Teaching Loving Math

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Teaching Loving Math

By
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An Honors Thesis Submitted in Partial Fulfillment of the Requirements for Graduation from the Western Oregon University Honors Program

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Abstract

This project is the start of a resource manual on using best practices for teaching math for elementary school teachers. The manual will discuss teaching math using both best practices and a positive attitude, and will include many ideas for working with kids and math in a fun way. The resource manual will include sections to help increase teacher’s confidence prior to beginning working with kids on mathematics lessons.
During my time at Western Oregon University, from my sophomore year until part way through my senior year, I worked as a tutor in WOU’s Math Center (wou.edu/mathcenter). While technically I tutored all lower-level math classes, and up to calculus, that was not what the majority of my time was spent doing. Most of my shifts in the Math Center were spent helping my fellow students with the various math classes specifically designed for, and required for, elementary education majors. This was a different type of math, which focused on not only the concepts, but also the various ways those concepts could be applied, and the conceptual understanding one needs when teaching these concepts. As someone who took these classes, I found the subject fascinating! I have always loved math, and learning the intricate details of what goes into teaching it, and learning the reasoning behind the different methods for teaching mathematics to children fascinates me. I found what I was learning in these classes as a student was the process, and the different approaches, as I already knew most of the math itself. This excitement was not the case though for many of the students who came into the Math Center.

The fellow education majors I tutored needed assistance with a variety of things, ranging from math concepts they needed to relearn, or had never learned, to needing help understanding the relevance of the math they were doing. The thing that was the hardest though, was these elementary education majors, the people who would be teaching the next generation of students this wonderful subject, repeatedly told me the same thing. They didn’t like math. Either they found it hard,
confusing, or for some people, just pointless. This attitude seemed to change as we worked together on their classes. One of the benefits of tutoring is that you get to work with people in a one-on-one setting, something you don’t always get while teaching an entire class, and this one-on-one setting led me to a couple of realizations. First, “I don’t like math,” typically actually means “I am not confident in math.” Once I had taken the time to help people solve a couple of problems, and gotten way too excited about how fun the problems were in the process, the comments about not liking math seemed to lessen. As people became more confident in their own mathematical capabilities, they seemed more excited about teaching it.

The second thing I learned is that the people who didn’t like math were telling me that they have never liked math. They often said things like, “Math has always been my hardest subject.” Because of these comments, I started asking people about their elementary school math teachers, and more often than not, the people struggling with math told me their teachers either didn’t help them in math, or didn’t like math themselves. This shocked me. The idea that a teacher could let their students know that they themselves did not enjoy something they were teaching, and that a teacher would pass that on to the students, was deeply troubling. This is where the idea for this thesis first formed. I realized that I grew up with teachers who loved math, and taught me to love it as well, and I began to wonder, how can teachers intentionally teach this love of mathematics?

There are a few things needed in order for a teacher to teach math with a positive attitude. The first, is confidence in their own ability. So the question arose of
how do you teach confidence in something through a written project, specifically in education? There is a book by Harry Wong, *The First Days of School; How To Be An Effective Teacher* (Wong, 1991). Wong goes over classroom management tools so that teachers can feel ready to start in the classroom. What I loved about this book when I used it, was that rather than having to read the whole thing, one could simply turn to the exact issue they were having, and there was concise information about that aspect of classroom management. I wanted to emulate that, with chapters that help teachers gain confidence in a particular topic they may be teaching, immediately telling them things they need to remember, standards it applies to, and common mistakes to look for, all of which can be reviewed in the five minutes before a lesson. My long-term goal is to create a resource where teachers can gain this quick confidence on all elementary grade level math concepts, and the format of this can be seen in the first grade chapters included in this thesis.

The next thing that is important for teachers to pass on about the love of mathematics is a healthy dose of over the top excitement. If you as a teacher don’t seem to be enjoying what you are teaching, how can you expect your students to? As such, the other aspect of these review chapters needed to be included:

Elementary school appropriate math jokes. By simply having math jokes ready for whatever concept you are teaching that day, students will see that the teacher is enjoying and having fun with the math they are doing. This enjoyment is key, as projecting a positive attitude about math is insanely important to getting your students to enjoy math. While there are studies which have looked into this, and I will talk about this more in the next chapter, I wanted to get some data myself, to see
how teachers' confidence and enjoyment of math affects their students. I decided to conduct a survey of teachers and their students on their enjoyment, confidence, and competence, in math.

This survey was an amazing learning experience for me, and the process of it was not what I had planned at all. In fact, this was one of the first things I worked on for my thesis, and in doing so it changed aspects of what the overall plan was for the thesis. I created a survey for teachers, and then a separate survey for their students, hoping to compare the individual teachers to the responses of their class. However, with the complications of surveying students, both in the full days of teachers and the IRB policies on experiments involving students, I did not actually get any responses from classes. I did, however, receive information from teachers, and got a small amount of quantitative data pointing to what I had suspected, paired with teacher testimony confirming exactly what we had been discussing: teachers need to love the math they are teaching!

One teacher simply commented "I have recently heard a commercial, I believe for a bank that says "Middle School math is hard"! I could not believe it. I remember when a talking Barbie said this as well ["math class is hard"]. We certainly have to change the mindset of mathematics and that is not just calculations and computations, but problem-solving, solving puzzles, seeing relationships, etc…" Students are constantly hearing that what they are doing is hard or boring, rather than learning the exciting subject math can be.

Kayla Adair, a middle school math teacher, wrote: "I wish parents knew how much their own views of math were impacting their child's ability in mathematics."
Half of my daily efforts in teaching go into just simply convincing kids that IF they believe that their effort is going to pay off, that it just might. So many kids just don't believe that they're capable of learning math. I hear things from, "No one in my family is good at math!" to, "I suck at math" to, "why try?!"

Hearing these testimonies from teachers regarding the negative impacts students are getting on mathematics further motivated me in this task, the goal of mathematics education cannot be to just have students be able to solve a couple of problems that the teacher doesn't want to do either. Instead it must be to teach students to love the subject, building confidence and excitement for learning as they do.
Think back to the elementary school teachers you had growing up. Specifically, how did they approach teaching mathematics? Your teachers probably fall into one of two categories: the “Let’s struggle through this together…” teachers or the “Hooray it’s time for math!” teachers.

So how do these two approaches affect your students? First, we need to think about the impact that our own attitude has on our students. In their article, *Teacher and Teaching Effects on Students’ Attitudes and Behaviours* (Blazar and Kraf, 2017), Blazar and Kraf discussed this effect. In this study, the authors found that teachers' emotional support and organization are two of the largest factors in affecting student learning. Their study went on to describe how “teachers have large effects on self-reported measures of students’ self-efficacy in math, and happiness and behavior in class.” If a teacher approaches a situation with the closed mindset of math is hard so let's struggle, they will pass that mindset on to their students, which can cause a number of issues (Blazar & Kraft, 2017).

“In a study of elementary school students, researchers at the Stanford University School of Medicine found that having a positive attitude about math was connected to better function of the hippocampus, an important memory center in the brain, during performance of arithmetic problems” (Digitale, 2018).

This quote comes from an article in Stanford Medicine which referenced a study in which researchers looked into the correlation between attitude towards and ability in mathematics. It was found that a positive attitude towards mathematics can
have a large effect on a student’s mathematical capabilities. Simply put, students who like math do better. This raises the question: How can we help our students to like math?

Helping our students to love what they are learning is when we start to see our “Hooray it’s time for math!” teachers shine. These teachers demonstrate to students how exciting the math they are engaging with can be. A person’s relationship with mathematics can be heavily influenced by their elementary school teachers. If students see that a teacher avoids or dreads getting to the mathematics portion of the day, or starts all of their lessons with a let’s just get this over with attitude, those students will develop a mindset of mathematics as a difficult and aggravating subject. With what we know about how much our students’ attitudes can affect their mathematical capabilities, we want to ensure that we do not encourage any negative attitudes in our students.

Instead, we should be encouraging our students to love mathematics. We as teachers, need to demonstrate a positive approach to teaching and doing mathematics. This can be done in a number of ways. First, our language as teachers needs to shift. Simple things such as the tone of voice, and the language we use when preparing for our math lessons are essential. As teachers, we are actors, and so if you are reading this and thinking to yourself, “Yeah, but honestly I don’t really want to do the math either… do I actually have to like it?” The amazing answer is no! While I personally love teaching math, and think it is one of the best subjects out there, you don’t have to. Simply act as though you do. One of a teacher’s roles is as an actor projecting positivity in any situation to students. Students look to you to see
how they should be responding to situations, so if you seem happy, your kids will be happier to! In addition, your positive attitude may change your own feelings towards mathematics in the process. And, while perhaps not quite as life changing as instilling a passion for mathematics, happier students are simply more engaged, and easier to teach. So have fun with the math! Smile, look excited, laugh when you make a mistake, demonstrate that it’s OK to learn from your errors, and be excited to try again. Your positive attitude will help shift the attitude of the entire class.

I want to make sure it is clear that a positive attitude is not “Math is so easy! You should be having no problems getting this done!”, but instead, “These problems are such a fun challenge, let’s solve this puzzle to get the answer!” Our focus is not trying to get students to think they will never struggle with math. Instead, our focus is on helping students to develop a growth mindset towards mathematics. A growth mindset is simply the idea that when we get stuck, we continue trying, enjoying the challenge and taking joy in the progress we make (Dweck, 2008). With this, students should be encouraged to get stuck, encouraged to ask for help, and encouraged to make mistakes. When a student gets something wrong or tells you that they don’t know how to approach a problem, this is a perfect time to teach growth mindset in an organic way. Rather than simply crossing a problem out as wrong, or sighing and re-explaining yourself to the student, take this opportunity to get excited! When a student tells you they don’t know what they did wrong or don’t know how to start, smile! Tell them, “AWESOME! That means you have an opportunity to learn something!”. Take the situation of frustration and anger, and turn it into a fun
experience where students get to build their mathematics skills, while building the relationship with the teacher as someone they can come to for help.

This is not meaning that all math should be beyond a student’s capabilities, but rather that, as with literacy instruction, students should have a balance of building confidence with what they know, and having moments of struggle where they can grow their strengths. If we teach math only at the hardest level, and immediately move on once students have developed the skills, then students will always be viewing math as a struggle, and as something that they need to be in the right mindset for. If however, we instead give students opportunities to use the math they are good at in other settings, and encourage them to view problems as puzzles, we can truly help them to be successful.

Another benefit of teaching this amazing subject with a positive outlook, is the relationships that it helps you build with the students. As we have learned from trauma-informed teaching and studies, such as the famous Adverse Childhood Experiences study, one of the most significant influences a child can have is knowing that they have at least one caring adult in their lives (Felitti et. al, 1998). Taking this time of teaching mathematics, which is often a purely academic time in the school day, and turning it into a time when we can demonstrate positive attitudes and excitement, can have an extraordinarily powerful impact on our students. Especially when we are addressing their frustrations with math, or times when they get stuck, we should ensure we are being excited to help students solve the problem and learn some new skills as they do. If we approach their problems in math as things that are a bother to us, or things that we will sigh and get angry at as we help
them learn, that tells the students that we do not care about their problems. If instead, they come to us with a problem in math, and leave feeling happier and like they learned something, those students will feel more comfortable reaching out to us with other problems in their lives. Thus, approaching math as an exciting and loved subject, can help students learn to approach problems with a growth mindset, and to reach out to the teachers that care about them and are here to help when they reach problems they cannot solve alone.
Classroom Learning Structure

Now that we have established the benefits of teaching a love of math, we may now delve into the finer details of creating a classroom atmosphere to support this approach. Just as teachers need confidence in order to convey a positive attitude about mathematics, our students need to build confidence, along with a passion for the subject. It is important that students feel empowered to take control of their mathematics learning, building the confidence to do math on their own. Much of this control and empowerment, comes from the environment in which the mathematics is being taught. As such, the configuration of the room, the groups students are in, and the accessibility of manipulatives and other math tools, are all things which must be taken into consideration.

This project makes recommendations for a variety of settings to introduce mathematical concepts. These recommendations are meant as a starting point, and hope to inform creating situations in which students can most easily succeed. However, as with any aspect of education, adaptability is key. Often, a combination of all work configurations can benefit student learning, and as teachers we should be constantly evaluating what works best for us, and for our students. That being said, no matter how students are working, there are certain aspects needed to facilitate the positive learning environment that is essential to teaching a love of mathematics.
**Whole Class Carpet Time**

When working with the whole class there are a couple of things that need to be taken into account. First; how much of this lesson is simply a demonstration by the teacher, versus the amount of student work that will be taking place” If the lesson is primarily filled with teacher demonstration, then a close setting where the teacher can quickly scan to observe student responses is essential. For this setting, which we will refer to as *Whole Class Carpet Time*, it is important to gather all students in one spot of the room. Many teachers utilize a carpet or circle method for instruction, and there are specific things to remember when teaching mathematics in this form. Whenever students are working in this method, it is important that they are still interacting with the math. Even if the teacher is the one doing the writing for the problem, students should be contributing their ideas to each step. Using concepts like think-pair-share or Popsicle sticks to gather student input ensures that all students know not only should they be listening to what is happening, but they should also be actively engaging with the material, and with the teacher (Lyman, 1981). The *Whole Class Carpet Time* should be used only for a small number of problems, and should quickly transition into a more student-centered form of learning. Not only does such a transition follow the *Gradual Release* method, it also allows you the opportunity to demonstrate your own enjoyment of working with the concept, and then immediately encourage your students to get excited about trying “one on their own” (Pearson & Gallagher, 1983).
Whole Class Seatwork Time

The second form of whole class instruction is what we refer to as Whole Class Seatwork Time. This is an environment in which the teacher guides students through individual work on problems, often pages in a workbook, as students follow along in their seats, mirroring what the teacher is doing. The Whole Class Seatwork Time setting should be used very sparingly, and only if the teacher keeps in mind some key practices that need to be employed while leading this type of learning experience. With math, if you make a mistake at any stage of your work, it can compound into the rest of the problem. While this seems like a frustration, that one small error can mess up a larger problem, it actually means that students are getting the chance to continue to practice the suggested skills, even if they are doing so with one wrong number. Even after making a mistake, the process of working through the problem is still beneficial for students to be following. However, when working in the full classroom seatwork setting, students who make a mistake at one part of the problem, can be lost for the rest of this instructional time. They are either so busy trying to correct their work that they miss the next step, or are simply following along and not drawing the connections between the steps they are making. This can lead to the opposite of teaching a passion for math; informing students, in a way, that they messed up, they are behind, and they can't do math. We want to avoid such negative messaging infiltrating students' mindsets as much as possible. If one is using this setting, it is essential that the teacher is not simply teaching it from the front of the room. When working through these problems, someone needs to be circulating the room, giving quick help and encouragement to students in order to
keep them on track and making the connection needed. The full class seatwork time method therefore works extremely well with a qualified co-teacher or classroom aid, however if done with a single instructor in the room, the teacher must constantly move around the room as they work through each step.

Group Work

*Group Work* can be an amazing way to get students to work and learn collaboratively, and can be a natural next step when following the Gradual Release method. In order to maximize all students' participation in *Group Work*, it is best to limit groups to three or four students. When students are working in groups, it is important there are adequate spaces in your classroom for all groups to work comfortably, effectively and iteratively. This can be done using intentionally designed table set ups around the room, student groups carefully spread into the hallway, or by using other designated group work spaces external to the classroom. It is important to balance giving groups choice in where their group wants to work, with ensuring groups are in a setting that can be productive.

To group productivity, groups should be very intentionally created, either grouping students by mathematical ability, or by ability to work well together, but however it is done, it must be intentional. With random group assignments in an elementary school classroom, time can be lost on off-topic conversations, student disputes, and you can run into the issue of one student doing all the work while others simply watch or check out. Non-intentional group design can waste valuable time, and is often not conducive to a positive and productive learning environment.
Group Work should be used when having students attempt complicated problems that need higher level thinking, and tasks should be designed to encourage and generate discussions within the groups. In order to help students to succeed in the group work setting, and prevent students from simply giving each other answers, sentence frames are often needed to give elementary school students the language needed to discuss mathematics (Reyes, 2015). These sentence frames should not be problem specific, requiring that students recall new discussion points every time they work in groups, but should instead be general, allowing students to apply these ideas and structures to all math discussions. “I think our first step should be ____ because _____” or “The word ____ tells me that we need to use ____ to solve this problem” are both great frames for students to share their ideas. In addition, sentence frames such as “What did you do to reach ____?” and “Can you explain this piece of the problem to me?” should also be used to encourage students to rely on each other. The group work method is a great way to allow the teacher to observe not only student math capabilities, but also to observe how students talk about math with each other. Such observations can be used to identify if there is a need to change the narrative and focus on building confidence and positivity.
Partner Work

If you find that students are not all participating in group work in larger group work settings, Partner Work is a great way to encourage student engagement, while still providing the support of a peer. Partner Work should involve students paired up to help each other. When teaching each other, it has been shown that the student doing the teaching often learns the most (Ward, 1987). In order to ensure that math time is not a time when students can feel left out of the social aspects of a lesson, partners should be, at least in part, assigned. This can be done as simply as by having students make a hand partner with someone near them, or more intentionally by pairing students with partners who will benefit them. Whenever pairing students by level, it is important to not simply put the highest achieving students with the lowest achieving and alternate until you reach the middle. While academically this may give students the needed support to all get to the same point, it creates an environment where partners are clearly the “good at math” partner and the “bad at math” partner. Since, as we know, no one is “bad at math”, this is not something we want to encourage. Instead, grouping students with some gaps but not an extreme difference in immediate ability will ensure that students are still helping to encourage each other’s growth, both with aptitude and attitude.

Individual Work (Including Self-paced Work)

This is the final step in that Gradual Release method. Here is where students truly get to attempt the work on their own, and build the individual confidence to know they can succeed at math. Whenever working individually, students should
have clear directions on what is expected. Teaching a love of the process of doing math will help to teach students that fastest isn’t always best. Students should be encouraged to try their best and focus, but also to enjoy the work they are doing. Whenever students are working individually, the teacher should be moving around the room, giving positive reinforcement to students as they work, and helping to redirect with words of encouragement, students who are getting frustrated with the work. It is essential that in order to give all students the chance to work hard and build their skills, clear instructions are given on what they should do once they have accomplished the assigned task. The answer to “What do I do when I’m done?” is essential to building this positive view of math. It should always be additional math work, as telling students they can switch to something else when they have finished encourages students to “just get through it”. Mathematical challenge work such as Mountain Math or accessible challenge worksheets will always allow students to continue utilizing their time, without distracting their classmates. This is another time when a teacher could incorporate math stations, having students go to those designated stations once they have finished the assigned tasks. However, in doing this it is essential that the activities in the math stations are not distracting to the students still working, nor are they essential instruction that other students should not be missing.

**Math Stations**

Another way to engage students positively with mathematics is through the use of *Math Stations*. Programs such as the *Math Daily 3*, allow students to have opportunities to work with different aspects of the subject, and also give the teacher
opportunities to do more targeted group and individual work with students (Boushey, 2006). As students work at different Math Stations, the teacher can pull groups or individuals to work with, allowing them to tailor lessons to the individual students who need them. While there are no specific mathematical concepts for Math Stations, they are a great way to introduce confidence and independence in your classroom, and can be a great tool to support your instruction.
Manipulatives

With all of the classroom layouts described in the previous chapter, the goals should be to encourage confidence and a love of mathematics. With this in mind, how students access manipulatives and math tools can play an important role. If manipulatives and tools are handed out by the teacher, it tells students that they don’t know what they need, they can’t be trusted to manage their own supplies, and they are not as responsible for the materials. This also takes valuable time handing out materials, time the students could be using to learn, and the teacher could be using to observe students or work with them. Instead, there should be a clear focus on independent access to manipulatives, once each manipulative has been explicitly introduced, along with how to store and use it.

Independent Access

All math manipulatives and tools should be accessible to students at all times. Allowing students the power and responsibility to manage classroom manipulatives and tools tells them they are trusted to know what they need, and tells them to treat their supplies with respect. This also encourages students to use their resources for math whenever they feel the need.

This does not mean that all manipulatives and math tools (such as scissors) are sitting out for students to use however they want right from the beginning. Instead, manipulatives should be introduced as needed, discussing the difference between toys and tools, and putting each manipulative out only after students know
how to use it, and the expectations of their use of it. Overall, the accessibility to manipulatives and tools, and all of the classroom layouts that are utilized in the mathematics classroom work towards the same goal: Giving students confidence in a positive learning environment, and creating a generation of learners who love the time they get to spend interacting with the wonderful subject of math, and who know how to apply it as a helpful tool in their future endeavors.

**Setting Up Manipulatives and Math Tools**

Manipulatives and math tools should always be labeled, in order to increase students' familiarity with the math language you would like them to use. How you group manipulatives is extremely important for what kind of work you want students to be doing with them. Manipulatives and tools that students either only need one of, or need a varying amount of, such as rulers, scissors, or counters and beans, can be all together in one container, as students will need to get however many they need, when they need them. For manipulatives such as counters, there should always be smaller containers near the bin that students can fill with whatever they need to help them carry them across the classroom. Reusing individual applesauce or yogurt containers works great here! Manipulatives and tools that students typically need specific amounts of, or an assortment of, such as play money or base ten pieces, should be in bags with the amount one student would need, and those bags should be further grouped by the number of kids in a table group. That way if all students will need the same manipulatives, one student can easily get sets for everyone.
Overall, how you sort your manipulatives will vary, however they should be intentionally sorted to maximize student use.

In keeping with the theme of maximizing student use, manipulatives and math tools should be stored in a location accessible to all students. They should not be behind the teacher desk or in a cabinet with closed doors, as those would both discourage students from accessing them. Instead, math manipulatives should be proudly displayed on shelves in one specific part of the room. There should be a clear location students know to go to where they can find all materials they would need. However, while all math manipulatives should be out where students can access them, how to use each manipulative should be explicitly taught before students have access to it. One great way to balance these is by putting out all manipulatives on shelves at the beginning of the year, and then putting caution tape or “learning soon” signs over the manipulatives you haven’t taught. This not only prevents students from misusing tools they have not yet learned, it also creates an air of excitement surrounding the upcoming manipulatives.

**Manipulatives and Classroom Norms**

Keeping in mind wanting students to be independent in their access to manipulatives, how we treat our manipulatives is something that must be explicitly taught. Before any math manipulatives are used in your classroom, one of the first lessons that should be taught is “toys vs. tools”. This can be done in a number of ways, from simple sorting activities to full class discussions, but needs the clear distinction that students are expected to use tools as tools, and if they are unable to
do that they will not be allowed to manage their own manipulatives anymore. Note that the language of taking away math manipulatives should be avoided, as we want to encourage students to use these, and the language of losing the ability to choose when they use them or to use them without asking should be used instead. How we use manipulatives and math tools should be taught as a general subject, and then each tool should be taught individually before students have access to each material.

**A note on manipulatives during COVID-19**

During a time when we are being told that students should not be sharing any materials, it is important to still give students access to math manipulatives. In this case, each student should have a specific container of math manipulatives in their work space, and those manipulatives should be treated in the same way as they would if they were in the whole class, with students being expected to treat them well, and decide when they will use them. If you are finding you don’t currently have enough manipulatives to give each student a full set, find a pdf of them and print them on cardstock if you can. It is much preferable to give students paper manipulatives or to find other materials to use as manipulatives than to not give students the access to these crucial learning tools.
Chapter 6 gives a series of teacher notes and introductory examples that embrace the philosophy and pedagogy of Teaching Loving Math. These chapters focus on building teacher confidence and joy with regard to each individual subject, and setting teachers up to successfully help their students build their math skills in a positive environment. This chapter describes the purpose of each of the following chapters.

Section 1 - Teacher Notes

CCSSM

This section will reference which of the content standards from the Common Core State Standards for Mathematics is most relevant to the topic.

Example problem

This will give an example problem for the topic. A step-by-step discussion will be included.

Key ideas

These are key ideas that you should keep in mind while teaching this lesson. Review this section briefly before teaching to be confident in your ability to speak to the topic.

Classroom setup

This section will reference the chapter on Classroom Learning Structures and which classroom setup is best for the lesson.
Manipulatives and Math Tools

This section will describe the manipulatives and other math tools needed for the lesson.

Common errors

This section focuses on common errors you should look for in student work, and how to address these as you see them.

Potential joke

The best section by far. Each subject has a recommended joke, but you can also add any of your own that you would like! Weave these jokes into your lesson to show how much fun math can be!

Section 2 - Introductory Example

This section will walk you through an example problem to demonstrate to the students. It has a box which shows what you should be putting on your board at each step, as well as notes for you and even some directly scripted pieces as you work through the problem with your students. Every one of these sections ends with the same last step: “Smile at your students! Ask them if they want to try one on their own now.” This final step is essential, as it embraces the positive attitude all teachers should possess, and encourages the transition to positive mathematical independence in students.
Step-by-step

- After the introductory set up notes, step-by-step instructions that reference the example problem will be included to walk you through, step-by-step how to explore an example problem with your students.

- Notes inside the boxes is what you write on the board or under the document camera.

- Notes written outside the boxes are notes for you, the teacher.
Word Problems with Addition - Teacher Notes

CCSSM
1.OA.A.1
Use addition and subtraction within 20 to solve word problems involving situations of adding to, taking from, putting together, taking apart, and comparing, with unknowns in all positions, e.g., by using objects, drawings, and equations with a symbol for the unknown number to represent the problem.

Example problem
Sam has 5 blue marbles, their mom gives them 3 red marbles, how many marbles does Sam have in all?

Key ideas
- Make sure to point out the language “in all”
- Organizing the marble pictures in the shape of a 10-frame will help students make connections in the future
- Have number lines available to all students

Classroom setup
- Individual Work
- Group Work or Partner Work can be used to support emerging readers

Manipulatives and Math Tools
- Number line handout marked with 0 to 20
- Ten Frame sheets
- Counters (20 per student)

Common errors
- Students counting the last numeral of the first addend twice, i.e. 1,2,3,4,5 - 5,6,7
  Fix: Give this student physical manipulatives, and help them count them out all together
- Students counting starting back at 1, instead of counting on from the first number, i.e. 1,2,3,4,5 plus 1,2,3 equals 3
  Fix: Help these students by counting everything as one large group out loud for them.

Potential Joke
Q: How do cows add?
A: With cow-ulators.
**Word Problems with Addition - Introductory Example**

1. Show the question, and read the question out loud, underlining or circling the numbers and the key words (in all) as you read.

   Sam has 5 blue marbles, their mom gives them 3 red marbles, how many marbles does Sam have in all?

2. Write blank plus blank equals, pointing out the (in all) tells you this is an addition problem.

   Sam has 5 blue marbles, their mom gives them 3 red marbles, how many marbles does Sam have in all?

   __ + __ = __

3. Draw the first five marbles, emphasizing where you got “5” from.

   Sam has 5 blue marbles, their mom gives them 3 red marbles, how many marbles does Sam have in all?

   __ + __ = __

4. Draw the additional 3 marbles using a different color, emphasizing where you got “3” from.

   Sam has 5 blue marbles, their mom gives them 3 red marbles, how many marbles does Sam have in all?

   __ + __ = __

5. Add the underlined numbers into your equation. [Say Sam has 5 blue marbles and 3 red marbles]

   Sam has 5 blue marbles, their mom gives them 3 red marbles, how many marbles does Sam have in all?

   5 + 3 = _
6. Count and mark the first number in the picture (or draw the first number in the picture) [say: 1,2,3,4,5]

Sam has 5 blue marbles, their mom gives them 3 red marbles, how many marbles does Sam have in all?

\[5 + 3 = \_\]

7. Count the second number, continuing on from the first. [say: 6,7,8]

Sam has 5 blue marbles, their mom gives them 3 red marbles, how many marbles does Sam have in all?

\[5 + 3 = \_\]

8. Write the number you reach in the final blank. [say *Five plus three equals eight*]

Sam has 5 blue marbles, their mom gives them 3 red marbles, how many marbles does Sam have in all?

\[5 + 3 = 8\]

9. Write a sentence with the answer and units [say: 8 what?] call on a student to answer the question “8 what?” marbles, make sure to mention in all, coming from the problem.

Sam has 5 blue marbles, their mom gives them 3 red marbles, how many marbles does Sam have in all?

\[5 + 3 = 8\]

Sam has 8 marbles in all.

10. Smile at your students! Ask them if they want to try one on their own now.
Word Problems with Subtraction - Teacher Notes

CCSSM
1.OA.A.1
Use addition and subtraction within 20 to solve word problems involving situations of adding to, taking from, putting together, taking apart, and comparing, with unknowns in all positions, e.g., by using objects, drawings, and equations with a symbol for the unknown number to represent the problem.

Example problem
Sam has 12 cookies and eats 3 of them. How many cookies does Sam have left?

Key ideas
- Show that cookie pictures can just be simple circles, they don’t have to draw out full pictures as is shown below
- Organizing the cookie pictures in the shape of a 10-frame will help students make connections in the future

Classroom setup
- Individual Work
- Group Work or Partner Work can be used to support emerging readers

Manipulatives and Math Tools
- Number line handout marked with 0 to 20
- Ten Frame sheets
- Counters (20 per student)

Common errors
- Students not taking away the final piece, i.e. 12, 11, 10 - there are 10 cookies left!
  Fix: teach this student to count what is left over after taking away the right number. This can be done by counting what is not crossed out, or if the student is still confused, having them use manipulatives to see the part left over.
- Student answers being off by 1 or 2, above or below, with no consistency, i.e. not knowing their addition and subtraction facts within 20.
  Fix: Give this student a number line, they may be having issues keeping the numbers straight with their fingers or in their head.
- Student giving the amount subtracted as the answer, i.e. “12 - 3 = 1, 2, 3, so 3!”
  Fix: This student is missing which part of the problem to look for the answer in. Help this student understand by using multiple people in the example. “If you had twelve cookies and I took three away, how many cookies would you have left?”

Potential joke
Q: Sam had 60 cookies, they ate 30 of them. What does Sam have now?
A: A tummy-ache!
Word Problems with Subtraction - *Introductory Example*

1. Show the question, and read the question out loud, underlining or circling the numbers and the key words (left) as you read.

Sam has **12** cookies and eats **3** of them. How many cookies does Sam have **left**?

2. Write blank minus blank equals blank, pointing out the word “left” tells you this is a subtraction problem.

Sam has **12** cookies and eats **3** of them. How many cookies does Sam have **left**?

___ - ___ = ___

3. Draw all 12 cookies, emphasizing where you got “12” from. *You can just draw circles, pointing out to students that math drawings don’t need to be detailed.*

Sam has **12** cookies and eats **3** of them. How many cookies does Sam have **left**?

___ - ___ = ___
4. Add the 12 into your equation blanks, showing since 12 is the whole, you will be taking the part from 12.
   [Say this 12 goes at the start of our number sentence]

   Sam has 12 cookies and eats 3 of them. How many cookies does Sam have left?

   \[
   12 - \_ = \_ 
   \]

5. Cross out three of the cookies
   [Say Sam eats three of the cookies: 1,2,3]

   Sam has 12 cookies and eats 3 of them. How many cookies does Sam have left?

   \[
   12 - \_ = \_ 
   \]
6. Add the 3 into your equation, showing that is the part you are taking from the whole. 
[Say *this three is what is taken away from our 12 cookies*]

<table>
<thead>
<tr>
<th>Sam has <strong>12</strong> cookies and eats <strong>3</strong> of them. How many cookies does Sam have left?</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="Image" alt="Cookies Diagram" /></td>
</tr>
<tr>
<td>12 - 3 = ___</td>
</tr>
</tbody>
</table>

7. Count and mark the remaining cookies.
[say: *Now we count how many Sam has left: 1,2,3,4,5,6,7,8,9*]

<table>
<thead>
<tr>
<th>Sam has <strong>12</strong> cookies and eats <strong>3</strong> of them. How many cookies does Sam have left?</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="Image" alt="Cookies Diagram" /></td>
</tr>
<tr>
<td>12 - 3 = ___</td>
</tr>
</tbody>
</table>
8. Write the amount of cookies left (9) after the equals sign 
[say *12 take away 3 equals 9*]

Sam has 12 cookies and eats 3 of them. How many cookies does Sam have left?

\[12 - 3 = 9\]

9. Write a sentence with the answer and units [say: 9 what?] call on a student to answer the question “9 what?” - Cookies] make sure to mention the word “left” coming from the problem

Sam has 12 cookies and eats 3 of them. How many cookies does Sam have left?

\[12 - 3 = 9\]

Sam has 9 cookies left.

10. Smile at your students! Ask them if they want to try one on their own now.
Missing Addend - Teacher Notes

CCSSM
1.OA.B.4
Understand subtraction as an unknown-addend problem. For example, subtract 10 - 8 by finding the number that makes 10 when added to 8.

Example problem
7 + ___ = 11

Key ideas
● Fact families or number bonds can really help with these problems. They are used to number bonds for addition and subtraction so they help with the missing addend portion.

Classroom setup
● Whole Class Seatwork Time is great for the first few problems
● Individual Work as students start to grasp the concept

Manipulatives and Math Tools
● Number Bonds or Fact Family Triangles handout
● Counters (20 per student)
● Number line handout marked with 0 to 20

Common errors
● Students adding the first part to the whole, i.e.
  7 + 11 = 18
  Fix: Help this student by giving them the structure of a number bond, and showing that the part after the equals sign goes in the middle. Additionally, working with fact families can help too.

Potential joke
Q: What do you need to add to 0 to get 8?
A: A belt!
Missing Addend - *Introductory Example*

1. Show the equation. Talk about the missing part
   [Say *11 is the whole, 7 is one of the parts, what part is missing?*]

   \[
   \begin{array}{c}
   \text{7 + __ = 11} \\
   \end{array}
   \]

2. Draw out the number 7
   [Say: *Our first part is 7 - 1, 2, 3, 4, 5, 6, 7 as you write*]

   \[
   \begin{array}{c}
   \text{7 + __ = 11} \\
   \begin{array}{c}
   \text{●●●●●} \\
   \text{●●} \\
   \end{array}
   \end{array}
   \]

3. Draw the rest of the pieces needed to count up to 11 (try using circles instead of dots, or two different colors
   [Say *8, 9, 10, 11*]

   \[
   \begin{array}{c}
   \text{7 + __ = 11} \\
   \begin{array}{c}
   \text{●●●●●} \\
   \text{●●} \\
   \text{〇〇〇} \\
   \text{〇} \\
   \end{array}
   \end{array}
   \]

4. Count the part you added, or the “missing part”
   [Say *1, 2, 3, 4 - the missing part is 4*]

   \[
   \begin{array}{c}
   \text{7 + __ = 11} \\
   \begin{array}{c}
   \text{●●●●●} \\
   \text{●●} \\
   \text{〇〇〇} \\
   \text{〇} \\
   \text{〇} \\
   \end{array}
   \end{array}
   \]
5. Write the 4 in your equation. Read the equation:
   [Say 7 plus 4 equals 11, the missing part is 4]

\[
\begin{align*}
7 + 4 &= 11 \\
\text{\scalebox{0.7}{\begin{tikzpicture}[scale=0.5]
    \draw[fill=black] (0,0) circle (0.5cm);
    \draw[fill=black] (1,0) circle (0.5cm);
    \draw[fill=black] (2,0) circle (0.5cm);
    \draw[fill=black] (3,0) circle (0.5cm);
    \draw[fill=black] (4,0) circle (0.5cm);
    \draw[fill=black] (5,0) circle (0.5cm);
    \draw[fill=white] (6,0) circle (0.5cm);
    \draw[fill=white] (7,0) circle (0.5cm);
    \draw[fill=white] (8,0) circle (0.5cm);
    \draw[fill=white] (9,0) circle (0.5cm);
    \end{tikzpicture}}}
\end{align*}
\]

6. Next use a number bond to show students the relationship between missing addends and subtraction.
   [Say Now we need to check our work, we are going to check by putting our numbers in a number bond]

\[
\begin{align*}
7 + 4 &= 11 \\
\text{\scalebox{0.7}{\begin{tikzpicture}[scale=0.5]
    \draw[fill=black] (0,0) circle (0.5cm);
    \draw[fill=black] (1,0) circle (0.5cm);
    \draw[fill=black] (2,0) circle (0.5cm);
    \draw[fill=black] (3,0) circle (0.5cm);
    \draw[fill=black] (4,0) circle (0.5cm);
    \draw[fill=black] (5,0) circle (0.5cm);
    \end{tikzpicture}}}
\end{align*}
\]

7. Add the original part and whole into the number bond
   [Say We know our first part is 7, and our whole is 11]

\[
\begin{align*}
7 + 4 &= 11 \\
\text{\scalebox{0.7}{\begin{tikzpicture}[scale=0.5]
    \draw[fill=black] (0,0) circle (0.5cm);
    \draw[fill=black] (1,0) circle (0.5cm);
    \draw[fill=black] (2,0) circle (0.5cm);
    \draw[fill=black] (3,0) circle (0.5cm);
    \draw[fill=black] (4,0) circle (0.5cm);
    \draw[fill=black] (5,0) circle (0.5cm);
    \end{tikzpicture}}}
\end{align*}
\]
8. Complete the number bond, show the subtraction problem that would go with the number bond
[Say 11 minus 7 equals what]

\[ 7 + 4 = 11 \]

9. Put the 4 in the number bond and the subtraction problem
[Say 11 minus 7 equals 4. We have done our work a second way, and shown that the two parts make a whole with addition and subtraction. Isn’t this a fun number family?]

\[ 7 + 4 = 11 \]

10. Smile at your students! Ask them if they want to try one on their own now.
Comparing Two-Digit Numbers - *Teacher Notes*

CCSSM 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 <.

Example problem
Use the symbols <, >, or = to show the relationship between each pair of numbers.

\[
15 \_ 32 \quad 65 \_ 56 \quad 74 \_ 75
\]

Key ideas
● Students will not be able to do this until they understand place value. Specifically, students will need to understand that when comparing numbers they first look at the 10s place, and then at the ones.
● Talk about how with problems like the first one even though 5 is more than 2 in the ones place, since the 3 represents thirty that is still the greater number
● “The alligator eats the greater number”

Classroom setup
● Whole Class Seatwork Time for instruction and first few problems
● Individual Work once students start to grasp the concept

Manipulatives and Math Tools
● Base ten pieces
● Base ten chart handout
● Counters (As needed by students, only with smaller numbers)
● Number line handout marked with 0 to 100

Common errors
● Students not understanding which side the symbol opens to.
  Fix: Use alligator teeth, or pacman, to show “eating” the greater number.

● Students looking at the ones place before the tens place, i.e.
  *Student thinking 17 > 24 because 7 is greater than 4*
  Fix: Have this student use base ten pieces for both number so that they understand that more tens is always the greater number

Potential joke
Q: Why did the camper find their sleeping bag so quickly?
A: Because they knew to look in the ten(t)es first!
Comparing Two-Digit Numbers - *Introductory Example*

1. Show the question, and read the instructions out loud

| Use the symbols <, >, or = to show the relationship between each pair of numbers. |
|-----------------|-----------------|-----------------|
| 15 _ 32         | 65 _ 56         | 74 _ 75         |

2. Explain to students which symbol is greater than and which symbol is less than

[Say *The symbol opens up to the greater number*]

Note: Some teachers choose to make the symbol an alligator mouth or pacman

| Use the symbols <, >, or = to show the relationship between each pair of numbers. |
|-----------------|-----------------|-----------------|
| 15 _ 32         | 65 _ 56         | 74 _ 75         |

3. Do the first problem with the students. Ask students which number is greater, and

have them answer. After they answer, whether or not they get that 32 is greater,

explain that 32 is greater because it has more 10s than 15. Draw the symbol.

Say: *Which number is greater, 15 or 32? [student answers] That's right! We know that 32 is greater because it has more tens. 32 has 3 tens and 15 only has 1. After writing the symbol say “15 is less than 32”*

| Use the symbols <, >, or = to show the relationship between each pair of numbers. |
|-----------------|-----------------|-----------------|
| 15 < 32         | 65 _ 56         | 74 _ 75         |
4. Now do the second problem with the students. Ask students which number is greater, and have them answer. Explain that 65 is greater because it has more 10s than 56. Draw the symbol.

[Say: *This problem is a little harder because the numbers are very close, remember to first look at which has more tens. Which number is greater, 65 or 56?* [student answers] We know that 65 is greater because it has more tens. 65 has 6 tens and 56 only has 5.]

After writing the symbol say "65 is greater than 56"

| Use the symbols <, >, or = to show the relationship between each pair of numbers. |
|---|---|---|
| 15 < 32 | 65 > 56 | 74 _ 75 |

5. Finally, do the third pair with the students. Ask students which number is greater, and have them answer. Explain that since they both have 7 tens, 75 is greater because 75 has more ones than 74. Draw the symbol.

Say: *For this problem both numbers have the same amount of tens, what should we look at next?* [Student answers ones, or tell them the ones column] *So in that case which number is greater, 75 or 74?* [student answers] We know that 75 is greater because they have the same amount of tens, and it has more ones.

After writing the symbol say "74 is less than 75"

| Use the symbols <, >, or = to show the relationship between each pair of numbers. |
|---|---|---|
| 15 < 32 | 65 > 56 | 74 < 75 |

6. Smile at your students! Ask them if they want to try one on their own now.
Word Problems with Three Numbers - Teacher Notes

CCSSM
1.OA.A.2
Solve word problems that call for addition of three whole numbers whose sum is less than or equal to 20, e.g., by using objects, drawings, and equations with a symbol for the unknown number to represent the problem.

Example problem
Sam has 5 blue marbles, 3 red marbles, and 7 green marbles. How many marbles does Sam have in all?

Key ideas
● Show a picture of the addition
● Use the format of 10 frames to help students start to make tens in their head

Classroom setup
● Individual Work
● Group Work or Partner Work can be used to support emerging readers

Manipulatives and Math Tools
● Number line handout marked with 0 to 20
● Counters (20 per student)

Common errors
● Students adding only the last two numbers, i.e.
  \[ 5 + 3 + 7 = 10 \]
  Fix: Give this student manipulatives, having them physically add all three groups will help them see where all of the number come from

Potential joke
Q: Why was the wizard so bad at math?
A: He never knew WITCH number to add first!
Word Problems with Three Numbers - Introductory Example

1. Show the question, and read the question out loud, underlining or circling the numbers and the key words (in all) as you read

   Sam has 5 blue marbles, 3 red marbles, and 7 green marbles. How many marbles does Sam have in all?

2. Write blank plus blank plus blank equals, pointing out the (in all) tells you this is an addition problem

   Sam has 5 blue marbles, 3 red marbles, and 7 green marbles. How many marbles does Sam have in all?
   __ + __ + __ = __

3. Draw the 5 blue marbles, emphasizing where you got “5” from. Write the 5 in your equation

   Sam has 5 blue marbles, 3 red marbles, and 7 green marbles. How many marbles does Sam have in all?
   
   5 + __ + __ = __

4. Draw the 3 red marbles, emphasizing where you got “3” from. Write the 3 in your equation

   Sam has 5 blue marbles, 3 red marbles, and 7 green marbles. How many marbles does Sam have in all?

   5 + 3 + __ = __
5. Draw the 7 green marbles, emphasizing where you got “7” from. Write the 7 in your equation

[Say Sam has 5 blue marbles and 3 red marbles]

Sam has **5** blue marbles, **3** red marbles, and **7** green marbles. How many marbles does Sam have **in all**?

Sam has **5** blue marbles, **3** red marbles, and **7** green marbles. How many marbles does Sam have **in all**?

\[ 5 + 3 + 7 = \_ \]

6. Count and mark blue and red marbles. Showing students that they know how to do this first part already

[say: 1,2,3,4,5,6,7,8  5 plus 3 equals 8, now let’s add our 7 green marbles!]

Sam has **5** blue marbles, **3** red marbles, and **7** green marbles. How many marbles does Sam have **in all**?

Sam has **5** blue marbles, **3** red marbles, and **7** green marbles. How many marbles does Sam have **in all**?

\[ 5 + 3 + 7 = \_ \]

7. Count the green marbles, continuing on from the first 8

[say: 8,9,10,11,12,13,14,15  8 plus 7 equals 15.]

Sam has **5** blue marbles, **3** red marbles, and **7** green marbles. How many marbles does Sam have **in all**?

Sam has **5** blue marbles, **3** red marbles, and **7** green marbles. How many marbles does Sam have **in all**?

\[ 5 + 3 + 7 = \_ \]
8. Write the 15 in the final blank, make sure to point out the “in all”
[say 5 plus 3 plus 7 equals 15. So Sam has 15 in all]

Sam has 5 blue marbles, 3 red marbles, and 7 green marbles. How many marbles does Sam have in all?

5 + 3 + 7 = 15

9. Write a sentence with the answer and units
[say: 15 what?] call on a student to answer the question “15 what?” marbles]

Sam has 5 blue marbles, 3 red marbles, and 7 green marbles. How many marbles does Sam have in all?

5 + 3 + 7 = 15

Sam has 15 marbles in all.

10. Smile at your students! Ask them if they want to try one on their own now.
Making 10s - Teacher Notes

CCSSM

1.OA.C.6
Add and subtract within 20, demonstrating fluency for addition and subtraction within 10. Use strategies such as counting on; making ten (e.g., 8 + 6 = 8 + 2 + 4 = 10 + 4 = 14); decomposing a number leading to a ten (e.g., 13 - 4 = 13 - 3 - 1 = 10 - 1 = 9); using the relationship between addition and subtraction (e.g., knowing that 8 + 4 = 12, one knows 12 - 8 = 4); and creating equivalent but easier or known sums (e.g., adding 6 + 7 by creating the known equivalent 6 + 6 + 1 = 12 + 1 = 13).

Example problem
8 + 6 = __

Key ideas
- Making 10s will help students to do mental math, so this is a concept to really spend some time on.
- The number partners that make 10s (i.e., 1+9, 2+8, 3+7….) should be shown as an anchor chart with visual representations, to show how these groups would look in your problem.

Classroom setup
- Whole Class Seatwork Time for instruction and first few problems
- Partner Work once students start to grasp the concept. Partner students who get it with students who need additional assistance.
- Individual Work once each student grasps the concept

Manipulatives and Math Tools
- Anchor chart on number partners that make 10s (or smaller handout)
- Counters (only 10 at first)

Common errors
- Students picking the wrong numbers to make tens, i.e.
  8+6 is 8+3+3, so 13
  Fix: this student needs help learning their 10 pairs. Give this student 10 counters, and show them how to use them to find out what the missing piece needed is, (see missing addend chapter) or help the student with some memorization techniques

Potential joke
Q: What are 10 things you can always count on?
A: Your fingers!
Making 10s - *Introductory Example*

1. Show the question, and read the question out loud

   \[ 8 + 6 = \_ \]

2. Draw two ten frames, explaining to students that this will help you see how the numbers break up

   \[ 8 + 6 = \_ \]

   ![Ten Frame](image1)

3. Draw the first number in the ten frame, point out that with 8 sections filled in, you still need two more to fill that ten frame

   \[ 8 + 6 = \_ \]

   ![Ten Frame with Circles](image2)
4. Draw the second number in the ten frame, counting out loud and emphasizing the first two
   [Say: \textbf{1,2,3,4,5,6}]

\[
\begin{array}{c}
8 + 6 = \_ \\
\begin{array}{c}
\text{\includegraphics[width=2in]{ TEN_FRAME_10.png}}
\end{array}
\end{array}
\]

5. Count the pieces you have, and write the answer in the problem. Count the full ten-frame all together, and then add in the final four
   [Say: \textbf{10,11,12,13,14} \textbf{8+6=14}]

\[
\begin{array}{c}
8 + 6 = 14 \\
\begin{array}{c}
\text{\includegraphics[width=2in]{ TEN_FRAME_10.png}}
\end{array}
\end{array}
\]
6. Now, show how we break down the ten frame into 8+2, and rewrite the second one as 4
   [Say: This ten is really showing us two parts, 8+2=10, 10 plus 1,2,3,4 equals 14]

7. Smile at your students! Ask them if they want to try one on their own now.
Understanding Equals - *Teacher Notes*

**CCSSM**

1.OA.D.7
Understand the meaning of the equal sign, and determine if equations involving addition and subtraction are true or false.
For example, which of the following equations are true and which are false?
6 = 6, 7 = 8 - 1, 5 + 2 = 2 + 5, 4 + 1 = 5 + 2.

**Example problem**
Are the following equations true or false?

| 6 = 6 | 7 = 8 - 3 | 10 - 1 = 4 + 5 |

_______ | _______ | _______

**Key ideas**
- Teaching students that equals means the two sides are balanced or the same is essential. Students understanding what equal means will help them understand both the commutative and the associative properties in mathematics.

**Classroom setup**
- Whole Class Carpet Time for instruction
- Individual Work

**Manipulatives and Math Tools**
- Counters (20 per student)
- Balance (Scale)

**Common errors**
- Students only looking at the numbers closest to the equals sign, i.e. 10 + 9 = 9 - 1 is true because nine is equal to nine!
  Fix: Show this student the equations on either side of a balance, so that the student can visualize that each equation is a full unit.

**Potential joke**
Q: Why did the number monsters weigh their meals?
A: They wanted to make sure they were both getting equal amounts.
Understanding Equals - *Introductory Example*

1. Show the equations, explain that when there is an equals sign it means that the two sides of the equation are the same.

<table>
<thead>
<tr>
<th>Equation</th>
<th>True/False</th>
</tr>
</thead>
<tbody>
<tr>
<td>$6 = 6$</td>
<td>True</td>
</tr>
<tr>
<td>$7 = 8 - 3$</td>
<td>False</td>
</tr>
<tr>
<td>$10 - 1 = 4 + 5$</td>
<td>True</td>
</tr>
</tbody>
</table>

2. Point out that we know $6$ is the same as $6$, so we can label that one true.

<table>
<thead>
<tr>
<th>Equation</th>
<th>True/False</th>
</tr>
</thead>
<tbody>
<tr>
<td>$6 = 6$</td>
<td>True</td>
</tr>
<tr>
<td>$7 = 8 - 3$</td>
<td>False</td>
</tr>
<tr>
<td>$10 - 1 = 4 + 5$</td>
<td>True</td>
</tr>
</tbody>
</table>

3. For the second equation, draw out the $7$ and the $8 - 3$.

<table>
<thead>
<tr>
<th>Equation</th>
<th>True/False</th>
</tr>
</thead>
<tbody>
<tr>
<td>$6 = 6$</td>
<td>True</td>
</tr>
<tr>
<td>$7 = 8 - 3$</td>
<td>False</td>
</tr>
<tr>
<td>$10 - 1 = 4 + 5$</td>
<td>True</td>
</tr>
</tbody>
</table>
4. Count both sides of the equation, and mark that they do not equal each other, which means the equation must be false. Label the equation false.

Are the following equations true or false?

<table>
<thead>
<tr>
<th>Equation</th>
<th>True</th>
<th>False</th>
</tr>
</thead>
<tbody>
<tr>
<td>$6 = 6$</td>
<td></td>
<td></td>
</tr>
<tr>
<td>$7 = 8 - 3$</td>
<td></td>
<td>True</td>
</tr>
<tr>
<td>$10 - 1 = 4 + 5$</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

5. Now draw out the third problem. Show both sides of the equation done out.

Are the following equations true or false?

<table>
<thead>
<tr>
<th>Equation</th>
<th>True</th>
<th>False</th>
</tr>
</thead>
<tbody>
<tr>
<td>$6 = 6$</td>
<td></td>
<td></td>
</tr>
<tr>
<td>$7 = 8 - 3$</td>
<td></td>
<td>True</td>
</tr>
<tr>
<td>$10 - 1 = 4 + 5$</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
6. Count both sides of the equation. Show that they both equal 9 so it must be true!

<p>| | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>True</strong></td>
<td><strong>False</strong></td>
<td><strong>True</strong></td>
</tr>
<tr>
<td>6 = 6</td>
<td>7 = 8 - 3</td>
<td>10 - 1 = 4 + 5</td>
</tr>
</tbody>
</table>

7. Smile at your students! Ask them if they want to try one on their own now.
Understanding Place Value (Tens) - Teacher Notes

CCSSM
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:

1.NBT.B.2.A
10 can be thought of as a bundle of ten ones — called a "ten."

1.NBT.B.2.C
The 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).

Example problem
How many tens are in the number 34?

Key ideas
- Place value charts can help students to organize the numbers. Especially at this younger age, keeping numbers and manipulatives straight can be confusing. Giving a place value chart to your students will help them to keep things organized.
- USE MANIPULATIVES! Giving students access to manipulatives will help to make this very conceptual topic concrete. Consider using bundles and sticks or base ten pieces.

Classroom setup
- Whole Class Carpet Time for example problem
- Partner or Group Work for the main lesson

Manipulatives and Math Tools
- Base ten pieces
- Base ten chart handout

Common errors
- Students making groups of 9 or 11 and calling it a ten, i.e.
  - 34 take away 10 is 23 OR with manipulatives counting one piece twice
Fix: Give this student physical manipulatives and a large place value chart. Directly teach skills in organizing their manipulatives to ensure each piece is only counted once

Potential joke
Q: Why did the ones only hang out in groups of 9?
A: They were afraid they would turn into a ten!
Understanding Place Value (Tens) - *Introductory Example*

1. Show the question, and read the question out loud

   How many tens are in the number 34?

2. Get out base 10 blocks. Count out 34 unit blocks onto a piece of paper, use these to show why we need to group them, as 34 units are hard to manage. Say: 1, 2, 3, ..., 32, 33, 34 - Here are 34 units. It isn't clear just by looking at them how many we have, we can make groups of ten to make that more clear.

   How many tens are in the number 34?
3. Count out ten ones and circle them on the paper three times, showing the three groups of ten. 
   Say: 1,2,3,4,5,6,7,8,9,10 there's one group of ten - 1,2,3...10 there's two groups of ten 1,2,3,...,10 there's three groups of ten! And 1,2,3,4 ones left over.

How many tens are in the number 34?

4. Exchange the first group of ten for a “long” explain to the students why ten ones equal one ten.
   Say: if we count this long, we see 1,2,3,4,5,6,7,8,9,10. This long is the same as ten ones, so we will call it a ten. Let's exchange each group of ten ones for one ten.

How many tens are in the number 34?
5. Put all of your pieces in a place value chart, pointing out how longs go in the tens place, and units go in the ones place.

**How many tens are in the number 34?**

<table>
<thead>
<tr>
<th>Tens</th>
<th>Ones</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image1.png" alt="Tens" /></td>
<td><img src="image2.png" alt="Ones" /></td>
</tr>
</tbody>
</table>

6. Count how many tens you have and how many ones you have and write it at the bottom of the chart.

Say: *1,2,3 tens are worth 10,20,30 - 1,2,3,4 ones are worth 4. Together we see our number 34 has three tens and four ones.*

**How many tens are in the number 34?**

<table>
<thead>
<tr>
<th>Tens</th>
<th>Ones</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image3.png" alt="Tens" /></td>
<td><img src="image4.png" alt="Ones" /></td>
</tr>
</tbody>
</table>

3 \hspace{1cm} 4
7. Ask students to tell a partner the answer to the question “So how many tens are in the number 34?”
   Say: Whisper to a partner “How many tens are in the number 34” Call on a student you heard say “three”

How many tens are in the number 34?

<table>
<thead>
<tr>
<th>Tens</th>
<th>Ones</th>
</tr>
</thead>
<tbody>
<tr>
<td>3</td>
<td>4</td>
</tr>
</tbody>
</table>

8. Write a sentence with the answer.
   Say: There are three tens in the number 34

How many tens are in the number 34?

<table>
<thead>
<tr>
<th>Tens</th>
<th>Ones</th>
</tr>
</thead>
<tbody>
<tr>
<td>3</td>
<td>4</td>
</tr>
</tbody>
</table>

There are 3 tens in the number 34!

9. Smile at your students! Ask them if they want to try one on their own now.
Mentally Adding and Subtracting 10 - Teacher Notes

CCSSM
1.NBT.C.5
Given a two-digit number, mentally find 10 more or 10 less than the number, without having to count; explain the reasoning used.

Example problem
What is 10 more than 36? What is 10 less than 36?

Key ideas
- Students need to conceptually understand place values. Rather than adding 1,2,3,4,5,6,7,8,9,10 students should simply be adding one ten.
- Using base 10 blocks can be a great way to introduce this concept

Classroom setup
- Whole Class Carpet Time for example problem
- Partner or Group Work for the main lesson

Manipulatives and Math Tools
- Base ten pieces
- Base ten chart

Common errors
- Students adding ten ones and losing track, i.e.
  Ten more than 36 is 36,37,38,39,40,41,42,43,44,45. 45!
  Fix: Make sure this student conceptually understands what a ten is. Take the time to help them work on exchanging ten ones for a ten, have them use manipulatives to add one ten in.

- Students adding a one instead of a ten, i.e.
  Ten more that 36 is 37
  Fix: Give this student a place value chart. Help them to understand the difference between tens and ones.

Potential joke
Q: What do you get when you add ten dogs to a room with fourteen cats in it?
A: A mess!
Mentally Adding and Subtracting 10 - *Introductory Example*

1. Show the question, and read the question out loud

   What is 10 more than 36? What is 10 less than 36?

2. Create a place value chart. Put base 10 pieces in the chart. Write the number of tens and the number of ones at the bottom of the chart

   *Say:* We have 10, 20, 30, 31, 32, 33, 34, 35, 36. That’s 1, 2, 3 tens and 1, 2, 3, 4, 5, 6 ones which is 36

   What is 10 more than 36? What is 10 less than 36?

   ![Place Value Chart]

   - **Tens:** 3
   - **Ones:** 6
3. Add one more long to the tens place. Write “3+1=4” at the bottom of the chart. 
   Say: Now we will add one more ten. We now have 1, 2, 3, 4 tens and 6 ones.

<table>
<thead>
<tr>
<th>Tens</th>
<th>Ones</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>3 + 1 = 4</td>
<td>6</td>
</tr>
</tbody>
</table>

What is 10 more than 36? What is 10 less than 36?

4. Ask a student “So what is 10 more than 36?” write the sentence at the bottom of the page
   Say: What is ten more than 36 [student answers 46] That’s right, ten more than 36 is 46

<table>
<thead>
<tr>
<th>Tens</th>
<th>Ones</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>3 + 1 = 4</td>
<td>6</td>
</tr>
</tbody>
</table>

Ten more than 36 is 46.
5. Next, reset the base 10 chart to find out what ten less than 36 is.
   Say: Now let's figure out what ten less than 36 is. We have three tens and 6 ones to start

<table>
<thead>
<tr>
<th>Tens</th>
<th>Ones</th>
</tr>
</thead>
<tbody>
<tr>
<td>3</td>
<td>6</td>
</tr>
</tbody>
</table>

What is 10 more than 36? What is 10 less than 36?

6. Remove one long. Write “3-1=2” at the bottom of the chart
   Say: Now we will take away one ten. We now have 1, 2 tens and 6 ones

<table>
<thead>
<tr>
<th>Tens</th>
<th>Ones</th>
</tr>
</thead>
<tbody>
<tr>
<td>3</td>
<td>6</td>
</tr>
</tbody>
</table>

What is 10 more than 36? What is 10 less than 36?
7. Ask a student “So what is 10 less than 36?” write the sentence at the bottom of the page
*Say: What is ten less than 36 [student answers 26] That's right, ten less than 36 is 26*

<table>
<thead>
<tr>
<th>Tens</th>
<th>Ones</th>
</tr>
</thead>
<tbody>
<tr>
<td>3</td>
<td>1</td>
</tr>
<tr>
<td>3 + 1 = 4</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td></td>
</tr>
</tbody>
</table>

Ten less than 36 is 26.

8. Smile at your students! Ask them if they want to try one on their own now.
Fact Families - Teacher Notes

CCSSM
1.OA.B.3
Apply properties of operations as strategies to add and subtract.

Example problem
Write the fact family for the numbers 2, 3, and 5.

Key ideas
● This represents the commutative property of addition. Make sure to use manipulatives or real life examples to show why 2+3 is the same as 3+2
● Students can easily fall into the plugging in the answers without understanding the concept trap with this problem. Be sure to follow this up with word problems or manipulatives to ensure students get the concept for this as well.

Classroom setup
● Whole Class Seatwork Time is great for the first few problems
● Individual Work as students start to grasp the concept

Manipulatives and Math Tools
● Number Bonds or Fact Family Triangles
● Counters

Common errors
● Students putting the numbers in without looking at the symbols in a fill in the blank worksheet, i.e.
  5+3=2, 5+2=3, 2-3=5, 3-2=5
  Fix: have this student start writing all four number sentences themselves, helping them to look carefully at the symbols
● Students forgetting to include either the subtraction or the addition
  Fix: For this student do the opposite. Scaffold more worksheets with the four spots to fill in the blank and have students start to get used to putting four answers.

Potential joke
Q: Why won't 2 and 3 go anywhere without 5?
A: Because they're a family!
Fact Families - *Introductory Example*

1. Show the question, and read the question out loud

   Write the fact family for the numbers 2, 3, and 5.

2. Put the three numbers in a triangle. Explain that this is one way we see fact families

   Write the fact family for the numbers 2, 3, and 5.

   ![Triangle with numbers 2, 3, and 5]

3. Write the four equations with blanks to demonstrate what four types of equations are in a fact family.

   Say: *In a fact family for addition and subtraction we always have two addition problems and two subtraction problems*

   Write the fact family for the numbers 2, 3, and 5.

   ![Triangle with numbers 2, 3, and 5 with equations]
4. Complete the first addition problem
   Say: *We know that two plus three equals five, so let's write that first*

   Write the fact family for the numbers 2, 3, and 5.

   \[
   \begin{array}{c}
   \text{2} \\
   \text{3} \\
   \text{5}
   \end{array}
   \]

   \[
   \begin{align*}
   2 + 3 &= 5 & \text{and} & & \text{5} - \_\_ &= \_\_ \\
   \_\_ + \_\_ &= \_\_ & \text{and} & & \text{5} - \_\_ &= \_\_
   \end{align*}
   \]

5. Write the second addition family, explaining that if we know two plus three equals five, that also means that 3 plus two equals 5. Show this with manipulatives.
   *Say: We know that two plus three equals five, that also tells us that three plus two equals five*
   Make sure to count out manipulatives to show this work

   Write the fact family for the numbers 2, 3, and 5.

   \[
   \begin{array}{c}
   \text{2} \\
   \text{3} \\
   \text{5}
   \end{array}
   \]

   \[
   \begin{align*}
   2 + 3 &= 5 & \text{and} & & \text{5} - \_\_ &= \_\_ \\
   3 + 2 &= 5 & \text{and} & & \text{5} - \_\_ &= \_\_
   \end{align*}
   \]
6. Fill in the first subtraction problem. Showing with the manipulatives that if you take 2 away from 5 you are left with 3
Say: Now let’s start with our largest number, five. Five take away two leaves us with three

Write the fact family for the numbers 2, 3, and 5.

\[
\begin{align*}
2 + 3 &= 5 \\
5 - 2 &= 3 \\
3 + 2 &= 5 \\
\text{__} - \text{__} &= \text{__}
\end{align*}
\]

7. Fill in the second subtraction problem. Showing with the manipulatives that if you take 3 away from 5 you are left with 2
Say: Let’s start again with our largest number, five. Five take away three leaves us with two

Write the fact family for the numbers 2, 3, and 5.

\[
\begin{align*}
2 + 3 &= 5 \\
5 - 2 &= 3 \\
3 + 2 &= 5 \\
5 - 3 &= 2
\end{align*}
\]
8. Read all four fact family problems. Show with manipulatives how all of these problems show the same thing.

Write the fact family for the numbers 2, 3, and 5.

\[
\begin{align*}
2 + 3 &= 5 \\
3 + 2 &= 5 \\
5 - 2 &= 3 \\
5 - 3 &= 2
\end{align*}
\]

9. Smile at your students! Ask them if they want to try one on their own now.
Addition Regrouping Within 100 (Base Ten pieces) - Teacher Notes

CCSSM
1.NBT.C.4
Add within 100, including adding a two-digit number and a one-digit number, and adding a two-digit number and a multiple of 10, using concrete models or drawings and strategies based on place value, properties of operations, and/or the relationship between addition and subtraction; relate the strategy to a written method and explain the reasoning used. Understand that in adding two-digit numbers, one adds tens and tens, ones and ones; and sometimes it is necessary to compose a ten.

Example problem

24 + 9 = __

Key ideas
- For 1st grade they only need to add a 2-digit number with a 1-digit number, or with a multiple of 10. They do not need to add two 2-digit numbers.
- Teach regrouping explicitly, and use manipulatives. You can always go back to the chapter on mentally adding or subtracting tens or the chapter on number partners for students who need more practice.

Classroom setup
- Whole Class Seatwork Time
- Individual Work

Manipulatives and Math Tools
- Base ten pieces
- Base ten chart handout
- Number line handout marked with 0 to 20 (only to show concept and get started)

Common errors
- Students adding the ones in the tens place or vice versa, i.e.
  
  \[ 24 + 5 = 74 \quad \text{or} \quad 24 + 50 = 29 \]
  
  Fix: Give this student manipulatives and work with them on understanding the difference between 10s and 1s

Potential joke
- Q: What did the teacher say to their class when they saw they were getting 5 saw students?
  
  A: I guess I will have to regroup you!
Addition Regrouping Within 100 (Base Ten pieces) - *Introductory Example*

1. Show the question, and read the question out loud

   \[
   24 + 9 = __
   \]

2. Put 24 base ten blocks in a place value chart.
   *Say, we have 1,2 tens and 1,2,3,4 ones*

   \[
   \begin{array}{c|c}
   \text{Tens} & \text{Ones} \\
   \hline
   \quad & \quad \\
   \end{array}
   \]

   \[
   24 + 9 = __
   \]

3. Add the additional nine units to the ones place. Have students solve 4 + 9 On the vertical side show 4 + 9 = 13
   *Say: Now let's add the 9 ones in, 1,2,3,4,5,6,7,8,9. What is 4 + 9? [student answers 13] That's right we have 1,2,3,4,...,12,13 ones. We now have 2 tens and 13 ones.*

   \[
   \begin{array}{c|c}
   \text{Tens} & \text{Ones} \\
   \hline
   \quad & \quad \\
   \end{array}
   \]

   \[
   24 + 9 = __
   \]
4. Ask students if you can have twelve units in the ones place, exchange ten units for a long. 
Say: “Can you have thirteen units in the ones place?” [Student answers no] 
“Then let’s exchange these ten units for a long. We now have 1,2,3 tens and 1,2,3 ones.

<table>
<thead>
<tr>
<th>Tens</th>
<th>Ones</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>3</td>
</tr>
</tbody>
</table>

24 + 9 = ___

5. Ask a student “So what is 24 + 9?” Fill in the answer on the original problem
Say: So what is 24 + 9? [student answers 33] That's right, 24 + 9 = 33

<table>
<thead>
<tr>
<th>Tens</th>
<th>Ones</th>
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<tbody>
<tr>
<td></td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>3</td>
</tr>
</tbody>
</table>

24 + 9 = 33

6. Smile at your students! Ask them if they want to try one on their own now.
Addition Regrouping Within 100 (on paper) - Teacher Notes

CCSSM
1.NBT.C.4
Add within 100, including adding a two-digit number and a one-digit number, and adding a two-digit number and a multiple of 10, using concrete models or drawings and strategies based on place value, properties of operations, and/or the relationship between addition and subtraction; relate the strategy to a written method and explain the reasoning used. Understand that in adding two-digit numbers, one adds tens and tens, ones and ones; and sometimes it is necessary to compose a ten.

Example problem
24 + 9 = __

Key ideas
- For 1st grade they only need to add a two-digit number with a one digit number, or with a multiple of ten. They do not need to be adding two two-digit numbers.
- Teach regrouping explicitly, and use manipulatives. You can always go back to the chapter on mentally adding or subtracting tens or the chapter on number partners for students who need more practice.

Classroom setup
- Whole Class Seatwork Time
- Individual Work

Manipulatives and Math Tools
- Manipulatives from previous chapter to introduce
- Paper and pencil while doing individual work

Common errors
- Students adding the ones in the tens place or vice versa, i.e.
  \[ 24 + 5 = 74 \quad \text{or} \quad 24 + 50 = 29 \]
  Fix: Give this student manipulatives and work with them on understanding the difference between 10s and 1s

Potential joke
Q: What do you get when you add 9 to 35?
A: A first grade math problem!
Addition Regrouping Within 100 (on paper) - *Introductory Example*

1. Show the question, and read the question out loud

\[ 24 + 9 = \_ \_ \]

2. Write the problem in vertical form
   *Say: I like to write these problems up and down to help me see the tens and ones*

\[ \begin{array}{c}
24 + 9 = \_ \\
24 \hspace{2cm} \\
\_ \\
\_ \\
\end{array} \]

3. Start by adding four and nine and writing thirteen on the side, do this in a different color to show your work
   *Say: When we are adding two digit numbers, we always start with the ones. What is 4 + 9? [student answers 13]. Great! Let’s write that here*

\[ \begin{array}{c}
24 + 9 = \_ \\
24 \\
\_ \\
\_ \\
\_ \\
13 \end{array} \]
4. Ask students if you can have thirteen ones in the one’s place. Separate the tens and the ones, write the ones under the line and the tens above the tens spot. 

Say: “Can you put thirteen in the one’s place?” [Student answers no] “So, we put the three ones in the ones spot, and carry the tens over.

\[
\begin{array}{c}
24 + 9 = \_
\end{array}
\]

\[
\begin{array}{c}
\underline{2} \quad \underline{4} + \underline{9} = \_
\end{array}
\]

\[
\begin{array}{c}
\underline{1}
\end{array}
\]

\[
\begin{array}{c}
2 \quad \underline{1}
\end{array}
\]

\[
\begin{array}{c}
\underline{3}
\end{array}
\]

5. Finally, add the tens, and write the answer in the initial problem.

Say: 1 + 2 = 3, that gives us three tens, so twenty four plus nine equals thirty three.

\[
\begin{array}{c}
24 + 9 = 33
\end{array}
\]

\[
\begin{array}{c}
\underline{1}
\end{array}
\]

\[
\begin{array}{c}
2 \quad \underline{1}
\end{array}
\]

\[
\begin{array}{c}
\underline{3}
\end{array}
\]

6. Smile at your students! Ask them if they want to try one on their own now.
Integrating Mathematics Into Daily Lessons

While the previous sections in this chapter gave specific examples of how to teach standard aligned topics, and a few key ideas to keep in mind, this section takes a different approach. The concepts that fall within the Common Core State Standards for Mathematics domains of Measurement and Data, and Geometry will be discussed in this section.

Grade 1 Measurement and Data CCSSM Standards focus on comparing lengths of objects, using full units to measure objects, telling time, and interpreting data. All of these are larger skills that students need to develop over time, and not during individual lessons focused on a single skill. As such, rather than individual lessons, these skills should be incorporated into other parts of your school day. The concepts revolving around measurement and interpretation of data can be easily woven into science lessons, with clear paths to incorporate the interpretation of data into Social Studies as well. Time telling often fits better into a regular morning meeting, calendar time, or any time during the day when you are going over schedules or activities with the students. A mathematics focused calendar time is also a great time to incorporate in the concepts housed within the Geometry domain of the CCSSM.

The Grade 1 Geometry domain focuses on identifying shapes and defining attributes of shapes, composing shapes, and introducing some of the foundations of fractions by partitioning circles into two and four parts. These concepts can be perfectly introduced little by little in a daily math time, or can be slowly woven into different lessons with project based learning.
With these two domains of the CCSSM, the most natural way to teach them is through project based learning. Project based learning is the process of students using multiple subjects to work through projects, learning as the knowledge is relevant to what they are doing, rather than isolating the individual subjects. Research has shown that this method of learning can be very beneficial to students' learning (Barron & Darling-Hammond, 2008). While these concepts do not fit naturally into the structure shown above, they can be easily incorporated into the rest of the elementary school day.

The final benefit of teaching these concepts through project based learning and integration into the classroom is that it can really help foster that positive atmosphere surrounding mathematics in the classroom. As the opportunities to utilize this mathematics arise, teachers should demonstrate excitement at this chance! Students seeing teachers' love of math even when not in the formal mathematics lessons will help solidify the students' positive attitude towards the subject, both within and outside the classroom.
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