropriate tools strategically—which is better for what circumstance: chart or graph?
- CCSS.Math.Practice.MP6
  Attend to precision—in creating chart
- CCSS.Math.Practice.MP7
  Look for and make use of structure
- CCSS.Math.Practice.MP8
  Look for and express regularity in repeated reasoning

2nd Grade

- CCSS.Math.Content.2.MD.A.4
  Measure how much longer one object is than another
- CCSS.Math.Content.2.MD.D.10
  Draw a graph to represent a data set with up to four categories

3rd Grade

- CCSS.Math.Content.3.MD.B.3
  Draw scaled graph to represent a data set with several categories. Solve one- and two-step "how many more" and "how many less" problems using graphs

4th Grade

- CCSS.Math.Content.4.MD.A.1
  Know relative sizes of measurement units including km, m, cm; kg, g; lb., oz.; l, ml. Express in a larger unit in terms of a smaller unit. Record measurement equivalents in a table
- CCSS.Math.Content.4.MD.B.4
  Make a line plot to display a data set of measurements in fractions of a unit

5th Grade

- CCSS.Math.Content.5.MD.B.2
  Make a plot to display a data set in fractions. Use to solve problems

Extension:

- *Offer websites on graphing (see http://nlvm.usu.edu/en/nav/vlibrary.html).*

- *Add project due date to class calendar created in Google Calendar or similar and embedded into class website, wiki, or blog.*

More Information:

- *Lesson questions? Go to Ask a Tech Teacher.*
- *If using this for an assessment, see full list of assessment items by grade level at end of unit.*

Assessment
2nd Grade

_____Did student join class discussion?

_____Did student locate and open workbook started on prior project?

_____Did student troubleshoot hardware problems (if any)?

_____Did student format spreadsheet as required?

_____Was student able to take/make helpful suggestions from/to peers?

_____Did student follow directions presented to group?

_____Did student work well with partner?

_____Did student use domain-specific language in class conversation?

_____Did anecdotal observations show student working tenaciously on project?

_____Did student understand that chart and table represented the same data?

_____Did student critically think when analyzing data?

_____Could student answer questions about data when asked; for example, could student quantify value in a given category? Did student understand the relationship between information included in chart and graph?

_____Could student express chart differences by unit of length located on Y axis?

_____Could student express a preference for using a table or chart to evaluation data? Were they able to support their decision with facts?

_____Did student understand the relationship between the table and the chart?

_____Could student answer questions about representations made in both table and chart?

_____Did student see both chart and graph as a strategic tool useful in representing data?

_____Did student complete project?

_____Did student save/export to his/her digital portfolio?

_____Did student embed spreadsheet in blog even if it required the use of a screenshot?

Assessment
3rd Grade

_____Did student join class discussion?

_____Did student locate and open workbook started on prior project?

_____Did student troubleshoot hardware problems (if any)?

_____Did student transfer knowledge from prior spreadsheet lessons to this one and use it appropriately?

_____Did student format spreadsheet as required?

_____Did student work well with partner?

_____Was student able to take/make helpful suggestions from/to peers?

_____Did student follow directions when presented to group?

_____Did student use domain-specific and/or academic language in class conversation?

_____Did anecdotal observation show student working tenaciously on project?

_____Did student understand that chart and table represented same data?

_____Did student critically think when analyzing data?

_____Could student measure chart to determine which selection was larger and by how much?

_____Could student answer questions about data when asked?

_____Could student express differences by the Y axis unit of length?

_____Could student express a preference for using a table or chart to evaluate data? Could s/he support decision with facts?

_____Did student understand relationship between table and chart?

_____Could student answer questions about representations in table/chart?

_____Did student complete project?

_____Did student save/export to his/her digital portfolio?

_____Did student embed spreadsheet in blog?

_____Did student post article into their blog and comment on other posts?

Assessment
4th Grade

_____Did student join class discussion?

_____Did student locate and open workbook started on prior project?

_____Did student transfer knowledge from prior spreadsheet lessons to this one and use it appropriately?

_____Did student troubleshoot hardware problems (if any)?

_____Did student format spreadsheet as required? Did student insure it clearly represented data being discussed?

_____Did student work well with partner?

_____Was student able to take/make helpful suggestions from/to peers?

_____Did student follow directions independent of teacher instruction?

_____Was student able to use backchannel device to provide feedback?

_____Did student use domain-specific language in class conversation?

_____Did student understand that chart and table represented the same data?

_____Did student think critically when analyzing data?

_____Could student determine which chart and/or table selection was larger and by how much?

_____Could student express differences by the Y axis unit?

_____Could student providing supporting evidence for why s/he preferred a table or chart to evaluate data?

_____Did student understand relationship between table and chart?

_____Could student answer questions about representations in table/chart?

_____Did student complete project?

_____Did student save/export to his/her digital portfolio?

_____Did student embed spreadsheet or screenshot of spreadsheet into blog?

_____Did student post article into his/her blog and comment on other posts?

Assessment
5th Grade

_____Did student join class discussion?

_____Did student locate and open workbook started on prior project?

_____Did student transfer knowledge from prior spreadsheet lessons to this one and use it appropriately?

_____Did student troubleshoot hardware problems (if any)?

_____Did student format spreadsheet as required? Did student insure it clearly represented data being discussed?

_____Did student work well with partner?

_____Was student able to take/make helpful suggestions from/to peers?

_____Did student follow directions independent of teacher instruction?

_____Was student able to use backchannel device to provide feedback?

_____Did student use domain-specific language in class conversation?

_____Did student understand chart and table represented same data?

_____Did student think critically when analyzing data?

_____Could student determine which chart and/or table selection was larger and by how much?

_____Could student express differences by Y axis unit?

_____Could student providing supporting evidence for why s/he preferred a table or chart to evaluate data?

_____Did student understand relationship between table and chart?

_____Could student answer questions about representations in table/chart?

_____Did student complete project?

_____Did student save/export to his/her digital portfolio?

_____Did student embed spreadsheet in blog?

_____Did student post article to his/her blog and comment on others?

7…Excel—Summative

Vocabulary	Tech Problem solving	Common Core
• *Calculation* • *Count* • *Data* • *Doc* • *Domain-specific* • *Format* • *Formula* • *Four-function* • *Function* • *Geek* • *Hyperlink* • *Model* • *Quantitative* • *Read only* • *Spreadsheet* • *Transfer knowledge* • *Worksheet*	• *My cell says **** (widen column)* • *Can't find hyperlink tool (use Ctrl+K)* • *Data I put in didn't take (push enter)* • *Formula doesn't work (start with =)* • *Assessment takes longer than thirty minutes? Adjust requirements.* • *Computers don't work? Help students solve problems—don't do for them.* • *Can't save assessment—says 'read only' (save under a different name)* • *What's the difference between save and save-as?* • *Chart embeds into worksheet (highlight data; click F11)* • *Formula won't work (did you start with =? Did you try Help?)* • *My work disappeared (did you save-early-save-often?)*	*CCSS.ELA-Literacy.WHST.6-8.1* *CCSS.Math.Content.6.EE.A.1* *CCSS.Math.Content.6.EE.A.2* *CCSS.Math.Content.6.EE.B.6* *CCSS.Math.Content.6.EE.C.9*
Time Required *90 minutes*	**NETS-S Standards** *4a, 6a*	**Grade** *Middle School*

Essential Question

What are the best tools for sharing number-oriented information?

Overview

Summary

Students confirm knowledge of spreadsheet skills that enable them to share number-oriented information while independently reviewing, collaborating with neighbors, and completing a summative assessment on topic.

By the end of this unit, middle school students will review all eight Standards for Mathematical Procedures, 1 WHST and 4 EE Math Standards, as well as solidify use of spreadsheets to convey rigorous mathematical information.

Big Idea

Much information is best communicated quantitatively—through numbers, graphs, charts, tables.

Materials

Spreadsheet program, assessment, four-function calculator (if appropriate to your school)

Teacher Preparation

- Know what spreadsheet skills are important in all classes.
- This lesson plan can be done in the classroom or tech lab. Consider co-teaching:

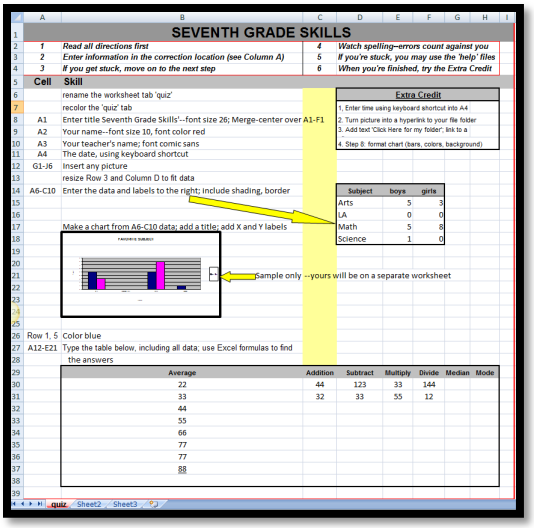
  - *Grade level teacher can reinforce academic topics*
  - *Tech lab teacher can reinforce tech skills*

- Something happen you weren't prepared for? No worries. Common Core is about critical thinking and problem solving. Show students how you fix the emergency without a meltdown and with a positive attitude.

Steps

_____**Required skill level: Knowledge of spreadsheet skills.** Students who have used the SL curriculum since 2nd grade are ready. Others: Adapt expectations and/or teaching.

_____Spreadsheets are a proven method of modeling data, and 'modeling' is one of Common Core's Standards for Mathematical Practice that describe expertise educators seek in students. An understanding of spreadsheets should start as soon as students begin math concepts, as a strategic tool used when appropriate to task.



_____What is a spreadsheet? How does it turn data into information? Name some spreadsheet programs (hint: Excel, Google Spreadsheet, Numbers, Open Office, Zoho Docs). Why is it important to know how to use them? Prod students for answers that include (from Common Core):

- *Communicate ideas effectively*
- *Present relationships between information clearly and efficiently*
- *Develop coherent understanding of topic*

_____Discuss 'formulas'. What are they? Students typically use *add, average, alphabetize*, but spreadsheets offer many more. Point students toward formula bar to explore. Discuss popular (and more advanced) formulas, i.e., standard deviation, Sin/Cos, if-then arguments, PMT (to calculate payment for a loan), depreciation of an asset, concatenations. Demonstrate a few.

_____Discuss how spreadsheets assist attaining Common Core goals:

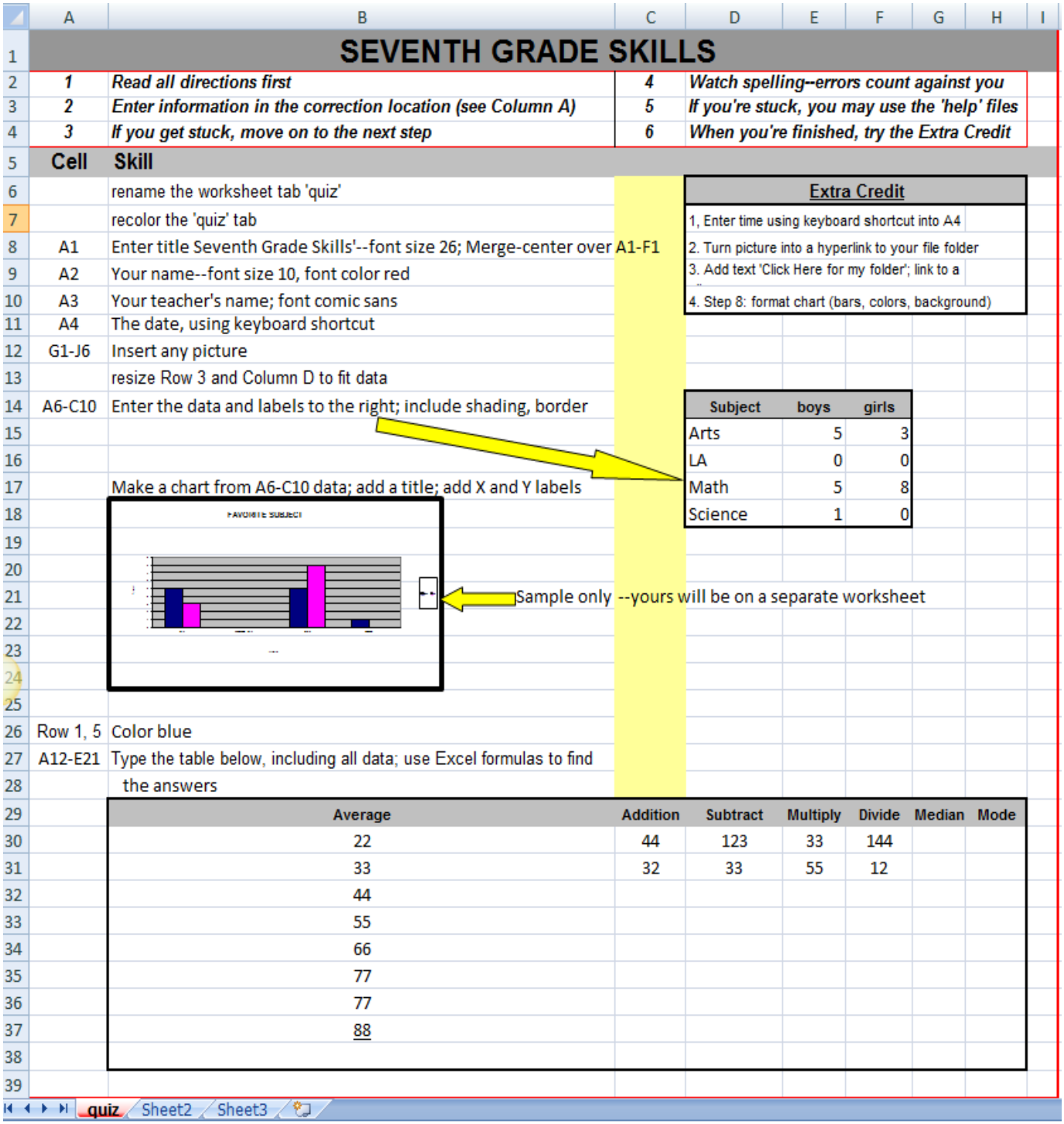
- *Make sense of problems and persevere in solving them*
- *Reason abstractly and quantitatively*
- *Construct viable arguments and critique reasoning of others*
- *Model with mathematics*
- *Use appropriate tools strategically*
- *Attend to precision*
- *Look for and make use of structure*

_____What tasks are best suited to spreadsheets instead of word processing? Presentation software?

_____Open workbook in Google Docs, Excel, OO, other. Name worksheet '*Assessment*'. Recolor tab.

_____Today, students will assess their 1) general knowledge of spreadsheets, and 2) skills they are most likely to use in Middle School/High School. *Figure 16* is a sample, but collect skills relevant to your school.

Figure 16



SEVENTH GRADE SKILLS

1	*Read all directions first*	4	*Watch spelling--errors count against you*
2	*Enter information in the correction location (see Column A)*	5	*If you're stuck, you may use the 'help' files*
3	*If you get stuck, move on to the next step*	6	*When you're finished, try the Extra Credit*

Cell	Skill
	rename the worksheet tab 'quiz'
	recolor the 'quiz' tab
A1	Enter title Seventh Grade Skills'--font size 26; Merge-center over A1-F1
A2	Your name--font size 10, font color red
A3	Your teacher's name; font comic sans
A4	The date, using keyboard shortcut
G1-J6	Insert any picture
	resize Row 3 and Column D to fit data
A6-C10	Enter the data and labels to the right; include shading, border
	Make a chart from A6-C10 data; add a title; add X and Y labels
Row 1, 5	Color blue
A12-E21	Type the table below, including all data; use Excel formulas to find the answers

Extra Credit

1, Enter time using keyboard shortcut into A4
2. Turn picture into a hyperlink to your file folder
3. Add text 'Click Here for my folder'; link to a
4. Step 8: format chart (bars, colors, background)

Subject	boys	girls
Arts	5	3
LA	0	0
Math	5	8
Science	1	0

Sample only --yours will be on a separate worksheet

Average	Addition	Subtract	Multiply	Divide	Median	Mode
22	44	123	33	144		
33	32	33	55	12		
44						
55						
66						
77						
77						
88						

quiz Sheet2 Sheet3

_____Give students one class to complete assessment. Do not answer questions. All skills have been covered between 2nd and 5th grade. Adjust assessment as needed to satisfy particular circumstances. You may choose to make this a collaborative exercise or individual.
_____Remind students:

- *Formatting is required. How does formatting make a doc easier to understand?*
- *Know when a table or graph is best. Be able to argue why*
- *Start each formula with =*
- *Understand formulas; be prepared to decode properties*
- *When finished, try Extra Credit*

_____Display assessment on class Smartscreen or make it available for download to student stations in read-only format. Students work by themselves (or you may decide in groups).
_____Review test-taking strategies:

- *Answer questions you know first—go back for others*
- *Don't know entire answer? Answer what you know*
- *Check work when done*
- *If a skill is difficult, try to find help in another question*

> *Technology differentiates for student learning styles by providing an alternative method of achieving conceptual understanding, procedural skill and fluency, and applying this knowledge to authentic circumstances.*
>
> *—Common Core*

_____Expect students to independently solve problems listed at beginning of lesson as well as hardware problems.
_____Walk around while students work; answer questions that aren't skills related.
_____Remind students to 'save early save often'—about every ten minutes.
_____Remind students to transfer knowledge to classroom or home.
_____When finished, students upload assessment to drop box, share via Google Apps, or save to digital portfolio. No printing.
_____If using Google Spreadsheet, embed into student blog and reflect on this exercise using domain-specific vocabulary. Or take a screenshot with Windows Snipping Tool, Jing or another program.
_____When student finishes blog entry, have them comment on another student's.
_____*A note: Every chance you get, use technology to facilitate teaching. Lead by example. Students will see you use tech quickly and facilely and follow your good example. They want to use tech. Don't discourage them!*

Common Core (truncated for brevity; refer to original Standards for exact wording)

Standards for Mathematical Practice

- CCSS.Math.Practice.MP1
  Make sense of problems and persevere in solving them
- CCSS.Math.Practice.MP2
  Reason abstractly and quantitatively
- CCSS.Math.Practice.MP3
  Construct viable arguments; critique reasoning of others by commenting on their blogs.
- CCSS.Math.Practice.MP4

Model with mathematics. Why is this a good model of the data set? Can you think of another way to present the information and conclusions?

- CCSS.Math.Practice.MP5
  Use appropriate tools strategically
- CCSS.Math.Practice.MP6
  Attend to precision
- CCSS.Math.Practice.MP7
  Look for and make use of structure
- CCSS.Math.Practice.MP8
  Look for and express regularity in repeated reasoning

Middle School

- CCSS.ELA-Literacy.WHST.6-8.1
  Write arguments focused on discipline-specific content.
- CCSS.Math.Content.6.EE.A.1
  Write and evaluate numerical expressions involving whole-number exponents.
- CCSS.Math.Content.6.EE.A.2
  Write, read, and evaluate expressions in which letters stand for numbers.
- CCSS.Math.Content.6.EE.B.6
  Use variables to represent numbers and write expressions when solving a real-world or mathematical problem
- CCSS.Math.Content.6.EE.C.9
  Use variables to represent two quantities in a real-world problem that change in relationship to one another

Extension:

- *Students can work in groups.*
- *Students show how they arrived at conclusions using formula pieces to guide explanation.*
- *This is an excellent formative assessment at start of school year or summative for end.*

More Information:

- *Free online spreadsheets available at EditGrid and Zoho Docs.*
- *If using this for an assessment, see full list of assessment items by grade level at end of unit.*
- *Lesson questions? Go to Ask a Tech Teacher.*

Assessment

Middle School

_____Did student join class discussion?

_____Did student transfer knowledge from prior spreadsheet lessons to this one and use it appropriately?

_____Did student troubleshoot problems (hardware and topical—if any)?

_____Did student format spreadsheet as required?

_____Did student follow directions?

_____Did student complete assessment?

_____Did student work tenaciously throughout assessment?

_____Did student use academic and domain-specific language in class conversation and blog posts?

_____Did student think critically when analyzing data?

_____Could student provide supporting evidence for how s/he arrived at calculations?

_____Did student attempt extra credit?

_____Did student save/export to his/her digital portfolio? Did student upload for grading?

_____Did student post article into his/her blog and comment on posts of other students?

_____Other_____

_____

_____

_____

_____

8…Excel—Certification

Vocabulary	Tech Problem solving	Common Core
• *Calculation* • *Count* • *Data* • *Doc* • *Excel* • *Formula* • *Four-function* • *Function* • *Geek* • *Hyperlink* • *Model* • *Precision* • *Quantitative* • *Read only* • *Structure* • *Workbook* • *Worksheet*	• *Spreadsheet's gone (check taskbar)* • *What's today's date (Ctrl+; in Excel)* • *My cell says **** (widen column)* • *Can't find hyperlink tool (Ctrl+K)* • *Data entered didn't work (push enter)* • *Assessment takes too long? Adjust requirements and grading.* • *Student computers don't work? Help them solve problems—don't do for them.* • *Can't save assessment—says 'read only' (save under a different name)* • *What's the difference between save and save-as?* • *Chart embeds into worksheet (highlight data; click F11)* • *Formula won't work (did you start with =? Did you try Help?)*	*CCSS.ELA-Literacy.RST.6-8.3* *CCSS.ELA-Literacy.RST.6-8.4* *CCSS.ELA-Literacy.RST.6-8.7*
Time Required *6 hours*	**NETS-S Standards** *2b, 6a*	**Grade** *Middle School*

Essential Question

Why is a spreadsheet the appropriate tool? How do I use it strategically?

Overview

Summary

Students work independently to prepare for and take a nationally-recognized MS Excel certification.

By the end of this unit, middle school students will review seven of the Standards for Mathematical Procedures and 3 RST Math Standards, as well as solidify use of spreadsheet for conveying rigorous mathematical information.

Big Idea

Know how to use technology to evaluate quantitative information and ideas efficiently.

Materials

Internet Excel Certification information (websites, practice tests)

Teacher Preparation

- If you have access to a backchannel device (like Today's Meet, Socrative, Padlet, or Twitter), have that available. Twitter enables student collaboration in problem solving.
- This lesson plan can be done in the classroom or tech lab. Consider co-teaching:

- *Grade level teacher can reinforce academic topics*
- *Tech lab teacher can reinforce tech skills*

- Something happen you weren't prepared for? No worries. Common Core is about critical thinking and problem solving. Show students how you fix the emergency without a meltdown and with a positive attitude.

Steps

_____**Required skill level: Intermediate Excel and self-starter attitude.**

_____Spreadsheets are a proven approach to understanding problems and modeling data—and 'modeling' is one of Common Core's Standards for Mathematical Practice that describe expertise educators seek in students. Spreadsheets are one of a student's strategic tools.

_____Excel Certification is self-directed. Test is scheduled when student is ready. Here are examples of skills students should know:

1. *Add/ remove cell borders*
2. *Add digital signatures*
3. *AVERAGEIF*
4. *Axis information*
5. *Change Chart types*
6. *Change row function*
7. *Change row/column size*
8. *Change orientation*
9. *Change view*
10. *Chart trend over time*
11. *Chart elements*
12. *Color scales*
13. *Conditional formatting*
14. *Conditional Logic*
15. *Convert text to columns*
16. *COUNTA*
17. *COUNTIF*
18. *Create custom cell format*
19. *Create drop-down list*
20. *Custom AutoFilter*
21. *Cut, copy, paste data*
22. *Data bars*
23. *Define print area*
24. *Display and print formulas*
25. *Document Inspector*
26. *Enable multiple users*
27. *Ensure Data integrity*
28. *Fill a series*
29. *Filter data*
30. *Format cells*
31. *Format decimal places*
32. *Format rows and columns,*
33. *Format text*
34. *Format date*
35. *Format worksheet*
36. *Format Data and Content*
37. *Formulas*
38. *Freeze panes*
39. *Headers and footers*
40. *Hide a row or column*
41. *Hide/unhide worksheets*
42. *Hide Ribbon*
43. *HLOOKUP*
44. *Icon sets*
45. *Insert and modify shapes*
46. *Insert comments*
47. *Keywords to properties*
48. *Mark workbooks as final*
49. *MAX*
50. *Merge and split cells*
51. *MIN*
52. *Mixed references*
53. *Modify a range*
54. *Modify/save a theme*
55. *Move a page break*
56. *Move embedded chart*
57. *Open/arrange windows*
58. *Paste Special*
59. *Paste without borders*
60. *Protect workbooks*
61. *Quick Styles*
62. *Remove duplicate rows*
63. *Remove private data*
64. *Restrict data*
65. *Save as template*
66. *Save as macro-enabled*
67. *Scale worksheet to fit*
68. *Secure Data*
69. *Set margins*
70. *Set print options*
71. *Show/hide gridlines*
72. *SmartArt graphics*
73. *Sort/filter data*
74. *Subtotal data*
75. *SUMIF*
76. *Track Changes*
77. *Troubleshoot formula*
78. *VLOOKUP*

_____Here are test-taking hints:

- *Most procedures are multi-step, but less than five. Do them right and they work.*
- *Tests are skills-based and take place in a simulated application environment.*
- *Exam is assessed on outcome and clicks.*
- *Users should be able to locate and utilize key features.*
- *Questions are not worded to be tricky or misleading.*

- *Be well versed in software, persistent.*
- *Takes about 90 minutes. Keep track of time.*
- *Skip questions you are not sure of. Return to them at end of test.*
- *If you think you clicked too many places looking for answer, reset question.*
- *Do not over-think questions. Stick to the literal.*

_____Before beginning, put backchannel device onto Smartscreen to track student comments as they work. Students access it on their devices. If using Twitter, encourage students to respond to classmate problems (if they know solution).

_____Students will use class and homework time to prepare using an MS approved prep website. Training takes approx. five hours. Students can study in groups. Remind them to use time wisely.

_____Part of prep will be creating an assessment in Flubaroo, Test creator, or Tests—whichever works for your group. These will be uploaded to a central location, such as:

- *Shared through Google Apps*
- *Class blog*
- *Class wiki*

...for use of all students. When students think they're ready, take one as practice. These can be assessed or not—your option.

_____Official test can be taken through an online location like Certiport or at your school if school has arranged to be a certified MS Office testing location.

_____During class, check for understanding. Expect students to make decisions that follow class rules.

_____*A note: Every chance you get, use technology to facilitate teaching. Lead by example. Students will see you use tech quickly and facilely and follow your good example. They want to use tech. Don't discourage them!*

Common Core (truncated for brevity; refer to original Standards for exact wording)

Standards for Mathematical Practice

- CCSS.Math.Practice.MP2
  Reason abstractly and quantitatively
- CCSS.Math.Practice.MP3
  Construct viable arguments
- CCSS.Math.Practice.MP4
  Model with mathematics
- CCSS.Math.Practice.MP5
  Use appropriate tools strategically
- CCSS.Math.Practice.MP6
  Attend to precision
- CCSS.Math.Practice.MP7
  Look for and make use of structure
- CCSS.Math.Practice.MP8
  Look for and express regularity in repeated reasoning

Middle School

- CCSS.ELA-Literacy.RST.6-8.3
  Follow precisely a multistep procedure when performing technical tasks.
- CCSS.ELA-Literacy.RST.6-8.4
  Determine the meaning of symbols, key terms, and other domain-specific words and phrases as they are used in a specific scientific or technical context
- CCSS.ELA-Literacy.RST.6-8.7
  Integrate quantitative or technical information expressed in words in a text with a version of that information expressed visually (e.g., a table).

Extension:

- *If available, have local business folk explain importance of MS Certification in business. Help students understand how time spent preparing contributes directly to college and career.*
- *Students can work in groups.*
- *Use Evernote or OneNote (if available) to collect and share notes on prep materials.*
- *Access free online Excel training.*
- *Use StudyBlue to create and share flash cards for Certification.*
- *Practice on MS 365 if available so students get used to taking tests online.*
- *Reflect in blog on achieving Certification. Was it important? Did student learn a lot? If they didn't pass, what happened? Student is graded NOT on achieving certification, but the process in pursuing it.*
- *This is an excellent KWL formative assessment or a summative assessment for end of a unit.*

More Information:

- *Get prep course at Lynda.com.*
- *Certification classes: Comma.*
- *Certification classes: Certiport.*
- *Lesson questions? Go to Ask a Tech Teacher.*
- *If using this for an assessment, see the full list of assessment items by grade level at end of unit.*

Assessment
Middle School

_____Did student join class discussion? With backchannel device?

_____Did student share study materials with classmates (via Google Apps, DropBox, other)?

_____Did student transfer knowledge from prior spreadsheet lessons to this one and use it appropriately?

_____Did student troubleshoot problems (if any)?

_____Was student able to follow multi-step videos and written directions in preparing Excel skills?

_____Was student able to decode domain-specific language in test preparation materials?

_____Did student work tenaciously throughout preparation?

_____Did student complete preparation working independently and tenaciously?

_____Did student take a student-created pre-test?

_____Did student take certification test?

_____Did student pass certification test?

_____Did student use academic and domain-specific language in class conversation and blog posts?

_____Did student think critically when investigating Excel problems?

_____Could student provide supporting evidence for how s/he arrived at solutions?

_____Did student blog on certification and comment on other posts? Did student use evidence when discussing topic?

_____Did student understand why spreadsheets are a strategic tool important to their academic career?

_____Other_____

_____

_____

9...Arrays

Vocabulary	Tech Problem Solving	Common Core
• *Addends* • *Arrays* • *Attribute* • *Autistic* • *Column* • *Context* • *Equation* • *Grid* • *Matrix* • *Pairing* • *Pi* • *Product* • *Row* • *Spreadsheet* • *Workbook* • *Worksheet*	• *Computer doesn't work (check common problems)* • *Cells aren't square (click between A/1)* • *Where's Excel embed code (only in Google Spreadsheet)* • *I don't understand directions (read, interpret, do your best, edit, revise, collaborate with neighbor)* • *Got wrong fill (try again with correct color)* • *Why must my name be in file name?* • *My spreadsheet disappeared (did you save-early-save-often?)* • *It's easier for me to do the multiplication (or addition) without arrays (That's OK. Understand how arrays work and then use approach that works best for you)*	*CCSS.ELA-Literacy.CCRA.SL.5* *CCSS.ELA-Literacy.CCRA.SL.2* *CCSS.Math.Content.2.MD.B.5* *CCSS.Math.Content.2.OA.C.4* *CCSS.Math.Content.3.NBT.A.3* *CCSS.Math.Content.3.OA.A.1* *CCSS.Math.Content.3.OA.A.3* *CCSS.Math.Content.3.MD.C.6* *CCSS.Math.Content.3.MD.C.7* *CCSS.Math.Content.3.G.A.2* *CCSS.Math.Content.4.NBT.B.5* *CCSS.Math.Content.4.OA.A.2* *CCSS.Math.Content.4.OA.B.4* *CCSS.Math.Content.5.MD.C.3* *CCSS.Math.Content.5.MD.C.5*
Time Required *25-45 minutes*	**NETS-S Standards** *3c, 6a*	**Grade** *2nd - 5th*

Essential Questions

How can I draw a picture of numbers?
How are patterns related to multiplication?

Overview

Summary

Use spreadsheet tools to visually represent arrays. Compare answers derived from array with those based on mental math, traditional math processes, and/or a four-function calculator.

This lesson contributes to coherence between math skills and strategic use of technology to deliver those.

Additionally, this lesson contributes to the rigor of your school's math program.

By the end of this unit, 2nd - 5th grade students will review two Anchor Standards in Language Arts, all eight Standards for Mathematical Procedures, up to 2 MD standards, up to 2 OA standards, up to 1 NBT standard, and 1 G standard, as well as review use of arrays in math concepts.

Big Idea

Mathematical concepts are often clearer when visualized.

Materials

Spreadsheet program, internet, four-function calculator (if appropriate to your school)

Teacher Preparation

- Have access to a screenshot program like Windows Snipping Tool or Jing.
- If students have blogs, have these set up.
- If you have access to a backchannel device (like Today's Meet, Socrative, Padlet), have that available.
- Have sample math problems to solve with arrays.
- Differentiate where possible for student learning styles.
- This lesson can be done in the classroom or tech lab. Consider co-teaching:
  - *Grade level teacher can reinforce academic topics*
  - *Tech lab teacher can reinforce tech skills*
- Something happen you weren't prepared for? No worries. Common Core is about critical thinking and problem solving. Show students how you fix emergencies without a meltdown and with a positive attitude.

Steps

_____**Required skill level: One spreadsheet project.**

_____Let's talk about models. What's a model? Anyone make plane models? Use Legos to create a building? Those are tangible. What about something intangible—can you 'model' a concept, idea? What tools are used to model? Have students read comics? What are those a 'model' for? How did the play they did earlier this year (or last year) 'model' an idea? Discuss how important it is in modeling to do it carefully, with precision. Each tool used must be exact and structured. In this way, anyone who sees the 'model' gets the message.

_____Common Core references arrays at every elementary grade level. Arrays are used for counting, organizing, measuring, multiplication, and fractions. How can they be considered 'models'?

_____Introduce arrays with a discussion of the amazing Daniel Tammet, author of *Born on a Blue Day*. He is an autistic savant who perceives words and numbers as shapes and colors. He can recite *pi* to several thousand places by visualizing the number as a landscape. See *More Resources* for links to Tammet's work.

Figure 18

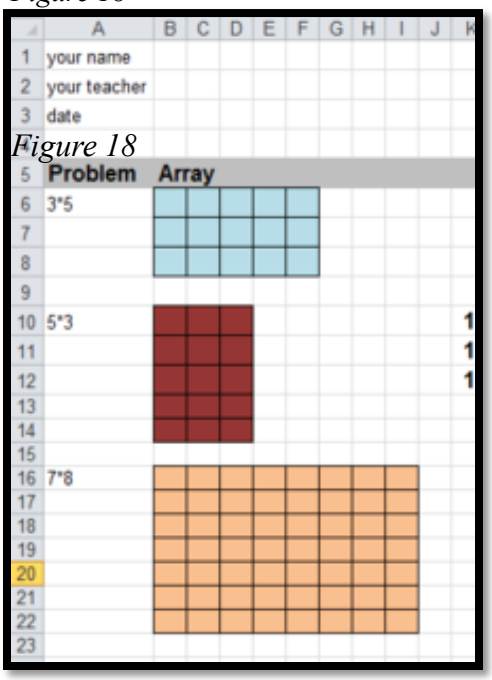


Figure 18

_____An array is a display of objects put into equal rows and columns (see *Figure 18*). In math, that means a grid-like arrangement of rows and columns enabling visualization of math. This is helpful to students who comprehend math best as an image rather than number (like Daniel Tammet).

_____Arrays offer an alternative model for multiplication problems. When some students see rows down and columns across and the tiny cells in between, they suddenly understand the logic and soon can answer without the array. This is differentiation.

_____Before beginning, put backchannel device onto Smartscreen to track student comments. Show students how to access it on their devices. As you demonstrate, address student comments.

_____Review spreadsheet—better yet, ask a student to review for class. Include rows, columns, numbers, letters, toolbars, how to format with color and text.

_____**2nd graders**: Postulate several addition problems in an array format. Have students verify sum is the same whether rows or columns are added. Have students click in each square and type a sequenced number as they add squares—one, two, three, and so forth until they run out of squares. On spreadsheet, to right of array, type equation that represents what is being added. Verify that whatever method student selects gives the same answer.

_____**Olders**: Postulate a problem, say three times five. In array syntax, this means a matrix (does this relate to the movie, *Matrix*?) 'three rows of five'. The delineated number of squares answers the function. What fraction of the whole would that be?

_____**All ages:** Give a word problem and ask students to work with a partner to solve it using an array.

_____Have students open spreadsheet program. For simplicity, use same workbook for all spreadsheet projects. In this case, name new tab 'Arrays'.

_____Set column width so sheet looks like graph paper (excepting column A where multiplication sentence is loaded). Discuss whether these squares equal centimeters, inches, millimeters, or another measure. What would the difference be? Should there be a legend to clarify?

> *Students develop an understanding of meanings of multiplication and division of whole numbers through activities and problems involving … arrays.*
>
> *—Common Core*

_____Add column titles 'Problem' and 'Array'. See *Figure 18* for example.

_____Working in groups, have students come up with three problems, say: *3*5, 5*3, 7*9*. Be sure to include a legend defining scale used to measure.

_____Color cells with paint bucket. Add cell borders to delineate.

_____With a partner, answer the following questions. Place answers to the right of arrays or in a separate section. Let students arrange as it suits them. Remind them: Make layout clear to viewer. Treat this like a problem (*How do I answer these questions so viewer can see what I'm talking about*?):

> *3. Use multiplication and division within 100 to solve word problems in situations involving equal groups, arrays, and measurement quantities, e.g., by using drawings and equations with a symbol for the unknown number to represent problem. (3rd grade)*
>
> *—Common Core*

- *What counting pattern is shown by array? Why does pattern find total number of items in array?*
- *What objects in classroom or school are arranged as an array?*
- *Write an addition or multiplication sentence to go with array. Describe how columns and rows are used to find parts of a multiplication sentence.*
- *What part of the whole is each square? Measured as a width or as part of the area? How can student determine answer? For example, one square might be ½ of the total width. It also might be 1/6th of the total area.*

_____Now, student partners create five of their own problems and solve in the same manner. Create problems representative of math being learned in class. Include fractions if appropriate. For example, a third grader will multiply one-digit whole numbers by multiples of 10 in the range 10–90 (e.g., 9 × 80, 5 × 60). A fourth grader will create a word problem.

_____Next: Show how a rectangle with an area of ten can be represented by different arrays—such as 1 x 10 and a 2 x ?.

_____What about volume? How is that represented with arrays? What portion would one square represent? Let students use problem solving strategies—see what they come up with. After the right amount of time, have students work in groups with Legos to solve the problem, then transfer that knowledge to spreadsheet array. Share that thinking in a blog post.

_____Have student groups create as many arrays as possible with area of 24 (1 by 24; 2 by 12; 3 by 8). As they work:

- *Discuss thinking with each other; revise as needed.*
- *Understand arrays are a model, much as a graphic organizer.*
- *Consider how an array's visual display is different from a mathematical sentence?*

> *5. Multiply a whole number of up to four digits by a one-digit whole number, and multiply two two-digit numbers, using strategies based on place value and the properties of operations. Illustrate and explain the calculation by using equations, rectangular arrays, and/or area models. (4th Grade)*
>
> *—Common Core*

_____Save to student digital portfolios, including last name in file name. Why? Embed page into student blog if using GAFE/Google Spreadsheet. If not using GAFE, save a screenshot of page and add to student blog with a reflection on how this visual arrangement enhanced understanding—or didn't. Compare and contrast to a numeric sentence.

_____Occasionally when students have difficulty doing what you are teaching, ask why. And listen. You may be surprised by the answer.

_____Tech Problems listed at beginning of lesson are the most common students will face. Expect students to solve these. Additionally, expect students to solve hardware problems as independently as possible, to persevere in solving them no matter how difficult they seem, and to use appropriate tools for finding solution. Consider:

- *Monitor problems—is power on*
- *Mouse problems—is light on underside (means it's getting power)?*
- *Sound problems—are headphones plugged in? Is student using correct headphones? Is sound on?*
- *Computer problems—is power on? Is student logged in correctly?*

> *6. Find quotients … Illustrate … by equations, rectangular arrays, and/or area models. (5th grade)*
>
> *—Common Core*

_____Throughout class, expect students to make decisions that follow class rules.

_____As you teach, incorporate domain-specific vocabulary and expect students to do the same.

_____Remind students to transfer knowledge to class or home.

_____As students leave classroom, have them line up in arrays.

_____*A note: Every chance you get, use technology to facilitate teaching. Lead by example. Students will see you use tech quickly and facilely and follow your good example. They want to use tech. Don't discourage them!*

Common Core (truncated for brevity; refer to original Standards for exact wording)

Anchor Standards

- CCSS.ELA-Literacy.CCRA.SL.5
  Make strategic use of digital media and visual displays of data to express information and enhance understanding of presentations.
- CCSS.ELA-Literacy.CCRA.SL.2
  Integrate and evaluate information presented in diverse media and formats

Standards for Mathematical Practice

- CCSS.Math.Practice.MP1
  Make sense of problems and persevere in solving them
- CCSS.Math.Practice.MP2
  Reason abstractly and quantitatively
- CCSS.Math.Practice.MP3
  Construct viable arguments
- CCSS.Math.Practice.MP4
  Model with mathematics
- CCSS.Math.Practice.MP5
  Use appropriate tools strategically
- CCSS.Math.Practice.MP6
  Attend to precision
- CCSS.Math.Practice.MP7
  Look for and make use of structure
- CCSS.Math.Practice.MP8
  Look for and express regularity in repeated reasoning

2nd Grade

- CCSS.Math.Content.2.MD.B.5
  Use addition and subtraction within 100 to solve word problems …
- CCSS.Math.Content.2.OA.C.4
  Use addition to find the total number of objects arranged in rectangular arrays with up to 5 rows and up to 5 columns; write an equation to express the total as a sum of equal addends

3rd Grade

- CCSS.Math.Content.3.NBT.A.3
  Multiply one-digit whole numbers by multiples of 10 in the range using place value and properties of operations
- CCSS.Math.Content.3.OA.A.1
  Interpret products of whole numbers
- CCSS.Math.Content.3.OA.A.3
  Use multiplication and division within 100 to solve word problems in situations involving equal groups, arrays, and measurement quantities
- CCSS.Math.Content.3.MD.C.6
  Measure areas by counting unit squares
- CCSS.Math.Content.3.MD.C.7
  Relate area to the operations of multiplication and addition
- CCSS.Math.Content.3.G.A.2
  Partition shapes into parts with equal areas. Express area as a unit fraction of whole

4th Grade

- CCSS.Math.Content.4.NBT.B.5
  Multiply a whole number of up to four digits by a one-digit whole number, and multiply two two-digit numbers, using strategies based on place value and the properties of operations
- CCSS.Math.Content.4.OA.A.2
  Multiply or divide to solve word problems involving multiplicative comparison
- CCSS.Math.Content.4.OA.B.4
  Find all factor pairs for a whole number in the range 1–100

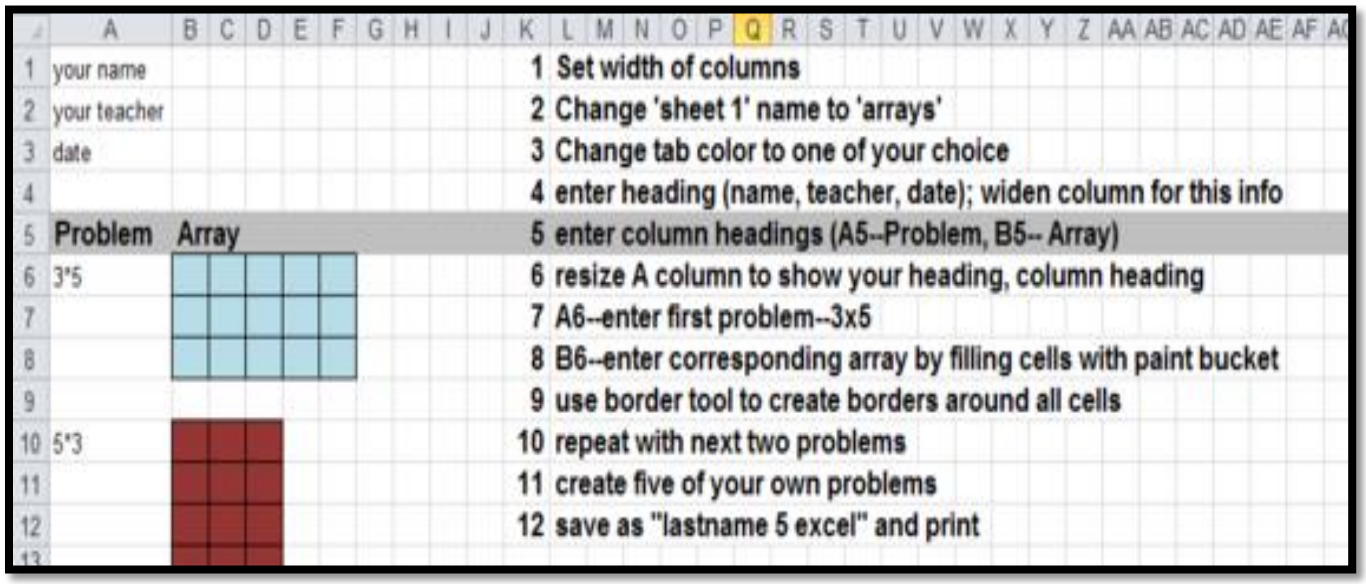
5th Grade

- CCSS.Math.Content.5.MD.C.3
  Recognize volume as an attribute of solid figures
- CCSS.Math.Content.5.MD.C.5
  Find volume of a prism with whole-number side lengths by packing it with unit cubes; show volume matches that found by multiplying edge lengths

Extension:

- *If using this for assessment, see full list of assessment items by grade level at end of unit.*
- *Students can work in groups.*
- *Use arrays to determine how many arrangements of rows and columns give the same multiplicative answer (factor a number). Do as a group on Smartscreen and then in groups.*
- *Show 5th graders how to determine volume of right rectangular prisms by viewing them decomposed into layers of cubes. Have them solve another problem the same way.*
- *Using Google Docs (with some adaptations), assign student groups to build arrays on shared spreadsheet. Display spreadsheet on Smartscreen as students work so they learn together.*
- *Have a student explain how s/he embedded Google Spreadsheet into a blog/website.*
- *Follow directions on right side Figure 19 as independent work.*

Figure 19



More Information:

- *See Daniel Tammet's Pi Landscape here.*
- *Click here for background on Tammet. Click here for TED talk.*
- *Lesson questions? Go to Ask a Tech Teacher.*

Assessment
2nd Grade

_____Did student join class discussion?

_____Did student locate and open workbook started on prior project if any)?

_____Did student format spreadsheet as required?

_____Did student follow directions when presented to group? Could student transfer information from Smartscreen to their digital device?

_____Did student work well with partner?

_____Was student able to take/make helpful suggestions from/to peers?

_____Did student use domain-specific language in class conversation?

_____Did student correctly build arrays to represent addition and multiplication problems?

_____Did student understand relationship between arrays and functions?

_____Did student critically think when analyzing data?

_____Did student understand how arrays contributed to their understanding of math? Did they connect the patterns created in arrays to math functions?

_____Did student come up with additional correctly-formed arrays?

_____Could student build an array to represent a word problem?

_____Did anecdotal observations show student working tenaciously on project?

_____Did student complete project?

_____Did student save/export to his/her digital portfolio?

_____Did student troubleshoot problems (if any)?

_____Other_____

_____

_____

Assessment
3rd Grade

_____Did student join class discussion?

_____Did student locate and open workbook started on prior project?

_____Did student format spreadsheet as required?

_____Did student follow directions when presented to group?

_____Did student work well with partner?

_____Was student able to take/make helpful suggestions from/to peers?

_____Did student use domain-specific language in class conversation?

_____Did anecdotal observations show student working tenaciously on project?

_____Did student correctly build arrays to represent addition and multiplication problems? Could student build an array to represent a word problem? Did student understand relationship between arrays and functions?

_____Did student critically think when analyzing data?

_____Did student understand how arrays and spreadsheets contributed to their understanding of math? Did they connect patterns created in arrays to math functions?

_____Did student understand how arrays connect area?

_____Did student find all factors of a number and represent that on spreadsheet?

_____Did students understand how each array was the composite of smaller equal parts, and as such, each part was $1/4^{th}$ or $1/3^{rd}$ (or similar) of the whole?

_____Did student come up with additional correctly-formed arrays?

_____Did student troubleshoot hardware problems (if any)?

_____Did student complete project?

_____Did student save/export to his/her digital portfolio?

Assessment
4th Grade

_____Did student join class discussion?

_____Did student locate and open workbook started on prior project (if any)?

_____Did student troubleshoot problems (if any)?

_____Did student format spreadsheet as required?

_____Did student work well with partner?

_____Was student able to take/make helpful suggestions from/to peers?

_____Did student follow directions presented to group and work independently when following a multi-step series of instructions?

_____Did student use backchannel device to get/give help?

_____Did student use domain-specific language in class conversation?

_____Did anecdotal observations show student working tenaciously?

_____Did student correctly build arrays to represent math problems? Could student build an array to represent a word problem? Did student understand relationship between arrays and functions?

_____Could student explain calculations using arrays to model answers?

_____Did student find all factors of a number and represent that on spreadsheet?

_____Did student understand how arrays and spreadsheets contribute to understanding math? Did they connect the patterns created in arrays to math functions?

_____Did student understand how arrays connect area, volume, multiplication, and addition?

_____Did student understand how each array was the composite of smaller equal parts, and as such, each part was $1/4^{th}$ or $1/3^{rd}$ (or similar) of whole?

_____Did student come up with additional correctly-formed arrays?

_____Did student complete project?

_____Did student save/export to his/her digital portfolio?

Assessment
5th Grade

_____Did student join class discussion?

_____Did student locate and open workbook started on prior project?

_____Did student troubleshoot problems (if any)?

_____Did student format spreadsheet as required?

_____Did student work well in a group—take/make suggestions from/to peers?

_____Did student follow directions presented to group and/or work independently when following a multi-step series of instructions?

_____Did student use backchannel device to get/give help?

_____Did student use domain-specific language in class conversation?

_____Did anecdotal observations show student working tenaciously?

_____Did student correctly build arrays to represent math problems? Could student build an array to represent a word problem?

_____Could student explain calculations using arrays to model answers?

_____Did student find all factors of a number and represent that on spreadsheet?

_____Did student see how arrays and spreadsheets contribute to understanding math, and relationship between arrays and functions?

_____Did student understand how arrays are connected to area, volume?

_____Did student understand how each array was the composite of smaller equal parts, and as such, each part was $1/4^{th}$ or $1/3^{rd}$ (or similar) of whole?

_____Did student come up with additional correctly-formed arrays?

_____Did student complete project?

_____Did student save/export to his/her digital portfolio?

10…Visual Organizers

Vocabulary	Tech Problem solving	Common Core
• *Alignment* • *Drop-down menus* • *F row* • *Font* • *Formatting* • *Graphic organizer* • *Menu bar* • *Sets* • *Subset* • *Tool bar* • *Venn Diagram* • *Visual learning*	• *I can't close down (try Alt+F4)* • *Where's my diagram toolbar (select diagram—you'll find it)* • *Can't find file (search by last name)* • *I can't find F row (at top of keyboard, with F keys)* • *How does one toggle between screens (Alt+Tab)* • *Students shouting out answers? Remind them of agreed-upon rules for discussions*	*CCSS.ELA-Literacy.RST.6-8.7* *CCSS.ELA-Literacy.WHST.6-8.6* *CCSS.Math.Content.6-7.SP.B.4* *CCSS.Math.Content.6.SP.B.5*
Time Required *45 minutes*	**NETS-S Standards** *2b, 4d*	**Grade** *6th Grade*

Essential Question

How do I communicate information and ideas visually?

Overview

Summary

Students organize data as groups within groups, visually representing conclusions.

This lesson contributes to the rigor of your school's math program, defined by Common Core as: *To help students meet the expectations of the Standards, educators need to pursue, with equal intensity, three aspects of rigor …: (1) conceptual understanding, (2) procedural skill and fluency, and (3) applications*. Using technology differentiates for student learning styles by providing an alternative method of achieving understanding, procedural skill, and applying knowledge to authentic circumstances.

By the end of this unit, 6th grade students will review all eight Standards for Mathematical Procedures and 1 WHST, 1 RST, and 2 SP standards, as well as inform themselves on the use of visual organizers to convey mathematical information.

Big Idea

Organize data in groups.

Students use information presented in graphs to solve word problems without allowing the graph to detract from the mathematics focus. In this way, coherence supports focus.

Materials

Word processing program that allows use of visual organizers

Teacher Preparation

- Have access to a screen shot program like Windows Snipping Tool or Jing.
- If students have blogs, have these set up.
- If you have access to a backchannel device (like Today's Meet, Socrative, Padlet, or Twitter), have that set up.
- This lesson plan can be done in the classroom or tech lab. Consider co-teaching:

    - *Grade level teacher can reinforce academic topics*
    - *Tech lab teacher can reinforce tech skills*

- Something happen you weren't prepared for? No worries. Common Core is about critical thinking and problem solving. Show students how you fix the emergency without a meltdown and with a positive attitude.

Steps

_____**Required skill level: Familiarity with visual organizers.**

_____Before proceeding, put backchannel device onto Smartscreen to track student comments. Show students how to access it on their computers. If using Twitter, encourage students to answer classmate problems (if they know solution). As you demonstrate, pay attention to students comments so you address their concerns.

> *Summarize numerical data sets in relation to their context (6th grade)*
>
> *—Common Core*

_____Today, we use word processing (any program that allows editing of graphic organizers) to investigate sets, probability. This was introduced in kindergarten and built upon every year. What are sets? Ask a few leading questions:

- *Is this class made up of the set of boys and girls?*
- *Do girls in this class have blonde, black, brown hair?*
- *Is there someone in the class who is a girl and has black hair?*

_____Have students come up with a definition of 'set'; refine it by asking questions to narrow focus.

_____When students arrive at an agreed-upon definition, test it on class. Start with one student—'Joey'. Can someone describe Joey?

- *He likes soccer*
- *He has a dog*
- *He has red hair*

_____Poll class on who else has these factors. Results may be:

- *Like soccer—8*
- *Have a dog—20*
- *Have red hair—2*

> *...variety in formats and types of representations—graphs, drawings, images, and tables in addition to text—can relieve some of the language demands that English language learners face when they have to show understanding in math...*
>
> *—Common Core*

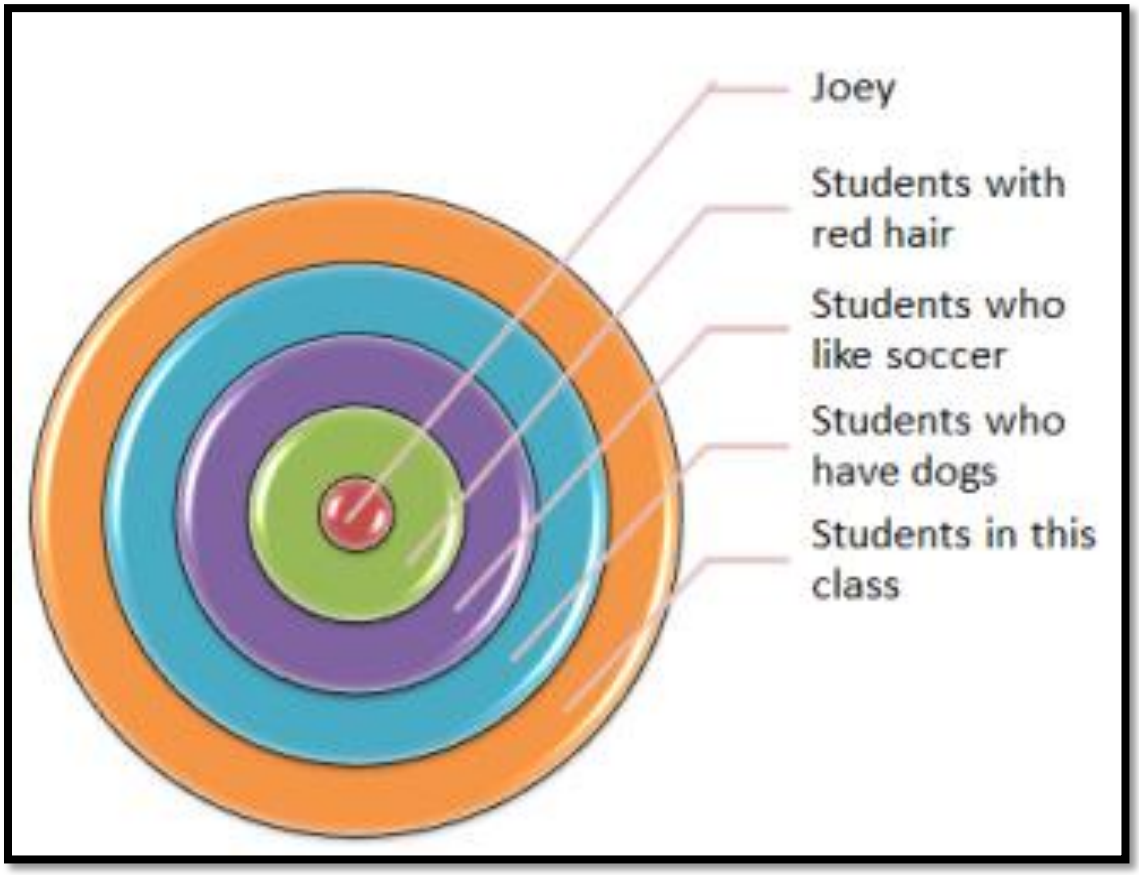
_____Ask everyone to stand. Those who like soccer, remain standing. Everyone else sit down. Those who have a dog and are standing, remain standing. Those with red hair and like soccer and have a dog, remain standing.

_____Order Target diagram from lowest number (Joey) to highest (class). That means:

In the set of all students in class, Joey is a subset of students who have read hair, like soccer, and have a dog.

_____Not very clear? On Smartscreen, open SmartArt in Word (or click here for online options). Pick 'target'. Write the above sentence visually, like *Figure 20:*

Figure 20



_____The smallest number (Joey) goes in middle, the largest (entire class) on outside rim. Other traits are sorted in between. This is a viable mathematical model to organize this problem.

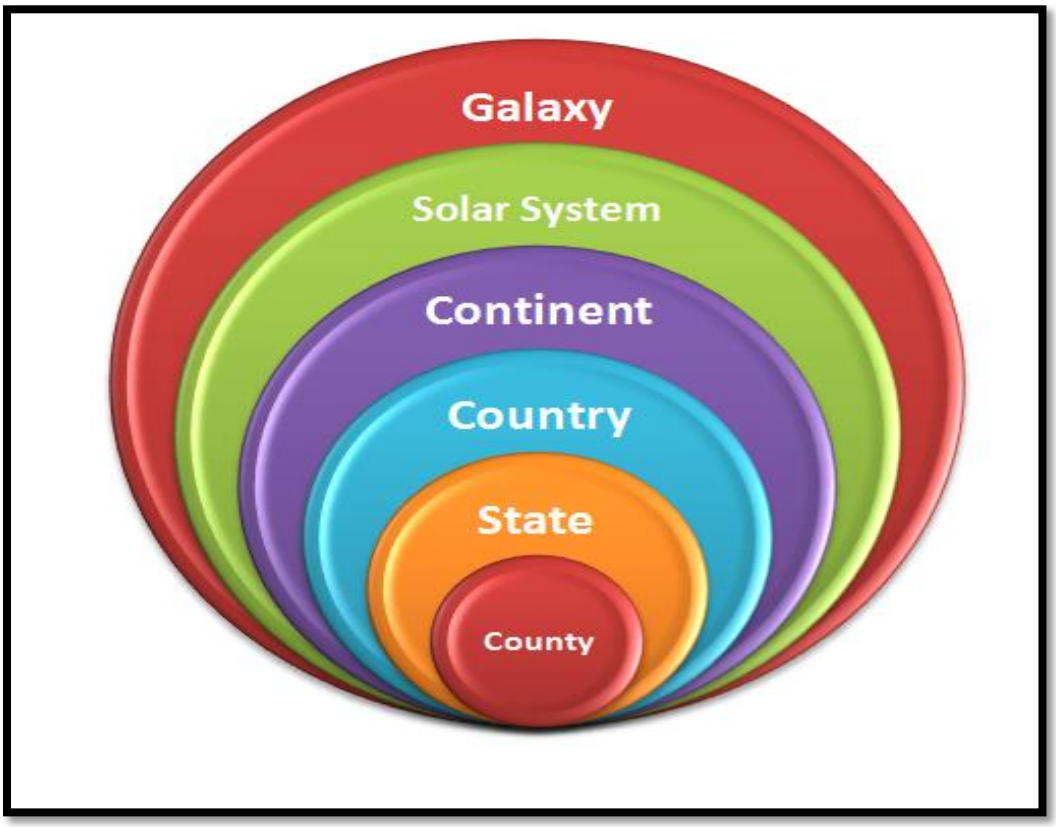
_____Let's try it on space (or what fits your class). How is the Universe organized? Gently, take suggestions until you get these categories:

- *City*
- *County*
- *State*
- *Country*
- *Continent*
- *Hemisphere*
- *Planet*
- *Solar system*

- *Galaxy*

_____Work together until students agree on an order, from smallest to largest: Are all counties in a state? Are all states in a country? And so forth. The result should look similar to *Figure 21*:
_____Now students open word processing program. Have a student review menus, ribbons, tools, layout.
_____Put heading (name-teacher-date) at top of page. How do students figure out date? Add title. Insert visual organizer. Students can collaborate as they determine what should go in each layer.
_____Remind students: Every time they use the computer, practice good keyboarding skills.
_____Remind students to save early/save often. Why? What does this accomplish?
_____When all layers complete, check grammar and spelling.
_____Format organizer. When completed, it might look like *Figure 21*.

Figure 21



_____If there's time, have students organize a topic they are discussing in class on their own (say, based on reading Peterson and Henderson's *Math Trek: Adventures in the Math Zone* or John Katz's *How Two Lost Boys Rode the Internet out of Idaho*.
_____Save both to digital portfolio. Why put student last name in file name? Demonstrate a search of student name. See how files show up even if they didn't save it right—if they saved it to network?
_____If using Google Docs, embed visual organizer into student blog ((if using other word processing program, take a screenshot and insert image into blog post). Write textually what image says visually. In other words: How would student express in a paragraph or two--or three—what is going on in picture. How would student explain the organization these sets convey for someone who couldn't see the picture?

_____When done, student reads a neighbor's post. Do they understand what s/he's explained? Is it as clear as the picture? Use domain-specific vocabulary to discuss.
_____As you teach, incorporate domain-specific vocabulary and expect students to do the same.
_____Occasionally when students have difficulty doing what you are teaching, ask why. And listen. You may be surprised by the answer.
_____Problems listed at beginning of lesson are the most common students face. Expect students to solve these independent of assistance. Additionally, expect students to solve hardware problems independently.
_____Throughout class, check understanding. Expect students to make decisions that follow class rules.
_____Remind students to transfer knowledge to class or home.
_____*A note: Every chance you get, use technology to facilitate teaching. Lead by example. Students will see you use tech quickly and facilely and follow your good example. They want to use tech. Don't discourage them!*

Common Core (truncated for brevity; refer to original Standards for exact wording)

Standards for Mathematical Practice

- CCSS.Math.Practice.MP1
  Make sense of problems and persevere in solving them
- CCSS.Math.Practice.MP2
  Reason abstractly and quantitatively
- CCSS.Math.Practice.MP3
  Construct viable arguments; critique reasoning of others by commenting on their blogs.
- CCSS.Math.Practice.MP4
  Model with mathematics
- CCSS.Math.Practice.MP5
  Use appropriate tools strategically
- CCSS.Math.Practice.MP6
  Attend to precision
- CCSS.Math.Practice.MP7
  Look for and make use of structure
- CCSS.Math.Practice.MP8
  Look for and express regularity in repeated reasoning

6th Grade

- CCSS.ELA-Literacy.RST.6-8.7
  Integrate quantitative or technical information expressed in words in a text with a version of that information expressed visually (e.g., in a flowchart, diagram, model, graph, or table)
- CCSS.ELA-Literacy.WHST.6-8.6
  Use technology, including the Internet, to produce and publish writing and present the relationships between information and ideas clearly and efficiently
- CCSS.Math.Content.6-7.SP.B.4
  Display numerical data in plots on a number line, including dot plots, histograms, box plots
- CCSS.Math.Content.6.SP.B.5
  Summarize numerical data sets in relation to their context

Extension:

- *Do project in groups.*
- *Add a table at bottom to organize levels.*

- *Have students save as PDF and publish to class website, blog, wiki.*

More Information:

- *Lots of online charting options—click here.*
- *Lesson questions? Go to Ask a Tech Teacher.*
- *If using this for an assessment, see full list of assessment items by grade level at end of unit.*

Assessment

Middle School

_____Did student join class discussion?

_____Does student understand difference between communicating visually and textually?

_____Did student troubleshoot problems (if any)?

_____Was student able to take/make helpful suggestions from/to peers?

_____Did student follow directions and work independently on this multi-step series of instructions?

_____Did student work well with a partner?

_____Did student use backchannel device to get/give help?

_____Did anecdotal observations show student working tenaciously?

_____Did student use good keyboarding habits while typing?

_____Did student visual organizer accurately reflect sets and subsets?

_____Was visual organizer a better representation of data than text? Or worse? What made it that way?

_____Did student format visual organizer to make it easier to understand?

_____Did student complete project?

_____Did student save/export to his/her digital portfolio correctly?

_____Did student communicate the same information textually as visual organizer did visually in a blog post? Was it clear? Did student include an embed or screenshot of visual organizer?

_____Did student comment on the post of a neighbor?

_____Did student use domain-specific language in their conversation and writing—in fact, in all communication?

_____Does student understand the concept of 'sets' and 'subsets'—that they organize data by groups?

11…Tessellations

Vocabulary	Tech Problem solving	Common Core
• *Adjacent* • *Align* • *Angles* • *Autoshape* • *Backchannel* • *Chevron* • *Embed* • *Escher* • *Fractals* • *Parallel* • *Pattern* • *Pattern recognition* • *Perpendicular* • *Tessellation* • *Vertex*	• *I can't line chevrons up. (Use spreadsheet gridlines.)* • *How do I select multiple cells at once? (Ctrl+click on each additional cell.)* • *How do I make graph paper on spreadsheet?* • *I can't find paint bucket (search toolbar. You'll find it.)* • *Shape I picked doesn't work right (some shapes can't be tessellated easily)* • *How do I embed from Excel (open in Google Apps and use embed code or screenshot)*	*CCSS.Math.Content.2.G.A.1* *CCSS.Math.Content.3.G.A.1* *CCSS.Math.Content.4.OA.C.5* *CCSS.Math.Content.4.G.A.2*
Time Required *35 minutes*	**NETS-S Standards** *1b, 4b*	**Grade** *2nd-4th*

Essential Question

Where can math be found in nature?

Overview

Summary

Students create tessellations using word processing, a spreadsheet, or a drawing program. Images reflect their understanding of models, symmetry, geometric shapes, angles, sides, parallel or perpendicular lines, and more.

By the end of this unit, 2nd-4th grade students will review five Standards for Mathematical Procedures, 1 G and 1 OA standards, as well as inform themselves on the use of tessellations.

Big Idea

Math and nature have similar attributes.

Materials

Internet, spreadsheet program (or word processing or drawing program as an alternative)

Teacher Preparation

- Have access to a screen shot program like Windows Snipping Tool or Jing if necessary.
- If students have blogs, have these set up.
- If you have a backchannel device (like Today's Meet, Socrative, Padlet), make it available.
- This lesson plan can be done in the classroom or tech lab. Consider co-teaching:

- *Grade level teacher can reinforce academic topics*
- *Tech lab teacher can reinforce tech skills*
- *Art teacher can reinforce Escher's tessellation concepts*

- Something happen you weren't prepared for? No worries. Common Core is about critical thinking and problem solving. Show students how you fix the emergency without a meltdown and with a positive attitude.

Steps

_____**Required skill level: Familiarity with software or tool being used for tessellations.**

_____Before beginning: 'Tessellations' are a type of model—a way to share an idea. What does it mean to 'model' an idea? What are some models students are aware of? There's the plane model students might have built with parents? What are other examples? What tools are used to model thoughts? Music? Fiction? Poetry? How did the play they did earlier this year (or last year) 'model' an idea? Discuss how important it is that modeling is done with precision. Each tool used must be exact. In this way, anyone who sees the 'model' gets the message.

_____A tessellation is a model—a puzzle—that repeats a particular pattern. It helps students 1) understand geometric principles as they experiment with shapes, 2) identify patterns as they explore problem solving.

_____Discuss M. C. Escher and his tessellated paintings. Maybe students recreate these in art class—connect if possible.

_____Ask students to identify tessellations they find in their lives (scales on a fish, a tortoise shell, a pineapple. The Blue Mosque and Hagia Sophia are famous Turkish sites which use tessellating patterns in their design), in school, in class (identify some).

Figure 22

Figure 23

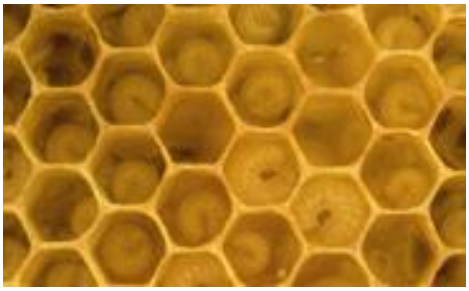
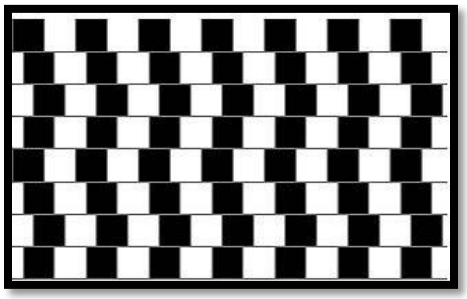


Figure 24



_____Note tessellations in nature (see *Figure 22-23*—mudflats, a honeycomb). Put these images on Smartscreen and discuss their mathematical attributes. What do students see (i.e. repeating patterns, no overlap, no gaps, parallel lines, angles, six sides)? When tessellations 'grow up', they're called fractals.

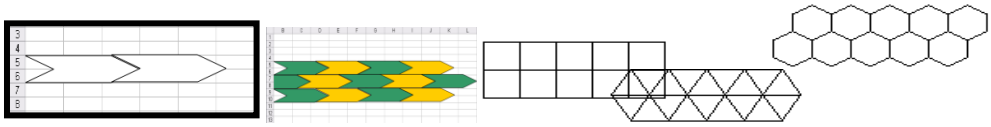
_____Students can create a simple tessellation with a spreadsheet program and a shape tool. Before beginning, put backchannel device onto Smartscreen to track student comments. Show students how to access it on their devices. You may want to limit this to **4th grade students**.

_____Open spreadsheet program (Google Spreadsheet, Excel, OO, Numbers, other). Review rows, columns, toolbars or ask students to share what they remember.

_____Set cell size to simulate graph paper by selecting entire worksheet (click intersection of column A and row 1). Now click line between column A and B to find pixel width (probably 64). Click line between row 1 and 2 and drag it to 64. This changes row width for entire spreadsheet.

_____Select *insert>picture>autoshapes>arrows>chevron*. Paint chevron two rows tall and three columns wide. Copy-paste fifteen times.

_____Arrange shapes nose to nose, five to a row. Use spreadsheet gridlines to be sure they're aligned,

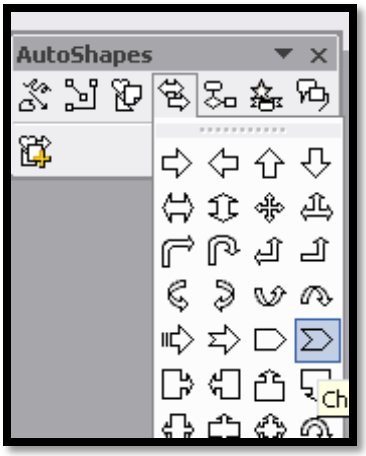


_____Use paint bucket to color shapes in a pattern.

_____Try other autoshapes. Which in *Figure 25* work? Which don't? Why?

_____Work with a partner to recognize, select, and tessellate a shape with a specified attribute, such as a given number of angles or faces. Identify triangles, quadrilaterals, pentagons, hexagons. If there aren't any, blend shapes. How many parallel lines can students find? How about angles? What attributes are alike? Different? Write notes on spreadsheet next to new shape to identify and discuss attributes.

Figure 25



_____Suggest attributes and ask students to find them with a partner, then tessellate it. For example, find and tessellate a shape with two sets of parallel lines. Or five angles.

_____Save images to digital portfolio. If using Google Spreadsheet, expect 4th graders to embed into their blog; reflect on this exercise using appropriate, domain-specific vocabulary. If they can't embed spreadsheet, take a screen shot with Snipping Tool, Jing or another program and insert image into post.

_____When student finishes blog entry, have him/her comment on another student's post.

_____Occasionally when students have difficulty doing what you are teaching, ask why. And listen. You may be surprised by the answer.

_____The problems listed at beginning of lesson are the most common students will face. Expect students to solve these independent of assistance or with limited assistance (for youngers). Additionally, expect all age students to solve hardware problems independently:

- *Monitor problems—is power on*
- *Sound problems—are headphones plugged in? Is sound on?*
- *Computer problems—is power on? Is student logged in correctly?*

_____Throughout class, check for understanding. Expect students to follow class rules.

_____Remind students to transfer knowledge to classroom or home.

_____*A note: Every chance, use technology in teaching. Lead by example. Students will see you use tech quickly and facilely and follow your good example.*

Common Core (truncated for brevity; refer to original Standards for exact wording)

Standards for Mathematical Practice

- CCSS.Math.Practice.MP3
  Construct viable arguments; critique reasoning of others
- CCSS.Math.Practice.MP4
  Model with mathematics
- CCSS.Math.Practice.MP6

Attend to precision

- CCSS.Math.Practice.MP7
  Look for and make use of structure
- CCSS.Math.Practice.MP8
  Look for and express regularity in repeated reasoning

2nd Grade

- CCSS.Math.Content.2.G.A.1
  Recognize and draw shapes having specified attributes, such as a given number of angles or equal faces. Identify triangles, quadrilaterals, pentagons, hexagons, and cubes

3rd Grade

- CCSS.Math.Content.3.G.A.1
  Understand that shapes in different categories may share attribute, and the shared attributes can define a larger category

4th Grade

- CCSS.Math.Content.4.OA.C.5
  Generate a number or shape pattern that follows a given rule
- CCSS.Math.Content.4.G.A.2
  Classify two-dimensional figures based on the presence or absence of parallel or perpendicular lines, or the presence or absence of angles of a specified size

Extension:

- *Discuss tessellations in optical illusions. Figure 24 looks like rows of crooked lines with a distorted checkerboard pattern, but the lines actually are straight.*
- *Try this website: http://nlvm.usu.edu/en/nav/frames_asid_163_g_3_t_3.html.*

More Information:

- *Lesson questions? Go to Ask a Tech Teacher.*
- *If using this for an assessment, see full list of assessment items by grade level at end of unit.*

Assessment
2nd Grade

_____Did student join class discussion?

_____Did student use domain-specific language in class conversation?

_____Did student locate and open workbook started on prior project? Did student transfer knowledge of spreadsheet skills from prior projects to this one?

_____Did student troubleshoot problems (if any)?

_____Did student recognize tessellations in images teacher showed? In nature? Around them in classroom?

_____Did student format spreadsheet as required (turning cells into graph paper)?

_____Could student draw shapes on spreadsheet with tools provided?

_____Did student correctly tessellate shapes?

_____Was student able to recognize and draw shapes having specified attributes, such as a given number of angles or a given number of equal faces.

_____Was student able to identify triangles, quadrilaterals, pentagons, hexagons, and cubes in tessellations?

_____Did student critically think when analyzing shapes?

_____Did student follow directions?

_____Did student work well with partner?

_____Was student able to take/make helpful suggestions from/to peers?

_____Did anecdotal observations show student working tenaciously on project?

_____Did student complete project?

_____Did student save/export to his/her digital portfolio?

Assessment
3rd Grade

_____Did student join class discussion?

_____Did student use academic and domain-specific language in class conversation?

_____Did student locate and open workbook started on prior project? Did s/he transfer knowledge of spreadsheet skills from prior projects to this one?

_____Did student troubleshoot tech and/or hardware problems (if any)?

_____Did student recognize tessellations in images teacher showed? In nature? Around them in classroom?

_____Did student format spreadsheet as required (turning cells into graph paper)?

_____Could student draw shapes on spreadsheet with tools provided?

_____Did student correctly tessellate shapes?

_____Was student able to recognize and draw shapes having specified attributes, such as a given number of angles or a given number of equal faces?

_____Was student able to identify triangles, quadrilaterals, pentagons, hexagons, and cubes in tessellations s/he created?

_____Did student critically think when analyzing shapes?

_____Did student follow directions when presented to group?

_____Did student work well with partner?

_____Was student able to take/make helpful suggestions from/to peers?

_____Did anecdotal observations show student working tenaciously on project?

_____Did student complete project?

_____Did student save/export to his/her digital portfolio?

_____Other_____

_____

_____

Assessment
4th Grade

_____Did student join class discussion?

_____Did student use academic and domain-specific language in class conversations?

_____Did student locate and open workbook started on prior project? Did student transfer knowledge of spreadsheet skills from prior projects to this one?

_____Did student troubleshoot tech and hardware problems (if any)?

_____Did student recognize tessellations in images teacher showed? In nature? Around them in classroom?

_____Did student format spreadsheet as required (turning cells into graph paper)?

_____Could student draw shapes on spreadsheet with tools provided? Did student correctly tessellate shapes?

_____Was student able to recognize and draw shapes having specified attributes, such as a given number of angles or a given number of equal faces.

_____Was student able to identify triangles, quadrilaterals, pentagons, hexagons, and cubes in the tessellations s/he created?

_____Did student critically think when analyzing the shapes?

_____Did student follow directions presented to group?

_____Did student work well with partner?

_____Was student able to take/make helpful suggestions from/to peers?

_____Did anecdotal observations show student working tenaciously?

_____Did student reflect on project in blog post? Comment on posts of classmates?

_____Did student save/export to his/her digital portfolio?

12…Problem Solving

Vocabulary	Tech Problem solving	Common Core
• *Authentic problems* • *Compare/contrast* • *Conjecture* • *Context* • *Deductive reasoning* • *Democratic society* • *Evidence* • *Gamification* • *Inductive reasoning* • *Life skill* • *Logical thinking* • *Mathematical language* • *Pattern* • *Problem solving* • *Proportional reasoning* • *Responsible citizen* • *Shortkeys* • *Strategies* • *Troubleshoot* • *Visual learner*	• *What's the difference between 'save' and 'save-as'?* • *Why 'save early save often'?* • *Which tool do I use (what works?)* • *It's confusing (ask a friend to explain)* • *I couldn't get on keyboarding website (try other one)* • *I don't know answer (Did you use all resources?)* • *I don't care about shortkeys (they are another solution to a problem)* • *I'm frustrated (but doesn't it feel great to solve a problem)* • *I can't do it (take a deep breath; try again)* • *Student computers don't work (help—don't do for them)* • *Students afraid to fail? Remind them success is based on effort, not crossing a finish line*	*CCSS.ELA-Literacy.SL.3.1a-d* *CCSS.ELA-Literacy.SL.3.3-6* *CCSS.ELA-Literacy.SL.4.2* *CCSS.ELA-Literacy.SL.4.4-5* *CCSS.ELA-Literacy.SL.5.4-5* *CCSS.ELA-Literacy.RST.6-8.3* *CCSS.ELA-Literacy.RST.6-8.4* *CCSS.ELA-Literacy.RST.6-8.7* *CCSS.ELA-Literacy.SL.6.2* *CCSS.ELA-Literacy.SL.6.4-5* *CCSS.ELA-Literacy.SL.7.2* *CCSS.ELA-Literacy.SL.7.4-5* *CCSS.ELA-Literacy.SL.8.4-5*
Time Required *180 minutes*	**NETS-S Standards** *4a, 4c*	**Grade** *3-Middle School*

Essential Question

How does technology help problem solving skills?

Overview

Summary

Students select one common tech problem and teach classmates how to solve it in a presentation format.

By the end of this unit, 3rd-middle school students will review four of the eight Standards for Mathematical Procedures, up to 8 SL and 3 RST standards, as well as review practical strategies for problem solving.

Big Ideas

Make things as simple as possible, but not simpler (Albert Einstein).

Materials

Problem Solving Board rubrics, SignUp Genius account (if using this), Google Calendar (if using this)

Teacher Preparation

- Have Problem-Solving Board sign-up sheets posted
- This lesson plan can be done in the classroom or tech lab. Consider co-teaching:

  - *Grade level teacher can reinforce academic topics*
  - *Tech lab teacher can reinforce tech skills*

- Something happen you weren't prepared for? No worries. Common Core is about critical thinking and problem solving. Show students how you fix the emergency without a meltdown and with a positive attitude.

Steps

_____**Required skill level: Enthusiasm for thinking.**

_____Discuss quote under 'Big Idea'. Who said that? What's it mean? Discuss quotes at end of unit. Take ten minutes for students to blog about one (if your students use blogs).

> *Mathematically proficient students start by explaining to themselves the meaning of a problem and looking for entry points to its solution*
>
> *—Common Core*

_____Discuss what it means to be a 'problem solver'. Who do students go to when they need a problem solved? Do students believe that person gets it right more often than others? Would they believe most people are wrong half the time? Relate 'problem solving' to literature being discussed in class (i.e., Louisa May Alcott's *Little Women*).

_____Wait—can learning problem solving in math help with life's problems? Have a discussion with students on that topic before moving on.

_____Discuss what Common Core notes as the difference between 'problems' and 'exercises'. Problems: Students work through what they haven't yet learned, figuring out how to solve. Exercises: Students apply what they have already learned to build mastery. Both are valuable, but here, we share strategies to resolve the unknown.

_____In school, students won't always know the difference. What starts as an exercise can quickly turn into problem solving as a sequence of activities leads from prior knowledge to new knowledge, or a new understanding. This is 'regularity in repeated reasoning'.

_____Problem solving is closely aligned with logical thinking, critical thinking, reasoning, and thought habits. Discuss why students should become problem solvers (hint: refer to prior point—most people are wrong half the time). Discuss characteristics of a 'problem solver' (from Common Core):

- *Use appropriate tools strategically*
- *Attend to precision*
- *Make sense of problems and persevere in solving them*
- *Value evidence*
- *Comprehend as well as critique*
- *Understand other perspectives and cultures*
- *Demonstrate independence*

_____Additionally, problem solvers:

- *Identify/define authentic problems/questions*
- *Accept responsibility for solving problems*
- *Troubleshoot*
- *Learn new skills by reflecting on past knowledge*

- *Know which tool is right for what task*

_____Finally, being a problem solver:

- *Is fundamental to an educated person*
- *Is required of a responsible citizen in a democratic society*
- *Is critical for a wide range of jobs*

> *…devise a strategy… lay out solution as a sequence of well justified steps. …the solution to a problem takes the form of a cogent argument that can be verified and critiqued…*
>
> *—Common Core*

_____Discuss strategies for problem solving:

- *Use teacher as a guide, not an oracle*
- *Use tools available*
- *Observe and collect data*
- *Be aware of surroundings*
- *Notice the forest and the trees*
- *Think logically*
- *Never say 'can't'*
- *Act out a problem*
- *Apply inductive reasoning*
- *Break a problem into simpler parts*
- *Distinguish between relevant and irrelevant information*
- *Draw a diagram*
- *Guess and check*
- *See patterns*
- *Translate data into mathematical language.*
- *Try, fail, try again*
- *Use conjecture and evidence to develop valid rules and procedures.*
- *Use proportional reasoning*
- *Use what has worked in the past*
- *Work backwards*
- *Embrace change*
- *Question 'the way it's always been done'*
- *Identify authentic problems; ask clarifying questions; trust yourself*
- *Do not fear risk-taking*

> *Proficient students are sufficiently familiar with tools appropriate for their grade to make sound decisions about when each of these tools might be helpful…*
>
> *—Common Core*

_____Introduce Problem Solving Board. This is a life skill that transcends a subject. Expect students to transfer knowledge to all parts of life.

_____Three parts to this project:

1. *Class presentation*
2. *Create a how-to in an online presentation/publishing tool*
3. *Submit a storyboard that shares organization (optional)*

_____Discuss common problems students face when using tech (see list at end of lesson). Students should own these by end of class (Throughout year, keep a list of problems for next year's Board).

_____Student presentations will open class, a warm-up like a Responsive Classroom activity. Add start date to class online calendar.

_____Presentation requires 1) independent investigation, 2) risk-taking for cautious students who feel a Right Answer lives out there somewhere, and 3) presentation skills discussed in Common Core 'Speaking and Listening':

- *Students will show classmates how to solve a problem using an online tool.*
- *Student presentation will be professional, clear, edited, and reworked where necessary.*
- *If information is technical, student will include a visual (Middle School only).*
- *Presentation will use appropriate eye contact, adequate volume, clear pronunciation.*
- *Speech style will fit audience.*
- *Students will take questions from audience that relate to subject.*
- *Students will have storyboard available for teacher.*
- *Problem solving presentation will provide answers, but also arguments, explanations, diagrams, mathematical models, and whatever else aids understanding.*

_____Students can work in groups. Sign up for a problem and presentation date via a program like Sign up Genius or Google Apps.

_____**First:** Student group selects a tool to show how to solve problem they selected. Here are suggestions, but students may come up with their own if teacher approves:

- *Animoto*
- *Comic builder ZimmerTwins)*
- *Widgets*
- *Flipboard*
- *online slideshow (Kizoa. Slideboom)*
- *Photocube (6 how-to pictures)*
- *Prezi*
- *Scratch*
- *Screencast-o-matic or Jing*
- *SketchUp*
- *video published to YouTube (class private channel), SchoolTube, Pupiltube, other*

> *Mathematically proficient students try to communicate precisely to others. They try to use clear definitions in discussion with others and in their own reasoning.*
>
> *—Common Core*

_____**Second (Optional):** Students create a storyboard using online tool showing how to solve problem. This will be turned in with final project. What is a storyboard? What is its purpose? Have students used one before?

_____**Third:** Using selected tool, students show clear understanding of how to solve problem. Students self-teach tool, using resources like online videos, friends, online instructions. Teaching themselves to use this tool is an authentic example of their personal problem solving skills.

_____**Fourth:** Students show classmates how to solve problem on agreed-upon date. Audience will follow agreed-upon rules for listening, ask questions to check understanding, stay on topic, and link comments to remarks of others.

_____**Fifth:** Students save project to digital portfolios and embed in blog to share with classmates.

_____Students get three class periods to prepare, one for presentation. Pay attention to these considerations while working:

- *determine target audience, goal, and purpose of presentation*
- *introduce presentation with a problem solving quote (see list at end of lesson)*
- *convey information, offer insights and analysis*
- *organize content so solution is evident*
- *show care in downloading and using public domain clipart*
- *use headings, illustrations, multimedia, and text*

_____Review grading (see assessment options at end of lesson).

_____As you teach, incorporate domain-specific vocabulary and expect students to do the same.

_____Throughout class, expect students to make decisions that follow class rules.
_____Moderate expectations depending upon grade level of students.
_____*A note: Every chance you get, use technology to facilitate teaching. Students will see you use tech quickly and facilely and follow your example. They want to use tech. Don't discourage them!*

Common Core (truncated for brevity; refer to original Standards for exact wording)

Standards for Mathematical Practice

- CCSS.Math.Practice.MP1
  Make sense of problems and persevere in solving them.
- CCSS.Math.Practice.MP3
  Construct viable arguments; critique reasoning of others.
- CCSS.Math.Practice.MP5
  Use appropriate tools strategically.
- CCSS.Math.Practice.MP6
  Attend to precision

3rd Grade

- CCSS.ELA-Literacy.SL.3.1a
  Come to discussions prepared, having studied required material; explicitly draw on that preparation to explore ideas under discussion
- CCSS.ELA-Literacy.SL.3.1b
  Follow agreed-upon rules for discussions
- CCSS.ELA-Literacy.SL.3.1c
  Ask questions to check understanding, stay on topic, and link comments to remarks of others
- CCSS.ELA-Literacy.SL.3.1d
  Explain their own ideas and understanding in light of the discussion
- *CCSS.ELA-Literacy.SL.3.3*
  Ask and answer questions about information from a speaker, offering appropriate detail
- CCSS.ELA-Literacy.SL.3.4
  Report with appropriate facts, speaking clearly at an understandable pace
- CCSS.ELA-Literacy.SL.3.5
  Create engaging audio recordings that demonstrate fluid reading at an understandable pace; add visual displays when appropriate to enhance facts or details
- CCSS.ELA-Literacy.SL.3.6
  Speak in complete sentences to provide requested detail or clarification

4th Grade

- CCSS.ELA-Literacy.SL.4.2
  Paraphrase information
- CCSS.ELA-Literacy.SL.4.4
  Report on a topic in an organized manner, using appropriate facts to support main ideas; speak clearly at an understandable pace
- CCSS.ELA-Literacy.SL.4.5
  Add audio and visual displays to presentations when appropriate to enhance main ideas

5th Grade

- CCSS.ELA-Literacy.SL.5.4
  Report on a topic, sequencing ideas logically and using appropriate facts and relevant, descriptive details to support main ideas; speak clearly at an understandable pace
- CCSS.ELA-Literacy.SL.5.5
  Include multimedia components in presentations to enhance development of main ideas

Middle School

- CCSS.ELA-Literacy.RST.6-8.3
  Follow precisely a multistep procedure when performing technical tasks
- CCSS.ELA-Literacy.RST.6-8.4
  Determine the meaning of symbols, key terms, and other domain-specific words and phrases as they are used in a specific scientific or technical context
- CCSS.ELA-Literacy.RST.6-8.7
  Integrate quantitative or technical information with a version expressed visually
- CCSS.ELA-Literacy.SL.6.2
  Interpret information presented in diverse media and formats and explain how it contributes to a topic, text, or issue under study
- CCSS.ELA-Literacy.SL.6.4
  Present findings, sequencing ideas logically and using pertinent descriptions, facts, and details to accentuate main ideas; use appropriate eye contact, adequate volume, clear pronunciation
- CCSS.ELA-Literacy.SL.6.5
  Include multimedia components (e.g., graphics, images, music, sound) and visual displays in presentations to clarify information
- CCSS.ELA-Literacy.SL.7.2
  Analyze the main ideas and supporting details presented in diverse media and formats
- CCSS.ELA-Literacy.SL.7.4
  Present claims and findings, emphasizing salient points in a focused, coherent manner
- CCSS.ELA-Literacy.SL.7.5
  Include multimedia components and visual displays in presentations to clarify claims and findings and emphasize salient points
- CCSS.ELA-Literacy.SL.8.4
  Present claims and findings, emphasizing salient points in a focused, coherent manner
- CCSS.ELA-Literacy.SL.8.5
  Integrate multimedia into presentations to clarify information, strengthen claims, add interest

Extension:

- *Add problem solving presentations to school server for benefit of all students.*

More Information:

- *Make sure students are good digital citizens as they research and create online projects*
- *If using this for an assessment, see full list by grade level at end of unit.*
- *Lesson questions? Go to Ask a Tech Teacher.*

Sample Problems	
When do I save and when 'save as'	What does 'BCC' mean in an email
What if the monitor doesn't work	How do I exit a screen I'm stuck in
What if the volume doesn't work	How do I use Discussion in the wiki
What if the computer doesn't work	I don't have Word at home. What do I do
What if the mouse doesn't work	My file's 'read only'. What do I do
When do I backspace and when delete	How do I make a macro in Word
What are 5 useful shortkeys	What's the difference between *format* and *edit*
What's 'see the forest for the trees' mean	How do I add a hyperlink in Word
What does 'select-do' mean	Why use Word? Why use Excel? PowerPoint?
I can't find a tool I need	How do I embed a widget
What if I can't find the tool I need	How do I save a blog post
What if the document disappears	How do I edit a Google Earth placemark
My doc is too large to email	What are three ways to communicate something
How do I search for a file	Is it better to communicate with words or images
How do I rename a folder	What is brainstorming? Mind mapping?
What if program freezes	How do I protect my digital footprint
What's a Mulligan? In this class?	What are 3 ways to keep info private on the internet
My internet toolbar disappeared	How do I share/collaborate on Google Apps
When must I use proper grammar on internet	What are 3 digital rights? Responsibilities?

Great Quotes About Problem Solving

Success consists of going from failure to failure without loss of enthusiasm.

—Winston Churchill

In times like these, it is good to remember that there have always been times like these.

— Paul Harvey *Broadcaster*

Never try to solve all the problems at once — make them line up for you one-by-one.

— Richard Sloma

Some problems are so complex that you have to be highly intelligent and well-informed just to be undecided about them.

— Laurence J. Peter

Life is a crisis - so what!

— Malcolm Bradbury

You don't drown by falling in the water; you drown by staying there.

— Edwin Louis Cole

The significant problems we face cannot be solved at the same level of thinking we were at when we created them.

— Albert Einstein

It is not stress that kills us. It is effective adaptation to stress that allows us to live.

— George Vaillant

The most serious mistakes are not being made as a result of wrong answers. The truly dangerous thing is asking the wrong questions.

— Peter Drucker *Men, Ideas & Politics*

Eighty percent of success is showing up.

—Woody Allen

The problem is not that there are problems. The problem is expecting otherwise and thinking that having problems is a problem.

—Theodore Rubin

On the infrequent occasions when I have been called upon ... to play the bongo drums, the introducer never seems to find it necessary to mention that I also do theoretical physics.

—Richard Feynman

Do not keep saying to yourself, if you can possibly avoid it, "But how can it be like that?" because you will get "down the drain," into a blind alley from which nobody has yet escaped. Nobody knows how it can be like that.

—Richard Feynman

The problem is not that there are problems. The problem is expecting otherwise and thinking that having problems is a problem.

— Theodore Rubin

It's not that I'm so smart, it's just that I stay with problems longer.

—Albert Einstein

There is a great difference between worry and concern. A worried person sees a problem, and a concerned person solves a problem.

—Harold Stephens

While average people are thinking negatively about problems, successful people view their problems positively. They love problems. They eat them for breakfast.

Why? Because problems create value; the more problems you can solve, the more valuable you will be, the more money you will make, the more responsibility you will have.

—Brian Klemmer

No problem can stand the assault of sustained thinking.

—Voltaire

Problems are only opportunities with thorns on them.

—Hugh Miller

Assessment
3rd Grade

_____Did student join class discussion?

_____Did anecdotal observations show student working tenaciously on project? Did s/he persevere in solving problem and creating how-to?

_____Did student follow guidelines for the use of online media when creating their project?

_____Did student demonstrate problem solving strategies in the use of his/her chosen presentation tool?

_____Was student able to independently solve his/her own problems when they arose?

_____Was student able to take/make helpful suggestions from/to peers?

_____Did student work well with partner? Did s/he come to work sessions prepared, ready to contribute?

_____Did student presentation explain how to solve the problem--with appropriate multi-media tools to contribute to explanation? Did student show a clear understanding of problem, how to solve it, and how to use selected tool in sharing information with audience?

_____Did student make presentation as simple as possible, using visuals where necessary to enhance information—but not oversimplify?

_____Did chosen technology add to presentation or detract?

_____Was student able to answer classmate questions about presentation?

_____Did both presenter and audience follow agreed-upon rules for discussions?

_____Did student use domain-specific language in class conversation, presentation, and prepared tool?

_____Did student ask appropriate questions of classmates after their presentations?

_____Did student complete all parts of project?

_____Did student save/export to his/her digital portfolio and embed project in blog, website or class wiki?

Assessment
4th Grade

_____Did student join class discussion?

_____Did anecdotal observations show student working tenaciously on project? Did s/he persevere in solving problem and creating how-to?

_____Did student follow guidelines for use of online media when creating project?

_____Did student demonstrate problem solving strategies in use of his/her chosen presentation tool?

_____Was student able to independently solve his/her own tech and hardware problems when they arose?

_____Was student able to take/make helpful suggestions from/to peers?

_____Did student work well with partner? Did s/he come to work sessions prepared, ready to contribute?

_____Did student presentation explain how to solve the problem--with appropriate multi-media tools to contribute to the explanation? Did student show a clear understanding of problem, how to solve it, and how to use selected tool in sharing information with audience?

_____Did student make presentation as simple as possible, using visuals where necessary to enhance information—but not oversimplify?

_____Did chosen technology add to presentation or detract?

_____Was student able to answer classmate questions about presentation?

_____Did both presenter and audience follow agreed-upon rules for discussions?

_____Did student use academic and domain-specific language in class conversation, presentation, and prepared tool?

_____Did student ask appropriate questions of classmates after their presentations?

_____Did student complete all parts of project?

_____Did student save/export to his/her digital portfolio and embed project in blog, website or class wiki?

Assessment
5th Grade

_____Did student join class discussion?

_____Did student work well with partner? Did s/he come to work sessions prepared, ready to contribute?

_____Did student demonstrate problem solving strategies in the use of his/her chosen presentation tool?

_____Did presenter and audience follow agreed-upon rules for discussions?

_____Did student follow guidelines for the use of online media in project?

_____Did student use academic and domain-specific language in class conversation, presentation, and prepared tool?

_____Did student independently solve own problems when they arose?

_____Did student presentation explain how to solve problem--with appropriate multi-media tools to contribute to explanation? Did student show a clear understanding of problem and how to solve it?

_____Did student presentation sequence ideas logically with appropriate facts and descriptive detail?

_____Did student use visuals where necessary to enhance information?

_____Did chosen technology add to presentation or detract?

_____Could student answer classmate questions about presentation?

_____Did student complete all parts of project?

_____Did student save/export to his/her digital portfolio and embed project in blog, website or class wiki?

_____Did student ask appropriate questions of classmates after their presentations?

Assessment
Middle School

_____Did student join class discussion?

_____Did student work well with partner? Did s/he come to work sessions prepared, ready to contribute?

_____Did student demonstrate problem solving strategies in the use of his/her chosen presentation tool?

_____Did presenter and audience follow agreed-upon rules for discussions?

_____Did student follow guidelines for the use of online media in project?

_____Did student use domain-specific language in class conversation, presentation, and prepared tool?

_____Did student independently solve own tech and hardware problems when they arose?

_____Did student presentation explain how to solve the problem--with appropriate multi-media tools that contributed to explanation? Did student show a clear understanding of problem and how to solve it?

_____Did student presentation sequencing ideas logically, with appropriate facts and descriptive detail?

_____Were steps precise, using correct technical terms where necessary?

_____Did student use visuals where necessary to enhance information?

_____Did chosen technology add to presentation or detract?

_____Could student answer classmate questions about presentation?

_____Did student complete all parts of project?

_____Did student save/export to his/her digital portfolio and embed project in blog or use screenshot where required?

_____Did student ask appropriate questions of classmates after their presentations?

13…Engineering and Design

Vocabulary	Tech Problem solving	Common Core
• *#hashtag* • *Abutment* • *Benchmark* • *Compression* • *Cross section* • *Deck* • *Dynamic load* • *Elevation* • *Joints* • *Loads* • *Magnitude* • *Members* • *Racking* • *Span* • *Static load* • *Structural* • *Truss* • *Tweet*	• *How do I share in Google* • *This is hard (did you do tutorial? Are you working with group?)* • *I'm not good on computer (think of it as gamifying education)* • *Program froze (look around screen—is a dialogue box open?)* • *Can I download program at home? (with parent permission)* • *Link doesn't work (Google address)* • *Teacher isn't around and I need help (use problem solving strategies from last unit)* • *I don't like science—or engineering (think of it as an online game)* • *Why do I need to know bridge building (Is that what you're learning?)*	*CCSS.ELA-Literacy.RST.6-8.3* *CCSS.ELA-Literacy.RST.6-8.4* *CCSS.ELA-Literacy.RST.6-8.7* *CCSS.ELA-Literacy.W.6-8.7* *CCSS.ELA-Literacy.W.6-8.8* *CCSS.ELA-Literacy.W.6-8.9*
Time Required *180 minutes*	**NETS-S Standards** *3c, 6a*	**Grade** *Middle School*

Essential Question

How can I use practical and theoretical knowledge to solve a problem?

Overview

Summary

Students virtually construct a viable, affordable bridge and submit it (if age limits met) to a national competition. They use theoretical knowledge in a practical application. When done, they reflect on importance of both theoretical and practical in problem solving.

This lesson contributes to the rigor of your school's math program, defined by Common Core: … *Use of technology differentiates for student learning styles by providing an alternative method of achieving conceptual understanding, procedural skill and fluency, and applying to authentic circumstances.*

By the end of this unit, middle school students will review all eight Standards for Mathematical Procedures, 3 W and 3 RST standards, as well as embrace an authentic experience in problem solving and the practical applications of math knowledge.

Big Ideas

Bridge building requires problem-solving strategies and critical thinking while connecting what is taught in the classroom and real world applications. Sometimes, success in college and career requires following rules (think of physics laws, Theory of Relativity), conforming to standards, and working as a group.

Materials

Internet, West Point Bridge Designer (WPBD), links on class start page, calculator (if appropriate to your school)

Teacher Preparation

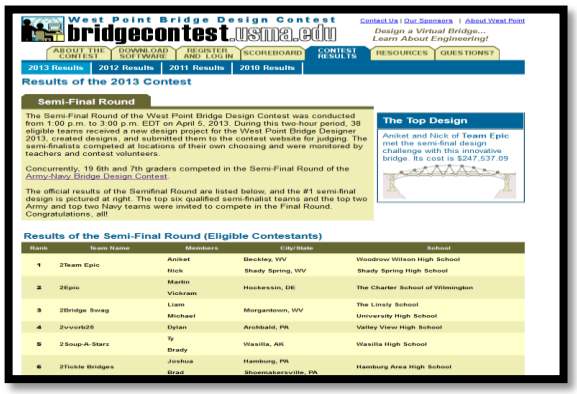
- Have access to a screen shot program like Windows Snipping Tool or Jing.
- If students have blogs, set them up.
- If you have access to a backchannel device (like Today's Meet, Socrative, or Twitter), set it up.
- Have Free West Point Bridge Designer on all student computers including netbooks, laptops.
- Co-teach with instructors for physics, math, geometry, history—subjects that can be integrated into project. This ties in with traditional science toothpick bridges. Class time in these subjects will be required to complete project in a reasonable amount of time.
- Something happen you weren't prepared for? No worries. Common Core is about problem solving. Show students how you fix the emergency without a meltdown and with a positive attitude.

Steps

_____**Required tech skill level: Understanding internet tools.**

_____What does it mean to 'model' something? What are examples? Anyone build model airplanes with parents? How about a model race car with Boy Scouts? Or a model using Legos? What was the purpose of those? Discuss how important it is that modeling be done with precision so student can figure out if plan will work and get a chance to rework the pieces (like Common Core's ***plan, revise, edit, rewrite*** under ELA Standards). The process helps students understand 1) abstract reasoning vs. real-world, and 2) more exact tools are, the easier it is for others to understand model's message.

_____This project ties into a variety of Common Core math and literacy standards. We focus on student ability to use theoretical knowledge, apply it to a virtual model, and make connections to the practical application of building a bridge. Students present findings in a focused, coherent manner with evidence, sound reasoning, and well-chosen details.



_____Before beginning, put backchannel device onto Smartscreen to track student comments as they work. Show students how to access it on their devices if necessary. If using Twitter, expect students to post answers to classmate problems.

_____Divide students into groups. Give them thirty minutes to prepare a class presentation (of about 5 minutes in length) on what goes into creating an effective bridge, based on videos in 'More Information'. Divide the following list of questions/issues among groups (find resources at end of lesson or by Googling. If using internet for research, review how to use it safely and effectively):

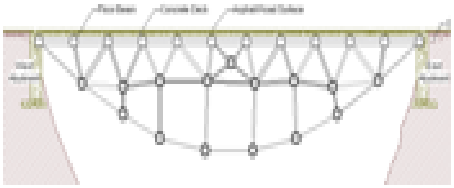
- *What are design components which occur regularly?*
- *What are principles of good design?*
- *How do structural components react to stress?*
- *Compare strength of different components of a bridge.*
- *Present experiences with various bridges at home and school.*
- *Why are bridges constructed?*

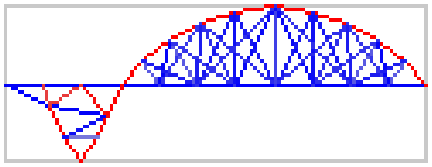
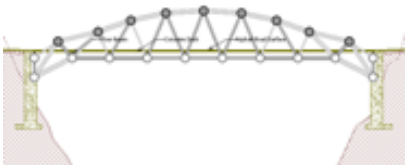
- *What is the importance of perimeter, area, volume, angle measure, capacity, weight and mass on bridges?*
- *Describe, extend, analyze, and explore patterns required in creation of a bridge.*
- *How do specialized structures perform specific functions?*
- *How are bridges affected by gravitational forces?*
- *How might a change or error in design affect function?*
- *How does design require taking constraints into account?*
- *Compare/contrast shapes of natural and human-constructed objects.*

_____When presentations are completed, each group begins WPBD (or similar). This is student-directed. You support, not teach. Here are two YouTube tutorials to get students started:

- https://www.youtube.com/watch?v=6w9VN7XeruU
- http://youtu.be/4Cb7Alttt8s

_____Here are winning WPBD designs from prior years (*reprinted with permission of West Point Bridge Building Competition*):



_____Student groups tweet daily under #hashtag *#dailyreflection* about progress, problems, solutions that provided assistance in reaching decisions. Discuss mathematical formulas used—with a calculator or paper and pencil or mental math. Discuss why student picked the tool they did to make decisions. Respond to tweets of other students.

_____After bridge is successfully built, save to homework dropbox (through school digital tool, Google Apps, or other).

_____Submit WPBD contest entry in appropriate category (under 13 years old or over).

_____Create a project website on Google Sites (or Weebly, Wix). Include:

- *how student came up with bridge design*
- *how design changed as bridge was built*
- *geometric shapes used in bridge and why*
- *strength of bridge compared to weight*
- *changes student would make next time*
- *screenshots and screencasts of work*
- *how-to information*
- *insights and analysis*
- *facts, definitions, details, examples*
- *domain-specific and academic language. Include a glossary if necessary*

- *headings, illustrations, charts, graphs, multimedia*
- *sources (including other students) for data and opinions—avoid plagiarism*

_____Reflect as a group on theoretical and practical processes in problem solving.

_____Problems listed at beginning of lesson are common. Expect students to solve these independently.

_____Throughout class, check for understanding. Expect students to make decisions that follow class rules.

_____*A note: Every chance you get, use technology to facilitate teaching. Lead by example. Students will see you use tech quickly and facilely and follow your good example. They want to use tech. Don't discourage them!*

> *… technology differentiates for student learning styles by providing an alternative method of achieving conceptual understanding, procedural skill and fluency, and applying this knowledge to authentic circumstances.*
>
> *—Common Core*

Common Core (truncated for brevity; refer to original Standards for exact wording)

Standards for Mathematical Practice

- CCSS.Math.Practice.MP1
  Make sense of problems and persevere in solving them
- CCSS.Math.Practice.MP2
  Reason abstractly and quantitatively
- CCSS.Math.Practice.MP3
  Construct viable arguments; critique reasoning of others by commenting on their blogs
- CCSS.Math.Practice.MP4
  Model with mathematics
- CCSS.Math.Practice.MP5
  Use appropriate tools strategically
- CCSS.Math.Practice.MP6
  Attend to precision
- CCSS.Math.Practice.MP7
  Look for and make use of structure
- CCSS.Math.Practice.MP8
  Look for and express regularity in repeated reasoning

Middle School

- CCSS.ELA-Literacy.RST.6-8.3
  Follow precisely a multistep procedure when performing technical tasks
- CCSS.ELA-Literacy.RST.6-8.4
  Determine the meaning of symbols, key terms, and other domain-specific words and phrases as they are used in a specific scientific or technical context
- CCSS.ELA-Literacy.RST.6-8.7
  Integrate quantitative or technical information expressed in words in a text with a version of that information expressed visually (e.g., a table)
- CCSS.ELA-Literacy.W.6-8.7
  Conduct short research projects to answer a question, drawing on several sources and generating additional related, focused questions that allow for multiple avenues of exploration
- CCSS.ELA-Literacy.W.6-8.8
  Gather relevant information from print and digital sources, using search terms effectively

- CCSS.ELA-Literacy.W.6-8.9
  Draw evidence from informational texts to support analysis, reflection, and research

Extension:

- *If you live in Mississippi, consider Mississippi Department of Transportation Bridge Building Competition*
- *Teach students to use an online calculator like these or one built into computer to verify answers. Be sensitive to whether your school allows calculator use.*
- *Review assessment criteria with students prior to beginning lesson.*

More Information:

- *Building Bridges, Domes, Skyscrapers, Dams & Tunnels*
- *Model bridge Design*
- *Bridge basics*
- *Nova's Build a Bridge*
- *Pictures of bridges*
- *World's Strangest Bridges!!*
- *If using this for an assessment, see the full list of assessment items by grade level at end of unit.*
- *Lesson questions? Go to Ask a Tech Teacher*

Assessment

Middle School

_____Did student join class discussion?

_____Did student troubleshoot hardware problems (if any)?

_____Did student make use of backchannel device? Assist classmates when possible?

_____Did student understand difference between 'theoretical' and 'practical' knowledge?

_____Could student independently solve his/her tech problems when they arose?

_____Was student able to take/make helpful suggestions from/to peers?

_____Did student work well with partner?

_____Did student presentation address required questions/issues?

_____Did student double-check mathematical work with calculator?

_____Did student follow guidelines for use of online media when creating project?

_____Did student persevere in creating virtual bridge? Was s/he successful in following a multi-step procedure for this technical task?

_____Did student research unknown information, using multiple sources where called for?

_____Did student complete project? Contest Entry? Website? Daily tweets?

_____Did student use domain-specific language in class, website, tweets?

_____Did student website fulfill requirements on list? Did student include screenshots, screencasts, videos, other sources where required? Did student clarify technical information with audio and visual aids where necessary?

_____Did student find value in modeling bridge? Did student understand the difference between theoretical and applied knowledge? Did student understand the value of creating a model prior to the real thing?

14…Number Square

Vocabulary	Tech Problem solving	Common Core
• *Ctrl* • *Cursor* • *Doc* • *Edit* • *Font* • *Format* • *Menu* • *Multiples* • *Number Square* • *Overtype* • *Password* • *Return* • *Reveal* • *Ribbon* • *Screen* • *Show/hide* • *Taskbar* • *Toolbar* • *Word processing* • *Wrap*	• *How do I open a program (double click icon)* • *How do I close a program (Alt+F4)* • *What's the difference between backspace and delete?* • *What's the difference between 'save' and 'save-as'?* • *What's the difference between 'edit' and 'format'?* • *What's the difference between menu, ribbon, toolbar?* • *Hardware problems? Students try to solve before you help* • *Occasionally when students have difficulty doing what you teach, ask why. And listen. You may be surprised by the answer.* • *Why have student name in file name?* • *I won a computer on internet!*	*CCSS.Math.Content.1.NBT.A.1* *CCSS.Math.Content.1.NBT.B.2* *CCSS.Math.Content.1.NBT.B.3* *CCSS.Math.Content.1.NBT.C.4* *CCSS.Math.Content.1.NBT.C.5* *CCSS.Math.Content.2.NBT.A.1* *CCSS.Math.Content.2.NBT.A.4*
Time Required *45 minutes*	**NETS-S Standards** *2b, 6a*	**Grade** *1, 2*

Essential Question

How do I use technology to learn math?

Overview

Summary

Students use digital number square to review elemental math concepts and edit/formatting skills.

By the end of this unit, 1st/2nd grade students will review five of the Standards for Mathematical Procedures and over half of Common Core's Number and Operations in Base Ten for 1st and 2nd grade, as well as Word basics that will get students through anything required in second grade.

Big Idea

Technology makes learning math easier.

Materials

Internet, template for Number Square, word processing program

Teacher Preparation

- Have Number Square file available on network server
- This lesson plan can be done in the classroom or tech lab. Consider co-teaching:
  - *Grade level teacher can reinforce academic topics*
  - *Tech lab teacher can reinforce tech skills*
- Something happen you weren't prepared for? No worries. Common Core is about critical thinking and problem solving. Show students how you fix the emergency without a meltdown and with a positive attitude.

Steps

_____**Required skill level: Inquiring mind.**

_____What does it mean to 'model' something? What are examples? Anyone build model airplanes with parents? How about a model race car with Boy Scouts? Or a model using Legos? What was the purpose of those? Discuss importance of precise modeling (so student can figure out if plan will work and get a chance to rework pieces—like Common Core's ***plan, revise, edit rewrite*** under ELA Standards).

_____Open Number Square (*Figure 26* or full-size image at end of lesson) on Smartscreen. Discuss:

- *What is a number square?*
- *Is it familiar to students?*
- *Do they see each row is a bundle of 10?*
- *How many is a bundle of ten tens?*
- *Discuss place value of each digit in a number.*
- *Notice how each column lays out (remember spreadsheet columns).*
- *Notice that all numbers ending in the same digit live in a column*
- *What else do students notice?*

Figure 26

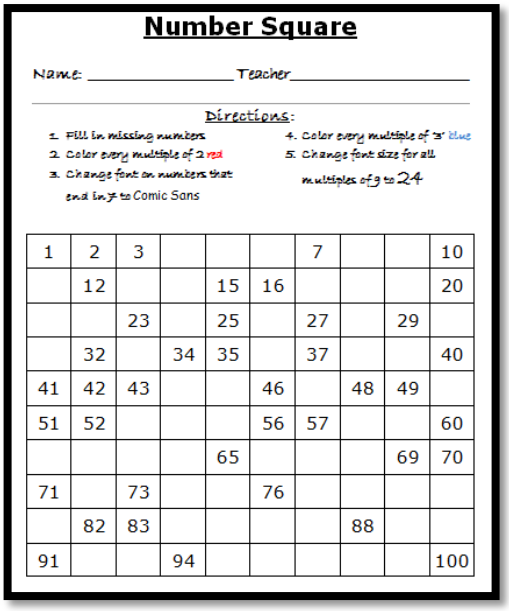
_____Open this game on Smartscreen. Play with students—how to arrange a Number Square.

_____***Note: Before going online**, discuss internet safety. Point out the 'digital neighborhood' of game, where students shouldn't go on internet page, ads. Circle back on class discussions about how to safely use internet.*

_____Review word processing program on Smartscreen:

- *appearance of screen*
- *tools and toolbars*
- *menus and ribbons students will use*
- *what cursor does*

_____Discuss difference between menus, ribbons, toolbars, taskbar. These organizational methods are confusing. Circle back on them



Number Square

Name: _____ Teacher_____

Directions:

1. Fill in missing numbers
2. Color every multiple of 2 red
3. Change font on numbers that end in 7 to Comic Sans
4. Color every multiple of 3 blue
5. Change font size for all multiples of 9 to 24

1	2	3				7			10
	12			15	16				20
		23		25		27		29	
	32		34	35		37			40
41	42	43			46		48	49	
51	52				56	57			60
				65				69	70
71		73			76				
	82	83					88		
91			94						100

often.

_____Review MS Word basics used today:

- *show where font size/color/type tools are*
- *discuss backspace and delete—what's the difference*

_____Show how to open Number Square template (you have probably stored it in a folder easily accessible for students). Demonstrate how to type student and teacher name into blanks (using 'overtype' if available or editing line).

_____Demo first line of Number Square:

- *fill in missing numbers*
- *change fonts as required in directions*
- *change colors as required in directions*
- *change sizes as required in directions*

Something happen you weren't prepared for? No worries. Common Core is about critical thinking and problem solving. Show students how you fix the emergency without a meltdown and with a positive attitude.

_____Discuss numbers—

- *two digits of a two-digit number represent amounts of tens and ones.*
- *think of 10 as a bundle of ten ones*
- *numbers from 11 to 19 are composed of a ten and one, two, three, four, five, six, seven, eight, nine ones*
- *numbers 10, 20, 30, 40, 50, 60, 70, 80, 90 refer to one, two, three, four, five, six, seven, eight, or nine tens (and 0 ones)*

_____After enough time, return to number square on Smartscreen while students have theirs up:

- *As a class, count by 10s.*
- *Compare two two-digit numbers; which is <, >, =?*
- *List addition/subtraction problems on Smartscreen and ask students to solve using number square. Ask one or more students to explain their reasoning.*
- *Using number square, find 10 more or less than a number—without counting. Ask a student to explain reasoning. Repeat process, this time without number square. Have one student explain his/her reasoning.*

_____Finished? Let students reformat their number square to reflect what they've learned about its use. They may color multiples of ten one color, single digit numbers one color—or something else that helps them make sense of the math process. You may be surprised what they come up with. Or, they may follow instructions on sample at end of lesson.

_____Don't expect students to finish. The goal is to get comfortable using tools, changing fonts, formatting doc--skills they will use often.

_____Throughout class, check for understanding. Expect students to solve problems as they maneuver through lesson. Problems listed at beginning of lesson are the most common students will face. Expect students to be able to solve these without assistance. Additionally, expect students to solve hardware problems independently:

- *Monitor problems—is power on*

- *Mouse problems—is there a light on underside of mouse (which means it's getting power)?*
- *Sound problems—are headphones plugged in? Is student using correct headphones? Is sound on?*
- *Computer problems—is power on? Is student logged in correctly?*

_____Save to digital portfolios with student last name and project name. Print. Assist if required.
_____Why is it important to include student last name in file name?
_____Close program with Alt+F4; leave station as it was (chairs in, desktop clean, headphones over tower, text behind monitor).
_____As you teach, incorporate domain-specific vocabulary and expect students to do the same.
_____Remind students to transfer knowledge to class or home.
_____*A note: Every chance you get, use technology to facilitate teaching. Lead by example. Students will see you use tech quickly and facilely and follow your good example. They want to use tech. Don't discourage them!*

Every chance you get, use technology to facilitate teaching. Lead by example. Students will see you use tech quickly and facilely and follow your good example.

Common Core (truncated for brevity; refer to original Standards for exact wording)

Standards for Mathematical Practice

- CCSS.Math.Practice.MP4
  Model with mathematics
- CCSS.Math.Practice.MP5
  Use appropriate tools strategically.
- CCSS.Math.Practice.MP6
  Attend to precision
- CCSS.Math.Practice.MP7
  Look for and make use of structure
- CCSS.Math.Practice.MP8
  Look for and express regularity in repeated reasoning

1st Grade

- CCSS.Math.Content.1.NBT.A.1
  Count to 120, starting at any number less than 120. In this range, read and write numerals and represent a number of objects with a written numeral
- CCSS.Math.Content.1.NBT.B.2
  Understand that the two digits of a two-digit number represent amounts of tens and ones. Understand the following as special cases
- CCSS.Math.Content.1.NBT.B.3
  Compare two two-digit numbers based on meanings of the tens and ones digits, recording the results of comparisons with the symbols >, =, and <
- CCSS.Math.Content.1.NBT.C.4
  Add within 100, using concrete models or drawings and strategies based on place value, properties of operations, and/or the relationship between addition and subtraction
- CCSS.Math.Content.1.NBT.C.5
  Given a two-digit number, mentally find 10 more or 10 less than the number

2nd Grade

- CCSS.Math.Content.2.NBT.A.1
  Understand that three digits of a three-digit number represent hundreds, tens, and ones
- CCSS.Math.Content.2.NBT.A.4
  Compare two three-digit numbers based on meanings of hundreds, tens, and ones digits
- CCSS.Math.Content.2.NBT.B.5
  Fluently add and subtract within 100

Extension:

- *Have students work in groups.*
- *Show students how to align text in cells, add borders and pictures to cells.*
- *Play this number square game (Give the Dog a Bone).*
- *Play another number square game (Mend the Number Square).*
- *Here's another number square game: Find Owl's Friends.*

More Information:

- *If using this for assessment, see full list of assessment items by grade level at end of unit.*
- *Lesson questions? Go to Ask a Tech Teacher.*

Number Square

Name: _____ Teacher_____

Directions:

1. Fill in missing numbers
2. Color two multiples of 2 red
3. Color three multiples of '3' blue
4. Change font size for nine multiples of 9 to 24

1	2	3				7			10
	12			15	16				20
		23		25		27		29	
	32		34	35		37			40
41	42	43			46		48	49	
51	52				56	57			60
				65				69	70
71		73			76				
	82	83					88		
91			94						100
101	102			105		107	108		
		113	114			117		119	120

Assessment
1st Grade

_____Did student join class discussion on number squares?

_____Could student independently solve his/her problems when they arose?

_____Was student able to open number square template with nominal assistance?

_____Was student able to understand and make use of concept of a number square? Did student see how number square 'models' math concepts?

_____Did student use domain-specific language in class?

_____Did student successfully use word processing program tools and toolbars to format number square?

_____Was student able to verbalize math concepts during group discussions, using domain-specific and academic vocabulary?

_____Did student understand strategic use of a number square, as compared to arrays and/or paper-pencil?

_____Did student understand purpose of number squares for understanding place value, tens, adding/subtracting, greater than, lesson than, equal to?

_____Was student able to make connections between rows and columns?

_____Did student work well with partner?

_____Did student recognize how tech assisted learning with a number square?

_____Was student able to take/make helpful suggestions from/to peers?

_____Did anecdotal observation of student reveal him/her working tenaciously and persevering to complete work?

_____Did student complete project? Save to digital portfolio? Correctly?

_____Did student understand use of shortkey to close program?

_____When playing number square games, did student use internet safely?

Assessment
2nd Grade

_____Did student join class discussion on number squares?

_____Was student able to verbalize math concepts during group discussions, using domain-specific and academic vocabulary?

_____Was student able to make connections between rows and columns?

_____Was student able to open number square template with nominal assistance?

_____Did student recognize how tech assisted learning a number square?

_____Did student successfully use word processing tools and toolbars to format number square?

_____Did student understand purpose of number squares for understanding place value, tens, adding/subtracting, greater than, lesson than, equal to?

_____Did student understand the strategic use of a number square, as compared to arrays and/or paper-pencil?

_____Did student understand use of shortkey to close program?

_____Did student use domain-specific language in class?

_____Did student work well with partner?

_____Was student able to take/make helpful suggestions from/to peers?

_____Was student able to understand and make use of concept of a number square? Did student see how number square 'models' math concepts?

_____Did anecdotal observation of student reveal him/her working tenaciously and persevering to complete work?

_____Could student independently solve his/her problems when they arose?

_____Did student complete project? Save to digital portfolio? Correctly?

_____When playing number square games, did student use internet safely?

15…Symbols

Vocabulary	Tech Problem solving	Common Core
• *Abstract* • *Digital portfolio* • *Icons* • *Model* • *Monitor* • *Network* • *Palette* • *Symbol* • *Symbolic* • *Text tool* • *Tool* • *Toolbar*	• *Monitor doesn't work (check power)* • *Volume doesn't work (check systray)* • *Shift doesn't work (is caps lock on?)* • *Caps lock doesn't work (is it on?)* • *Double-click doesn't work (push enter)* • *How do I close a program (Alt+F4)* • *I can't read (can you identify symbol?)* • *Why must student name be in file name?* • *Greeting didn't fit? Discuss layout and planning with students.* • *Drawing program won't save? Save screen shot (use Jing, Snippet, similar).*	*CCSS.ELA-Literacy.W.K.3* *CCSS.ELA-Literacy.W.K.5* *CCSS.ELA-Literacy.W.K.6* *CCSS.ELA-Literacy.W.1.5* *CCSS.ELA-Literacy.W.1.6*
Time Required *45 minutes*	**NETS-S Standards** *2b, 4d*	**Grade** *K-1*

Essential Question

How do symbols help share ideas faster and more efficiently?

Overview

Summary

Students use symbols found in world around them to communicate—much as they use symbols in math.

By the end of this unit, kindergarten-1st grade students will review four Standards for Mathematical Procedures and up to 3 W (from Language Arts Standards), as well as understand the use of technology to highlight the relationship between symbolic (abstract) thinking and problem solving.

Big Idea

Communicate information and ideas effectively using symbols.

Materials

Drawing software, online poll (if doing this), internet

Teacher Preparation

- Check with classroom teacher on math symbols students know
- Prepare poll if having students participate. Embed it where students can easily access.
- This lesson plan can be done in the classroom or tech lab. Consider co-teaching:
  - *Grade level teacher can reinforce academic topics*
  - *Tech lab teacher can reinforce tech skills*

- Something happen you weren't prepared for? No worries. Common Core is about critical thinking and problem solving. Show students how you fix the emergency without a meltdown and with a positive attitude.

Steps

_____**Required skill level: Familiarity with drawing program, typing, formatting.**
_____To prepare for college and career, students are expected to have the ability to 'reason abstractly':

...to abstract a given situation and represent it symbolically and manipulate the representing symbols as if they have a life of their own... (from Common Core)

_____Throughout Common Core Standards, students are expected to use and understand symbols—$, >, =, and more. Not just know '= means equal to' but connect the symbol to something bigger—a norm, a concept, deeper learning, constructed knowledge, the congruence between what is stated and what is learned. For example, if students understand the Statue of Liberty is emblematic of American independence, they will connect the two every time they see that symbol, be it in person or a story. And, when they unpack that knowledge, they understand what = means.
_____How do you develop this symbolic reasoning in learners? Discuss a book students are reading in class (Frank Baum's *Wonderful Wizard of Oz* or Tana Hoban's *I Read Signs)* and how it relates to symbolic thinking.

_____Ask students to name some American symbols (or a group of your choosing). As they do, list them on Smartscreen.
_____Ask what these are symbols of. When they share, summarize for them: *So, when you see an American flag, you think of patriotism, freedom, immigrants* (or whatever summarizes student thoughts).
_____Discuss idea that a picture is worth a thousand words. Discuss tech symbols (i.e., icons, tools on a toolbar). If possible, spiral back on a book being read in class with symbols in it.
_____What are some symbols used in math? What do they represent? How is it better to use a symbol for a concept than writing all those words?
_____Math, more than any other subject, relies on symbolic thinking and intangibles to scaffold understanding. Help students make those connections.
_____Open drawing program (KidPix, Paint, Pixie, TuxPaint, Kerpoof) with teacher assistance as needed. Students get better at this each week so refrain from jumping in when they seem stuck. If you have parent helpers, let them know this strategy.

_____Students will draw a symbol that represents their country (or another theme). If necessary, students practice one week, redo and print the next.
_____Use text tool to add student name and 'God Bless America' (or similar). See insets for examples.
_____When student finishes, ask a neighbor what story they see summarized. Does image deliver same message as words? As students talk, incorporate domain-specific vocabulary. Respond to classmate ideas by revising, editing, and reworking drawing.
_____After some time, share several pictures on Smartscreen and ask class to expand on what they see symbolized. Does it model a bigger conversation?
_____Continually throughout class, check for understanding. Expect students to solve problems as they maneuver through lesson and make decisions that follow class rules.

_____Print with assistance as needed; save to digital portfolios with student last name and project name.
_____Why is it important to put student name in file name? Demonstrate a search for student name. See how their files show up even if not saved right (i.e., under network *class folder* instead of *student folder*) if student saved to network. Including last name in file name makes it harder to lose work.
_____Remind students to transfer knowledge to class or home.
_____Occasionally when students have difficulty doing what you are teaching, ask why. And listen. Answer may surprise you.
_____Problems listed at beginning of lesson are the most common students will face. Expect students to be able to solve these independent of assistance. Additionally, expect students to solve hardware problems as independently as possible:

- *Monitor problems—is power on*
- *Mouse problems—is there a light on underside of mouse (which means it's getting power)?*
- *Sound problems—are headphones plugged in? Is student using correct headphones? Is sound on?*
- *Computer problems—is power on? Is student logged in correctly?*

_____Tuck chairs under desk, headphones over tower; leave station as student found it.
_____*A note: Every chance you get, use technology to facilitate teaching. Lead by example. Students will see you use tech quickly and facilely and follow your good example. They want to use tech. Don't discourage them!*

Common Core (truncated for brevity; refer to original Standards for exact wording)

Standards for Mathematical Practice

- CCSS.Math.Practice.MP2
  Reason abstractly and quantitatively
- CCSS.Math.Practice.MP4
  Model with mathematics.
- CCSS.Math.Practice.MP5
  Use appropriate tools strategically.
- CCSS.Math.Practice.MP8
  Look for and express regularity in repeated reasoning

Kindergarten

- CCSS.ELA-Literacy.W.K.3
  Use a combination of drawing, dictating, and writing to narrate event
- CCSS.ELA-Literacy.W.K.5
  With guidance and support from adults, respond to questions and suggestions from peers and add details to strengthen writing as needed
- CCSS.ELA-Literacy.W.K.6
  With guidance and support from adults, explore a variety of digital tools to produce and publish writing, including in collaboration with peers

1st Grade

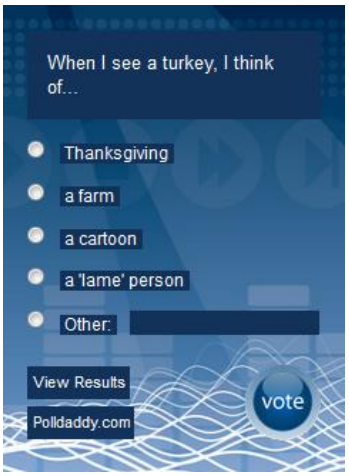
- CCSS.ELA-Literacy.W.1.5
  With support from adults, focus on topic, respond to questions, add details as needed

- CCSS.ELA-Literacy.W.1.6
  With guidance and support from adults, use a variety of digital tools to produce and publish writing, including in collaboration with peers

Extension:

- *Add stamps and/or stickers that fit drawing theme.*
- *To demonstrate how a picture evokes a 'thousand words', use a poll (see Figure 27):*
  - *Embed a poll (use PollDaddy or Google Apps for Education) into class internet start page or somewhere kindergarten and first graders are comfortable going*
  - *Ask what they think when they see a turkey (or other symbol). Give choices—Thanksgiving, 'lame' person, farm.*
  - *Have student answer anonymously*
  - *Display results on Smartscreen.*
  - *Likely, answer will be heavily weighted to one response.*

Figure 27



More Information:

- *Lesson questions? Go to Ask a Tech Teacher.*
- *If using this for an assessment, see full list of assessment items by grade level at end of unit.*

Assessment
Kindergarten

_____Did student join class discussion?

_____Did student transfer knowledge from other drawing lessons to this one (if there were prior lessons that used drawing program)?

_____Was student able to make connections between symbol and drawing?

_____Did student image and words communicate same information? Was 'a picture worth a thousand words'?

_____Did student understand connection between symbols like the flag and symbols used in math?

_____Did student work well with partner?

_____Was student able to take/make helpful suggestions from/to peers?

_____Did student successfully use drawing program tools, including text, to convey information?

_____Did student use domain-specific language in class?

_____Did anecdotal observation of student reveal him/her working tenaciously and persevering to complete work?

_____Did student troubleshoot problems (if any)? Could student independently solve his/her problems when they arose?

_____Did student complete project? Print? Save to digital portfolio and include last name in file name?

_____Did student answer poll question on class page (if doing extension)?

_____Did student leave station as it was when student arrived?

Assessment
1st Grade

_____Did student join class discussion?

_____Did student transfer knowledge from other drawing lessons to this one (if there were prior lessons that used drawing program)?

_____Did student image and words communicate the same information? Was 'a picture worth a thousand words'?

_____Did student understand connection between symbols like the flag and symbols used in math?

_____Was student able to make connections between symbol and drawing?

_____Did student work well with partner?

_____Was student able to take/make helpful suggestions from/to peers?

_____Did student successfully use drawing program tools, including text, to convey information?

_____Did student use domain-specific language in class?

_____Did anecdotal observation of student reveal him/her working tenaciously and persevering to complete work?

_____Did student troubleshoot problems (if any)? Could student independently solve his/her problems when they arose?

_____Did student complete project? Print? Save to digital portfolio and include last name in file name?

_____Did student answer poll question on class page (if doing extension)?

_____Did student leave station as it was when student arrived?

16…Word Problems

Vocabulary	Tech Problem solving	Common Core
• *Audio* • *Blabberize* • *Domain-specific* • *Embed* • *IPad* • *Little Bird Tails* • *Mathematical sentence* • *MP3* • *Sentence* • *Vocaroo* • *Voice thread* • *Web-based tool* • *Windows* • *Word problem*	• *My group members won't work (how have you solved that before?)* • *Don't understand (can group help?)* • *We made a mistake in our recording (that's OK. They aren't expected to be perfect)* • *Computer doesn't work (check common problems)* • *Student computers don't work? Have students think back to how problem was solved in the past.* • *Occasionally when students have difficulty doing what you are teaching, ask why. And listen. You may be surprised by the answer.*	*CCSS.Math.Content.K.OA.A.1* *CCSS.Math.Content.K.OA.A.2* *CCSS.Math.Content.1.OA.A.1* *CCSS.Math.Content.1.OA.A.2*
Time Required *25 minutes*	**NETS-S Standards** *3c, 6a*	**Grade** *K-1*

Essential Question

How do I understand numbers in a sentence?

Overview

Summary

Students use art and audio to represent a math problem, then ask classmates to solve it.

By the end of this unit, kindergarten and 1st grade students will review six Standards for Mathematical Procedures and 2 OA standards, as well as strengthen their understanding of word problems.

Big Idea

I can communicate the same information with words and pictures.

Materials

Internet, drawing program, audio program, iPads (if using these)

Teacher Preparation

- Have helpers available to assist students with online tools.
- This lesson plan can be done in the classroom or tech lab. Consider co-teaching:
  - *Grade level teacher can reinforce academic topics*
  - *Tech lab teacher can reinforce tech skills*

- Something happen you weren't prepared for? No worries. Common Core is about critical thinking and problem solving. Show students how you fix the emergency without a

Step

_____**Required skill level: Familiarity with online tools.**

_____Discuss strategies for adding and subtracting whole numbers based on student's prior work with numbers. Reinforce importance of 1) making sense of problems (have students read mysteries—say, P. D. Eastman's *Are You My Mother*? How does baby bird investigate problem of who its mother is?), and 2) persevering in solving problems (how does Else Minarik's *Little Bear* search for his birthday party?).

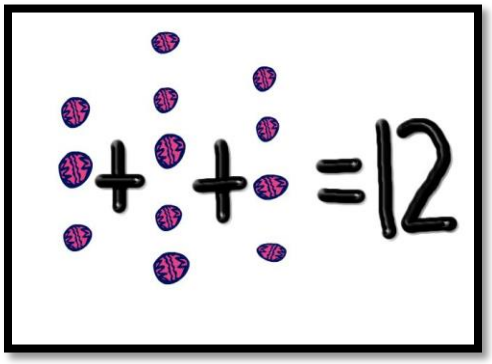
There was a boy who found three eggs at an Easter egg hunt. He went to show a friend, only to discover his friend had found five! Then his three-year old sister showed him four she had found. How many eggs did the group have for lunch?

_____Discuss the value of being able to reason both abstractly (understanding something exists you can't see) and quantitatively (knowing the question 'how many' is important). Share how various cultures count. Especially interesting is Lev Vygotsky's research into primitive tribes who didn't count past five. Some Bolivian herdsmen use counting methods linked to their way of life—i.e., knots on a string—an excellent representation of Common Core's admonishment to '*Look for and make use of structure*'. How can students construct viable arguments that lead to solutions (like creating a map from here to there).

_____Student groups devise a three-number addition problem whose sum is less than or equal to twenty. They create a story that symbolizes the problem (or base it on literature they are reading). For example, if problem is *3+5+4*, the following word problem would represent the operation:

There was a boy who found three eggs at an Easter egg hunt. He went to show a friend, only to discover his friend had found five! Then his three-year old sister showed him four she had found. How many eggs did the group have for lunch?

Figure 28



_____The word problem sentence should include 1) numbers discussed and 2) what must be done with numbers.

_____Once a word problem is agreed upon, group records it using a microphone, MP3 recorder, iPad, sound recorder that comes with Windows, or similar device. Here are some online tools you might also use—all require adult assistance with students of this age group:

- *Blabberize*
- *Little Bird Tales*
- *Vocaroo*
- *VoiceThread*

_____Note: If using an online tool, review rules for proper internet use with students.

_____Before recording, group practices the story enough that delivery is fluent and clear.

_____Next, group creates a drawing in Kerpoof, TuxPaint or KidPix that visually represents the numbers, operation, and solution (see *Figure 28*). For example, *Figure 28* uses stamps. This is student-directed. Enjoy their approaches.
_____Using both the audio word problem and picture:

- *Play audio and ask students to write mathematical sentence based on what they hear*
- *Show visual mathematical sentence and have students come up with a word problem*

_____As you teach, incorporate domain-specific vocabulary and expect students to do the same.
_____Problems listed at beginning of lesson are the most common students will face. Expect students to be able to solve these independently. Additionally, expect students to solve hardware problems:

- *Monitor problems—is power on*
- *Mouse problems—is there a light on underside of mouse (which means it's getting power)?*
- *Sound problems—are headphones plugged in? Is student using correct headphones? Is sound on?*
- *Computer problems—is power on? Is student logged in correctly?*

_____Throughout class, check for understanding. Expect students to make decisions that follow class rules.
_____Remind students to transfer knowledge to class or home.
_____Tuck chairs under desk, headphones over tower; leave station as student found it.
_____*A note: Every chance you get, use technology to facilitate teaching. Lead by example. Students will see you use tech quickly and facilely and follow your good example. They want to use tech. Don't discourage them!*

Common Core (truncated for brevity; refer to original Standards for exact wording)

Standards for Mathematical Practice

- CCSS.Math.Practice.MP2
  Reason abstractly and quantitatively
- CCSS.Math.Practice.MP3
  Construct viable arguments; critique reasoning of others
- CCSS.Math.Practice.MP4
  Model with mathematics.
- CCSS.Math.Practice.MP5
  Use appropriate tools strategically.
- CCSS.Math.Practice.MP6
  Attend to precision
- CCSS.Math.Practice.MP7
  Look for and make use of structure

Kindergarten

- CCSS.Math.Content.K.OA.A.1
  Represent addition and subtraction with objects, fingers, mental images, drawings, sounds, acting out situations, verbal explanations, expressions, or equations
- CCSS.Math.Content.K.OA.A.2
  Solve addition and subtraction word problems by using drawings to represent problem

1st Grade

- CCSS.Math.Content.1.OA.A.1
  Use addition and subtraction to solve word problems by using objects, drawings, and equations with a symbol for the unknown number to represent problem
- CCSS.Math.Content.1.OA.A.2
  Solve word problems that call for addition of three whole numbers by using objects, drawings, and equations with a symbol for the unknown number to represent the problem

Extension:

- *Using visual representation of problem, relate it to a class experience.*
- *Create a video of word problem using iPad camera by having student speak story while holding up drawing. This reinforces two methods of learning. Save videos to class wiki or an online library of word problems.*
- *Have students pretend they are Bolivian herdsmen who relate counting to their economic endeavors. Create a word problem based on their world.*

More Information:

- *Lesson questions? Go to Ask a Tech Teacher.*
- *If using this for an assessment, see full list of assessment items by grade level at end of unit.*

Assessment
Kindergarten

_____Did student join class discussion?

_____Could student independently solve his/her problems when they arose?

_____Did student make connections between word problems and math sentences?

_____Did student picture clearly represent the mathematical problem they were endeavoring to draw?

_____Did student transfer knowledge from other tech lessons to this one (if any)?

_____Did student connect math problem solving with literature being read in class?

_____Could student understand alternative approaches to counting used by groups around the world?

_____Could student create a math problem from a word problem and/or image, and vice versa?

_____Did student connect word problem, mathematical sentence, and image of others?

_____Did student use online tool effectively, with minimal assistance?

_____Was student able to take/make helpful suggestions from/to peers?

_____Did student work well in a group?

_____Did student successfully use word processing tools to write word problem, drawing tools to draw it, and recording tools to record?

_____Did group audio recording follow agreed-upon rules for speaking?

_____Did student use domain-specific language in word problem and taping?

_____Did anecdotal observation of student reveal him/her working tenaciously and persevering to complete work?

_____Did student complete project? Print? Save to digital portfolio?

_____Did student leave station as it was when student arrived?

Assessment
1st Grade

_____Did student join class discussion?

_____Could student independently solve his/her problems when they arose?

_____Did student connect word problems and math sentences?

_____Did student picture clearly represent mathematical problem they were endeavoring to draw?

_____Did student transfer knowledge from other lessons to this one (if any)?

_____Did student connect math problem solving with literature read in class?

_____Could student understand alternative approaches to counting used by cultures around the world?

_____Could student create a math problem from a word problem or image?

_____Did student connect word problem, mathematical sentence, and image of others?

_____Did student use online tool effectively, with minimal assistance?

_____Was student able to take/make helpful suggestions from/to peers?

_____Did student work well with in a group?

_____Did student successfully use word processing tools to write word problem, drawing tools to draw it, and recording tools to record?

_____Did group audio recording follow agreed-upon rules for speaking?

_____Did student use domain-specific language in word problem and taping?

_____Did anecdotal observation of student reveal him/her working tenaciously and persevering to complete work?

_____Did student complete project? Print? Save to digital portfolio?

_____Did student leave station as it was when student arrived?

17…Shapes in Math

Vocabulary	Tech Problem solving	Common Core
• *Circle* • *Drag-and-drop* • *Enter* • *Escape* • *Export* • *Fill* • *Icon* • *Log on* • *Oblong* • *Problem-solving* • *Rectangle* • *Spacebar* • *Square* • *Stamps* • *Symbol* • *Text tool* • *Tool bar*	• *Can't log on (what's user name)* • *Double-click doesn't work (push enter)* • *Drawing program won't save? Save screen shot with Jing, Snipping Tool, similar.* • *I spelled it wrong! (backspace)* • *Monitor doesn't work (check power and cable)* • *Shapes are not filled in? Show students correct KidPix shape tool.* • *Some tools are 'nested' beneath other tools? Explain how to find.* • *Students have trouble drawing feathers? That's OK. It's hard on kindergarten fine motor skills. Whatever they accomplish is fine.* • *What's the difference between save and export?*	*CCSS.Math.Content.K.G.A.1* *CCSS.Math.Content.K.G.A.2* *CCSS.Math.Content.K.G.B.5* *CCSS.Math.Content.1.G.A.2*
Time Required *25 minutes, 2x*	**NETS-S Standards** *1c, 4a*	**Grade** *K, 1*

Essential Question

How do shapes relate to the real world?

Overview

Summary

Students draw a holiday greeting with shapes they are studying, adding their name, a message, a face.

By unit's end, kindergarten/1st grade students will review four of the eight Standards for Mathematical Procedures and up to three Geometry standards, as well as scaffold 2nd and 3rd grade understanding of two- and three-dimensional shapes.

Big Idea

Shapes are everywhere and help us understand objects.

Materials

Drawing program, digital portfolio

Teacher Preparation

- What shapes are being discussed in class?
- What shapes are around your classroom?
- This lesson plan can be done in the classroom or tech lab. Consider co-teaching:

- *Grade level teacher can reinforce academic topics*
- *Tech lab teacher can reinforce tech skills*
- *Art teacher can teach use of shapes in drawing*

- Something happen you weren't prepared for? No worries. Common Core is about critical thinking and problem solving. Show students how you fix the emergency without a meltdown and with a positive attitude.

Steps

_____**Required skill level: Familiarity with drawing program, editing, formatting.**

_____Discuss shapes. What do students know from class conversations? Are shapes a way of modeling an idea? Does a shape always communicate idea regardless of circumstances (yes and no)? If necessary, remind students of agreed upon rules for discussions—such as listening to others and taking turns speaking.

_____If available, use Lucy Michelthwait's wonderful *I Spy Shapes in Art* as a foundation. Or Walter Wick's *A Drop of Water: A Book of Science and Wonder*—though this is a grade 2-3 exemplar, a discussion of soap bubble shapes is age-appropriate.

_____Common Core suggests:

Students describe their physical world using geometric ideas (e.g., shape, orientation, spatial relations) and vocabulary. They identify, name, and describe basic two-dimensional shapes, such as squares, triangles, circles, rectangles, and hexagons, presented in a variety of ways (e.g., with different sizes and orientations), as well as three-dimensional shapes such as cubes, cones, cylinders, and spheres. They use basic shapes and spatial reasoning to model objects in their environment and to construct more complex shapes.

Figure 29

Figure 30

_____Point to something in class (i.e., poster). What shape would create that? How about a CD? What about hole in center? Change object's orientation. Can student still determine shape? Point to different size circles—is that the same shape? What do you call small circle? Large one? What if you stretch sides—is it still a circle?

_____Take several different shapes. Can you put them together to create a different shape? Ask students to demonstrate.

_____Open drawing program—KidPix, TuxPaint, Kerpoof, or other. Today they'll create a greeting card that includes a holiday symbol from shapes.

_____Show sample on screen. What shapes are required for turkey (*Figure 29*)? Christmas tree (*Figure 30*)? Snow people (*Figure 31*)?

_____Compare and contrast creating greetings digitally and with paper-and-pencil. What is alike about the two methods (both creative, individual, colorful)? What is different (one's faster; one can say exactly what student wants; one looks more professional; one costs less; one is more personal)? Which do students prefer?

_____Ask students which tools are required to create greeting. Demonstrate those they select:

- *Drawing tool*
- *Shape or sticker tool*
- *Stamp tool (for face)*
- *Text tool*

Figure 31

_____Have students open drawing program while you show sample on screen.

_____Demonstrate drawing required shapes. This is hard on kindergarten fine motor skills so remind them they can practice, redo and start again next week.

_____Add face with stamp tool. As you add parts, discuss whether eyes are above/below nose? Is nose next to mouth? Discuss where each part is in relation to other parts?

_____In KidPix, show students how to reverse feet and ears with 'blue arrow' on tool bar, You'll be surprised how little trouble students have with this!

_____Add student name and greeting with text tool. Follow good grammar and spelling rules discussed in class. If you are co-teaching, have class teacher discuss this step.

_____If this is second week, ask students which tools they used last week. Have one student model how to draw, add face, add greeting and student name. Students know these skills so expect them to try to solve problems before asking for assistance.

_____As you teach, incorporate domain-specific vocabulary and expect students to do the same.

_____Continually throughout class, check for understanding.

_____When completed, export or save and print.

_____Occasionally when students have difficulty doing what you are teaching, ask why. And listen. You may be surprised by the answer.

_____Problems listed at beginning of lesson are the most common students will face. Expect students to solve these independent of assistance. Additionally, expect students to solve hardware problems:

- *Monitor problems—power on*
- *Mouse problems—light on underside of mouse (which means it's getting power)?*
- *Sound problems—headphones plugged in? Student using correct headphones? Sound on?*
- *Computer problems—power on? Student logged in correctly?*

> *Students describe their physical world using geometric ideas … and vocabulary. They identify, name, and describe basic two-dimensional shapes … presented in a variety of ways … as well as three-dimensional shapes … They use basic shapes and spatial reasoning to model objects in their environment and to construct more complex shapes.*
>
> *—Common Core*

_____Remind students to transfer knowledge to class or home.

_____*A note: Every chance you get, use technology to facilitate teaching. Lead by example. Students will see you use tech quickly and facilely and follow your good example. They want to use tech.*

Common Core (truncated for brevity; refer to original Standards for exact wording)

Standards for Mathematical Practice

- CCSS.Math.Practice.MP5
  Use appropriate tools strategically.
- CCSS.Math.Practice.MP6
  Attend to precision
- CCSS.Math.Practice.MP7
  Look for and make use of structure
- CCSS.Math.Practice.MP8
  Look for and express regularity in repeated reasoning

Kindergarten

- CCSS.Math.Content.K.G.A.1
  Describe objects in the environment using names of shapes, and describe the relative positions of these objects using terms such as above, below, beside, in front of, behind, and next to
- CCSS.Math.Content.K.G.A.2
  Correctly name shapes regardless of their orientations or overall size
- CCSS.Math.Content.K.G.B.5
  Model shapes in world by building shapes from components and drawing shapes

1st Grade

- CCSS.Math.Content.1.G.A.2
  Compose two-dimensional or three-dimensional shapes to create a composite shape, and compose new shapes from the composite shape

Extension:

- *Bring one student picture up on Smartscreen. Ask class to describe where a part (i.e., mouth) is in relation to other parts (i.e., student name) using words like* ***above, below, beside, in front of, behind, and next to****.*
- *Have students draw picture with another object placed above, below, beside, in front of, behind, or next to. As you watch, ask about that relationship.*
- *Use second week as formative assessment. What do students remember of skills practiced first week?*
- *Other useful shape books:*
  - *When a Line Bends, a Shape Begins*
  - *Mouse Shapes*
  - *Shape by Shape*

More Information:

- *Lesson questions? Go to Ask a Tech Teacher.*
- *If using this for an assessment, see full list of assessment items by grade level at end of unit.*

Assessment
Kindergarten

_____Did student join class discussion? Did they follow agree-upon rules for speaking and listening?

_____Did student understand how shapes create the world around him/her? Could s/he identify shapes in classroom?

_____Did student successfully use word processing and drawing tools?

_____Did student use good keyboarding habits when typing?

_____Did student demonstrate command of grammar when creating greeting?

_____Did student understand that digitally creating greetings are an alternative to drawing them on paper?

_____Did student transfer knowledge from other tech lessons to this one (if there were prior lessons)?

_____Did student use academic vocabulary in discussing shapes?

_____Did anecdotal observation of student reveal him/her working tenaciously to complete work?

_____Could student independently solve problems when they arose?

_____Did student follow directions for completion of project, including printing?

_____Did student save card to digital portfolio?

_____Did student leave station as it was when student arrived?

Assessment
1st Grade

_____Did student join class discussion? Did they follow agree-upon rules for speaking and listening?

_____Did student understand how shapes create the world around him/her? Could s/he identify shapes in classroom?

_____Did student successfully use word processing and drawing tools?

_____Did student use good keyboarding habits when typing?

_____Did student demonstrate command of grammar when creating greeting?

_____Did student understand that digitally creating greetings are an alternative to drawing on paper?

_____Did student transfer knowledge from other tech lessons to this one (if there were prior lessons)?

_____Did student use academic vocabulary in discussing shapes?

_____Did anecdotal observation of student reveal him/her working tenaciously to complete work?

_____Could student independently solve problems when they arose?

_____Did student follow directions for completion of project, including printing?

_____Did student save card to digital portfolio?

_____Did student leave station as it was when student arrived?

18…Shapes in our World

Vocabulary	Tech Problem solving	Common Core
• *2D* • *3D* • *Context* • *Cube* • *Diamond* • *Embed* • *Geometric* • *Graphic dictionary* • *Pyramid* • *Rectangle* • *Roots* • *Screenshot* • *Square*	• *Computer doesn't work (check common problems)* • *Where's embed code (try 'share' tool)* • *Screen froze (is dialogue box open?)* • *Caps don't work (Check caps lock)* • *Drawing program won't save? Save as screen shot using Jing, Snipping Tool, or similar* • *I spelled it wrong! (backspace or delete—which works better?)*	*CCSS.Math.Content.K.G.A.1* *CCSS.Math.Content.K.G.A.2* *CCSS.Math.Content.K.G.B.4* *CCSS.Math.Content.K.G.B.5* *CCSS.Math.Content.K.G.B.6* *CCSS.Math.Content.1.G.A.2*
Time Required *45 minutes*	**NETS-S Standards** *3b, 6b*	**Grade** *K, 1*

Essential Question

Does the orientation or position of a shape change what it is?

Overview

Summary

Students are Shape Sleuths--touring classroom and campus in search of geometric shapes in their physical world. When done, they draw the objects based on their shapes.

By unit's end, kindergarten/1st grade students will review five of the eight Standards for Mathematical Procedures and up to five Geometry standards, as well as scaffold 2nd and 3rd grade understanding of two- and three-dimensional shapes.

Big Idea

Shapes are the basis for many items found around us.

Materials

Internet, drawing program, Smartscreen, intra-school field trip, digital recording devices

Teacher Preparation

- Have adult helpers for Shape Sleuths
- Prepare as though for school field trip
- Know what shapes students discussed this year and where they are found around campus
- Consider co-teaching this lesson:
  - *Grade level teacher can reinforce academic topics*

- *Tech lab teacher can reinforce tech skills*

- Something happen you weren't prepared for? No worries. Common Core is about critical thinking and problem solving. Show students how you fix the emergency without a meltdown.

Steps

_____**Required skill level: Familiarity with drawing program, editing, formatting.**

_____Discuss shapes. What do students know from class conversations? Are shapes a way to model an idea? Does a shape always communicate the idea regardless of circumstances (yes and no)? If necessary, remind students of agreed upon rules for discussions—such as listening to others and taking turns speaking.

_____Common Core suggests:

Students describe their physical world using geometric ideas … and vocabulary. They identify, name, and describe basic two-dimensional shapes, such as squares, triangles, circles, rectangles, and hexagons, presented in a variety of ways (e.g., with different sizes and orientations), as well as three-dimensional shapes …

_____Point to something in classroom (i.e., a poster). What shape would it take to create that? How about a CD? What about hole in center? Change object's orientation. Can student still identify shape? Point to different size circles—is that the same shape? What do you call small circle? How about large one? What if you stretch sides—is it still a circle?

_____Take several different shapes. Can you put them together to create a different shape? Ask students to demonstrate.

_____Take students on a stroll around campus. Students will be 'Shape Sleuths', on a hunt for shapes discussed in class. Be sure to have extra helpers so students don't get separated.

_____Before starting Shape Sleuthing, read parts of Alice and Martin Provensen's, *The Year at Maple Hill Farm* to find shapes in nature, animals, surroundings. Or, use a similar book.

_____Walk around grounds and ask students to point out where they see squares, rectangles, circles, diamonds, cubes, pyramids and other shapes discussed in class. As you scribe for them, ask them to describe the relative positions of these objects using terms such as *above*, *below*, *beside*, *in front of*, *behind*, and *next to*.

_____Let students use digital tools like iPads, digital cameras, digital camcorders to record their observations. Encourage them to annotate images verbally with information on their spatial location. Include conclusions students draw about regularity in the use of shapes for certain purposes, i.e., doorways are usually rectangles. Balls are usually circles. Note student thoughts on why these shapes might serve the purpose well (i.e., why are balls round?). Are roofs usually triangles (not if you live in a snow area)?

_____Return to classroom and list shapes on Smartscreen. Ask students to remind you where they saw them using spatial vocabulary (*front of building, beside athletic field, on top of tower*, etc.). Jog their memories if necessary.

_____Have students draw one shape and its orientation in surroundings—building, play structure, window, etc.
_____Add to picture any notes they made and their name. Export and print.
_____As you teach, incorporate domain-specific vocabulary and expect students to do the same.
_____Problems listed at beginning of lesson are the most common students will face. Expect students to solve these independent of assistance. Additionally, expect students to solve hardware problems as independently as possible. Consider:

- *Monitor problems—is power on*
- *Mouse problems—is there a light on underside of mouse (which means it's getting power)?*
- *Sound problems—are headphones plugged in? Is student using correct headphones? Is sound on?*
- *Computer problems—is power on? Is student logged in correctly?*

_____Throughout class, check for understanding. Expect students to make decisions that follow class rules.
_____Remind students to transfer this knowledge to class or home.
_____Tuck chairs under desk, headphones over tower; leave station as student found it.
_____*A note: Every chance you get, use technology to facilitate teaching. Lead by example. Students will see you use tech quickly and facilely and follow your good example. They want to use tech. Don't discourage them!*

Common Core (truncated for brevity; refer to original Standards for exact wording)

Standards for Mathematical Practice

- CCSS.Math.Practice.MP2
  Reason abstractly and quantitatively
- CCSS.Math.Practice.MP5
  Use appropriate tools strategically
- CCSS.Math.Practice.MP6
  Attend to precision
- CCSS.Math.Practice.MP7
  Look for and make use of structure
- CCSS.Math.Practice.MP8
  Look for and express regularity in repeated reasoning

Kindergarten

- CCSS.Math.Content.K.G.A.1
  Describe objects in environment using names of shapes, and describe relative positions of these objects using terms such as above, below, beside, in front of, behind, next to
- CCSS.Math.Content.K.G.A.2
  Correctly name shapes regardless of their orientations or overall size
- CCSS.Math.Content.K.G.B.4
  Analyze and compare two- and three-dimensional shapes, in different sizes and orientations, using informal language to describe their similarities, differences, parts and other attributes
- CCSS.Math.Content.K.G.B.5
  Model shapes in the world by building from components and drawing shapes

- CCSS.Math.Content.K.G.B.6
  Compose simple shapes to form larger shapes. For example, "Can you join these two triangles with full sides touching to make a rectangle?"

1st Grade

- CCSS.Math.Content.1.G.A.2
  Compose two-dimensional or three-dimensional shapes to create a composite shape, and compose new shapes from composite shape

Extension:

- *Use iPad to list shapes found on campus during Shape Sleuthing. Then, project iPad screen onto Smartscreen. Any time you can use technology in a 'cool' way—do it!*
- *Draw shapes of objects found on school grounds on Smartscreen, but change their spatial orientation, position, size. Can students still identify what they see?*
- *Other useful shape books:*
  - *When a Line Bends, a Shape Begins*
  - *Mouse Shapes*
  - *Shape by Shape*

More Information:

- *Lesson questions? Go to Ask a Tech Teacher.*
- *If using this for assessment, see full list of assessment items by grade level at end of unit.*

Assessment
Kindergarten

_____Did student join class discussion? Did they follow agree-upon rules for speaking and listening?

_____Could student independently solve his/her problems that arose?

_____Did student identify symbolic shapes in stories being read in class?

_____Was student engaged in searching out shapes in his/her environment or did she/he get distracted?

_____Did student use academic vocabulary to place shapes in location?

_____Did student successfully use digital tools to records thoughts while Shape Sleuthing? Did s/he understand that their physical world could be described using geometric ideas?

_____Did student understand the use of placement words like 'above'?

_____Did student transfer knowledge from other tech lessons to this one (if there were prior lessons)?

_____Did student successfully use drawing tools to reproduce shapes from campus?

_____Did anecdotal observations of student reveal him/her working tenaciously and persevering to complete work?

_____Did student follow directions for completing and saving project, including printing?

_____Did student leave station as it was when student arrived?

_____Did student understand that the tech devices s/he used were alternatives to paper-and-pencil options?

Assessment
1st Grade

_____Did student join class discussion? Did they follow agree-upon rules for speaking and listening?

_____Could student independently solve his/her problems that arose?

_____Did student identify symbolic shapes in stories being read in class?

_____Was student engaged in searching out shapes in his/her environment or did she/he get distracted?

_____Did student use academic vocabulary to place shapes in location?

_____Did student successfully use digital tools to records thoughts while Shape Sleuthing? Did s/eh understand that their physical world could be described using geometric ideas?

_____Did student understand the use of placement words like 'above'?

_____Did student transfer knowledge from other tech lessons to this one (if there were prior lessons)?

_____Did student successfully use drawing tools to reproduce shapes from campus?

_____Did anecdotal observations of student reveal him/her working tenaciously and persevering to complete work?

_____Did student follow directions for completing and saving project, including printing?

_____Did student leave station as it was when student arrived?

_____Did student understand that the tech devices s/he used were alternatives to paper-and-pencil options?

19…Parts of a Whole

Vocabulary	Tech Problem solving	Common Core
• *Escape* • *File* • *Fill* • *Home row* • *Icon* • *Log-on* • *Nested* • *Oops Guy* • *Palette* • *Screen shot* • *Sections* • *Task bar* • *Texture fills* • *Tool bar*	• *Ask students to try to solve problems before asking for assistance.* • *Color flows out of section (attach edges)* • *Drawing program won't save? Use a screen shot with Jing, similar* • *I can't fit my name on page (move letters—and plan ahead next time)* • *If students have difficulty doing what you are teaching, ask why. And listen. You may be surprised by the answer.* • *Program disappears? (check taskbar)* • *Some Tools are 'nested' beneath other tools. Explain how to find these.*	*CCSS.Math.Content.K.G.B.5* *CCSS.Math.Content.K.G.B.6* *CCSS.Math.Content.1.G.A.2* *CCSS.Math.Content.1.G.A.3*
Time Required *25 minutes*	**NETS-S Standards** *1a, 4b*	**Grade** *K, 1*

Essential Question

How does art help me figure out math?

Overview

Summary

Students draw a thematic image, then divide it into pieces (halves, quarters, etc.). They work with a partner to describe segmentation and/or joining of the new shape that is formed, and their understanding of process.

By the end of this unit, kindergarten/1st grade students will review five of the eight Standards for Mathematical Procedures and 2 G, as well as inform themselves on shapes, addition, division.

Big Ideas

Students understand a whole is made up of parts—and parts can be joined to create a new shape.

Materials

Drawing program, iPad (if using Extension)

Teacher Preparation

- Determine student ability to divide/join a whole.
- This lesson can be done in the classroom or tech lab. Consider co-teaching:
  - *Grade level teacher can reinforce academic topics*
  - *Tech lab teacher can reinforce tech skills*

- Something happen you weren't prepared for? No worries. Common Core is about critical thinking and problem solving. Show students how you fix emergency with a positive attitude.

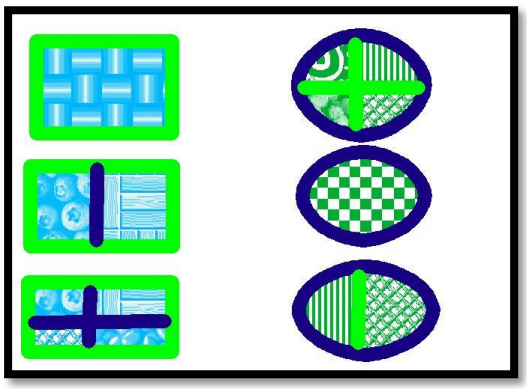
Steps

_____**Required skill level for this unit: Familiarity with word processing, editing, formatting.**

_____Introduce concept of whole, half, quarter. how to compose and decompose plane or solid figures (e.g., put two triangles together to make a quadrilateral), and build understanding of part-whole relationships.

_____Draw a shape on Smartscreen and ask students to describe geometric attributes. Draw another shape and ask same question.

Figure 32



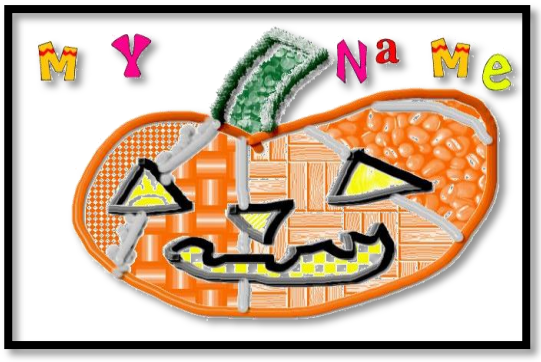
_____Now ask students how the two shapes are alike and different. You're looking for insights into measurement, size, angles or corners, and initial understandings of congruence and symmetry.

_____When conversation is completed, open drawing program (KidPix, TuxPaint, Paint, Kerpoof, or another) and ask students to draw a circle, rectangle, triangle, trapezoid as you draw one on Smartscreen.

_____Demonstrate how to divide shape into pieces (see *Figure 32* and *32*). Depending upon where students are in their math studies, 1) count pieces, 2) discuss how all pieces make a whole.

_____Have students do this, then fill sections with interesting textures. Discuss what new shapes are formed when original shape is subdivided. Discuss relationship of new shapes to original.

Figure 33



_____As you walk around class, ask students to explain what they are doing, and to describe new shape and its new attributes. Ask clarifying questions as needed.

_____Have students save work so you can use as student-initiated learning tools.

_____Display a subdivided shape on Smartscreen and ask students to describe it using words like 'half', 'halves', 'fourths', and 'quarters', and phrases like 'half of', 'fourth of', and 'quarter of'. Then, describe the whole as 'two of', 'four of'.

_____Now do a fun drawing: Use a holiday themed image (see *Figure 33*). Select desired color from palette; select a brush and draw the holiday symbol. Add a stem and face using different shapes. Separate into 3-4 sections. Let students make mistakes, try different colors, experiment. If using KidPix, show how 'Oops' guy works. Show how to 'blow up' and start over. It's OK. There's lots of time.

_____Print with assistance; save or export to digital portfolio. What's the difference between 'save' and 'export'? Remember to include last name in file name. Why?

_____Problems listed at beginning of lesson are the most common students will face. Expect students to solve these independently, including:

- *Monitor problems—is power on*
- *Mouse problems—is light on underside (which means it's getting power)?*
- *Sound problems—are headphones plugged in? Is student using correct headphones? Is sound on?*
- *Computer problems—is power on? Is student logged in correctly?*

_____Throughout class, expect students to make decisions that follow class rules.
_____Remind students to transfer knowledge to class or home.
_____Tuck chairs under desk, headphones over tower; leave station as it was.

Common Core (truncated for brevity; refer to original Standards for exact wording)

Standards for Mathematical Practice

- CCSS.Math.Practice.MP2
  Reason abstractly and quantitatively
- CCSS.Math.Practice.MP3
  Construct viable arguments; critique reasoning of others
- CCSS.Math.Practice.MP4
  Model with mathematics.
- CCSS.Math.Practice.MP5
  Use appropriate tools strategically
- CCSS.Math.Practice.MP7
  Look for and make use of structure

Kindergarten

- CCSS.Math.Content.K.G.B.5
  Model shapes in the world
- CCSS.Math.Content.K.G.B.6
  Compose simple shapes to form larger shapes

1st Grade

- CCSS.Math.Content.1.G.A.2
  Compose two- or three-dimensional shapes to create a composite shape, and compose new shapes from composite shape
- CCSS.Math.Content.1.G.A.3
  Partition circles and rectangles into equal shares, describe shares using words halves, fourths, and quarters, and use phrases half of, fourth of, and quarter of.

Extension:

- *Anytime you can inject tech into class, do it! Students love seeing gadgets in action. For example—take a video of students working and upload to class website/blog/wiki.*
- *Have students draw pieces of a divided shape—not whole shape. Save these. Display on Smartscreen. Have students identify decomposed shapes using correct terminology*

More Information:

- *If using this for assessment, see full list of assessment items by grade level at end of unit.*
- *Lesson questions? Go to http://askatechteacher.com*

Assessment
Kindergarten

_____Did student join class discussion? Did they follow agree-upon rules for speaking and listening?

_____Did student troubleshoot tech problems (if any)?

_____Could student use academic vocabulary to describe attributes of a shape? Could they describe attributes of decomposed and joined shapes?

_____Did student understand that a whole is made up of parts, and parts can be joined to create a new shape?

_____Could student identify attributes of different shapes, and understand how shapes are alike or different?

_____Did student understand the use of placement words like 'above', 'below', 'beside'?

_____Did student successfully use drawing program, tools, and toolbars?

_____Did student transfer knowledge from other tech lessons to this one (if there were prior lessons)?

_____Did anecdotal observations of student reveal him/her persevering to complete work?

_____Did student follow directions for completing and saving project, including printing?

_____Did student leave station as it was when student arrived?

_____Did student understand that the tech devices s/he used were alternatives to other options?

Assessment
1st Grade

_____Did student join class discussion? Did they follow agree-upon rules for speaking and listening?

_____Did student troubleshoot tech problems (if any)?

_____Could student use academic vocabulary to describe attributes of a shape? Could they describe attributes of decomposed and joined shapes?

_____Did student understand that a whole is made up of parts, and parts can be joined to create a new shape?

_____Could student identify attributes of different shapes, and understand how shapes are alike or different?

_____Did student understand placement words like 'above', 'below', 'beside'?

_____Did student successfully use drawing program, tools, and toolbars?

_____Did student transfer knowledge from other tech lessons to this one (if there were prior lessons)?

_____Did anecdotal observations of student reveal him/her persevering to complete work?

_____Did student follow directions for completing and saving project, including printing?

_____Did student leave station as it was when student arrived?

_____Did student understand that tech devices s/he used were alternatives to other options?

20…Architecture and Design

Vocabulary	Problem solving	Common Core
• *2-dimensional* • *3-dimensional* • *Ad* • *Architecture* • *Blueprint* • *Cursor* • *Desktop* • *Digital citizen* • *Digital neighborhood* • *Drag-and-drop* • *Floor plan* • *Footprint* • *Layout* • *Proportion* • *Scale* • *Screenshot* • *Structure* • *Tabbed browsing*	• *How do I print? (Ctrl+P)* • *How do I close (Alt+F4)* • *Got out of digital neighborhood (use back button)* • *I finished (use tabbed browsing to return to start page)* • *My neighbor doesn't listen (remember agreed-upon rules for speaking and listening?)* • *Where's a link in a website? (look for hand)* • *Drawing program won't allow saving? Save a screen shot (using Jing, Snippet, or similar).* • *Student computers don't work? Remind students how hardware issues cause problems. Don't do it for them unless you must!* • *2-story house? Be creative—pick some rooms, skip others.*	*CCSS.ELA-Literacy.SL.1.1a*
Time Required *45 minutes*	**NETS-S Standards** *4c, 5a*	**Grade** *1st*

Essential Question

Why is understanding layout of a room, house—or drawing—important to communicate information?

Overview

Summary

Students will spatially lay out a three-dimensional structure on a two-dimensional paper—three different ways.

By unit's end, first graders will review seven of eight Standards for Mathematical Procedures and 1 S&L standard, as well as inform themselves on the spatial layout and construction of structures.

Big Idea

Putting pieces in their proper place helps to communicate essential information to viewers, readers, others.

Materials

Internet, architecture websites, drawing program, links for online tools saved to class internet start page

Teacher Preparation

- Be familiar with architecture programs used for this lesson.
- This lesson plan can be done in classroom or tech lab. Consider co-teaching:

  - *Grade level teacher can reinforce academic topics*
  - *Tech lab teacher can reinforce tech skills*

- Something happen you weren't prepared for? No worries. Common Core is about critical thinking and problem solving. Show students how you fix the emergency without a meltdown and with a positive attitude.

Steps

_____**Required skill level: Familiarity with drawing program and internet.**

_____What does it mean to 'model' something? What are examples? Anyone build model airplanes with parents? How about a model race car with Boy Scouts? Or a model using Legos? What was the purpose? Discuss how important it is modeling be done with precision so student can figure out if plan will work--and if not, rework (like Common Core's ***plan, revise, edit rewrite*** under ELA Standards). The process helps students understand 1) abstract reasoning vs. real-world, and 2) the more exact student is, the easier for others to understand message in model.

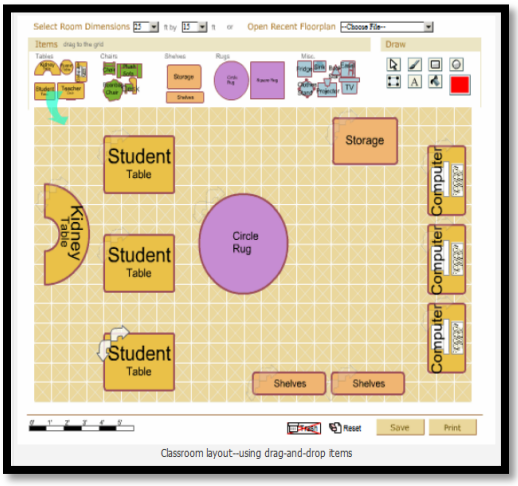
_____This project focuses on student ability to use theoretical knowledge, apply it to a virtual model, and make connections to practical application of designing a room, town.

_____Discuss design. This includes size, shape, texture, proportion, scale, mass and color. Apply to rooms, buildings, neighborhoods. Encourage students to think and analyze critically.

_____Before opening websites, review good digital citizenry. Demonstrate on Smartscreen. Ask students where today's digital neighborhood is? Where can they go on website and what should they avoid (ads)? How can they identify a link (cursor becomes hand)?

_____**#1: Visit Classroom Architect** (see *Figure 35*) and design classroom with drag-and-drop pieces. Demo, taking suggestions from class on layout. Students must think about where tables and storage are relative to other items. Ask questions like, *Is table next to…? What is in front of…? What is above it?* This is an active learning lesson that encourages visual thinking. Create a sample based on class input; show how to make corrections.

Figure 34



_____When finished, student develops his/her own floor plan, then discusses with neighbor. Use academic and domain-specific language. Does neighbor understand what you designed? Do they believe it represents what is there? Follow agreed-upon rules for discussion:

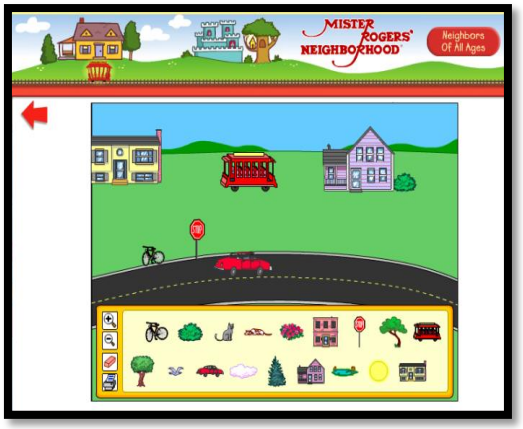
- *listen to each other with care*
- *speak one at a time*

- *build on each other's conversations*
- *ask clarifying questions*

If necessary, model these for students.

_____Print (you may need to print a screenshot using Windows Snipping tool or Jing. If so, show students how this is done); save to student digital portfolio with assistance.

Figure 35



_____**#2: Design a virtual town in Mr. Rogers Neighborhood** (see *Figure 36*). Discuss student home towns as a group. Are there stop signs? What types of buildings? Is it crowded? Drag and drop stamps to accessorize.

_____Print (Again, you may need to print a screenshot using Windows Snipping tool or Jing); save to student digital portfolio with assistance. Export if necessary. Why export? Include student last name in file name. Why? Discuss if necessary.

Figure 36

_____**#3: Draw a floor plan of student home** (see *Figure 37*). Open drawing program on Smartscreen (i.e., KidPix, TuxPaint, Kerpoof, or similar). I use KidPix because it offers a nice collection of building tools. Demonstrate how to design a floor plan using school as an example. Discuss with students as you draw, soliciting input. What rooms are in the school? Are there different ones in a house? What room is next to 'this' one? If there are two stories—get creative!

_____Now students draw their home. Have them mentally walk through rooms. Draw outline. Separate rooms with walls. Label parts with text tool. Use stamps and stickers to add items that belong in each area.

_____When students finish, have them chat with a partner about design and how this relates to class conversations on 'modeling', 'structures,' and 'architecture'. Does partner believe they understand how student home looks on the inside? Do they think they could walk through it in real life? Follow agreed-upon rules for discussions:

- *listen to each other with care*
- *speak one at a time*
- *build on each other's conversations*
- *ask questions to clear up confusion*

_____Export or save completed drawing. Why export? Print (again, you may need to use a screenshot); save to digital portfolio with assistance.

_____Continually throughout class, check for understanding. Expect students to solve problems and make decisions that follow class rules.
_____Remind students to transfer knowledge to class or home.
_____Occasionally when students have difficulty doing what you are teaching, ask why. And listen. You may be surprised by the answer.
_____The problems listed at beginning of lesson are the most common students will face. Expect students to solve these independently--as well as hardware problems:

- *Monitor problems—is power on*
- *Mouse problems—is light on underside (which means it's getting power)?*
- *Sound problems—are headphones plugged in? Is student using correct headphones? Is sound on?*
- *Computer problems—is power on? Is student logged in correctly?*

_____As you teach, incorporate domain-specific vocabulary and expect students to do the same.
_____Tuck chairs under desk, headphones over tower; leave station as student found it.
_____*A note: Every chance you get, use technology to facilitate teaching. Lead by example. Students will see you use tech quickly and facilely and follow your good example. They want to use tech. Don't discourage them!*

Common Core (truncated for brevity; refer to original Standards for exact wording)

Standards for Mathematical Practice

- CCSS.Math.Practice.MP2
  Reason abstractly and quantitatively
- CCSS.Math.Practice.MP3
  Construct viable arguments; critique reasoning of others
- CCSS.Math.Practice.MP4
  Model with mathematics
- CCSS.Math.Practice.MP5
  Use appropriate tools strategically
- CCSS.Math.Practice.MP6
  Attend to precision
- CCSS.Math.Practice.MP7
  Look for and make use of structure
- CCSS.Math.Practice.MP8
  Look for and express regularity in repeated reasoning

1st Grade

- CCSS.ELA-Literacy.SL.1.1a
  Follow agreed-upon rules for discussions

Extension:

- *Find stamps and stickers for outside items—trees, streets, rocks, bikes.*

More Information:

- *Lesson questions? Go to http://askatechteacher.com*
- *If using this for assessment, see full list of assessments by grade level at end of unit.*

Assessment
1st Grade

_____Did student join class discussion? Did s/he follow agree-upon rules for speaking and listening?

_____Could student use academic and/or domain-specific vocabulary to describe structures, architecture, layout?

_____Did student understand placement words like 'above', 'below'?

_____Did student successfully use drawing program?

_____Did student transfer knowledge from other tech lessons to this one (if there were prior lessons)?

_____Does student understand importance of properly placing items with goal of communicating essential information to viewers?

_____Did student effectively represent layout of home, neighborhood, classroom (in the eyes of a fellow student)?

_____Did student safely use internet sites, understanding correct way to use online tools?

_____Did anecdotal observation reveal student persevering to complete work?

_____Does student understand relationship between 'abstract reasoning' and the reality of class or home?

_____Did student save project with their last name in file name?

_____Did student save project to their digital portfolio?

_____Did student troubleshoot tech problems (if any)?

_____Did student leave station as it was when student arrived?

_____Did student feel tech tools used were appropriate to task?

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