The Teacher-to-Teacher initiative was created by the U.S. Department of Education to provide the latest strategies and research on educational practices that work in the classroom. This series features teachers from across the country presenting techniques that can be used with students of all ages. This series is just one way the Department of Education is helping teachers get the support they need so "No Child is Left Behind." (MUSIC) Hello, I'm Angela Newing, I'm an 8th grade Mathematics Teacher in Ann Arbor, Michigan. I was recently awarded the 2003 Presidential Award for Excellence in Science and Mathematics Teaching. In a few moments, you will be watching participants first, explore online Applets that I use in my classroom with students in order to help them understand math concepts. After navigating through the two resource guides there will be time for you to explore and hopefully you will have the opportunity to find resources that you can use with your students this upcoming fall. (MUSIC) Well hello. My name is Angela Newing and I would like to welcome you all to this session on how to use technology to help students enhance algebra instruction and their understanding of algebra. First, we will be examining on-line applets that can be used to help students improve their understanding of math concepts. Next, I will be helping you navigate through two resource guides that I use to find math applets, internet-based lesson plans technology projects and other math links. For those who are watching on video if you are following along with me and would like to be going along on the web I will be pausing momentarily so you can type in the address and then continue with me. Next, there will be some time for you to explore the technology on your own in order to find resources that you can use with your students when you go back into your classroom. And lastly, there will be time for you all to share with each other the resources that you have found. So let's begin. When I am trying to help my students understand fractions, percents and decimals I use this tool I call the fraction model. The fraction model is found at http://illuminations.nctm.org/mathlets/fractionpie. So on your internet at home that will be the address you type in. This is referred to as the fraction model. This was created, a collaboration among the National Council of Teachers of Mathematics, Marco Polo and the MCI Foundation. And this how it works. This top slider as you will see, changes the numerator of the fraction. As I move it you can see the decimal, percent and circle graph equivalent to that fraction. The bottom slider changes the denominator. I'm actually using version 1 at this time and version 1 has benchmarks. Benchmarks are for the numbers 1 2 4 5 8 and 10. This you might use with younger students, elementary grades, when you begin talking about fractions and helping them conceptually understand what fractions are you may want to use just version 1. We have benchmarks, so for example if you want to show students let's see that's one half, but here's one fourth or we also use one fifth. So those are some common fractions you begin with in younger grades. Version 2 allows you to have your numerator go all the way up to 20 as well as your denominator, without any benchmarks. The activity I will be showing you in a moment will actually be using version 3. Version 3 allows your numerator and denominator to go from zero to 100. So, for example, if I want to show students the fraction nine fourteenths you will see its decimal equivalent, its percent equivalent and of

course its circle graph. You're also allowed to see its rectangular model, if you prefer to use a rectangular model form instead or a set model. And again, in our classrooms, a lot of times students perform the algorithms. They can create equivalent fractions by finding a common denominator, by multiplying by a unit fraction. But do they really conceptually understand what it is and what they are doing? Well this is a tool I use to help them understand what they are doing and conceptualize it. Again we are always trying to help students construct their own meaning. And this is a tool I can use to help them make sense on their own of what they are doing. And now I will show you an activity that I actually use with this tool. You see she is so happy because she's understanding what's going on (laughter). Here is a question I ask my students. Order the set of numbers from smallest to largest using the fraction model. The numbers I have used are eight seventy-thirds, eight percent, sixteen percent, 24 one-hundredths and 4 twenty-fourths. These are all various forms. In algebra, students have to make conversions between fractions, percents and decimals. They have to be able to do that, in an algebra course. This question is pushing toward that thinking. Using the tool, I'm going to show you how they can go about doing that. The first fraction was eight seventy-thirds. So, if we go over to eight seventy-thirds. You may use the slider or the arrows. So we see all the different equivalent forms. You see the decimal form for eight seventy-thirds as well. Our next number in order was eight percent. Well this was already equal to ten point 96 percent. So we know eight percent would be smaller than this value using the percent form. But as a teacher I have to be careful, because I might be more tempted to use the percent form. But if I have a student who understands that circle graph they should be able to explain, in their own way, using that circle graph. We don't want to lock students out of their own understanding by locking them into only one particular representation. So allowing them to use all four forms is fine. Then we had sixteen percent and again I know how to order eight percent and sixteen percent. We also had point zero two four. Again using the decimal representation I know how to order that one. And the last one was four twenty-fourths. So we go to four twenty-fourths. Again we can see the percent and decimal as well as the circle graph to see that is actually larger then eight seventy-thirds as well. To push my students even further, this is an activity I actually give 6^{th} graders, if you want to know the actual grade. To push them to use all four representations I say "Explain how you would determine which is smaller, eight seventy-thirds or eight percent. Can you explain using your decimal forms? Can you explain using the percent forms? Can you explain using circle graphs? Can you explain using fraction form?" Again, causing them to think about all of the different representations of a fraction. And I'll share with you some student responses I've gotten. So using a circle graph here's Student #1. Student #1 says "If you have a pie that is cut into 73 pieces each slice would be bigger than if you cut the same pie into 100 pieces. So if one guy has 8 pieces out of 73 total, he has more pie than another guy who has 8 pieces out of 100. You can compare fractions with common numerators as easy as you can with common denominators." Did everybody catch that word "as easy"? When you have a student saying "as easy" that's what you're looking for. That means

there is a light bulb going on and they are understanding using this tool. And this is what we call an applet, again an applet is a little computer application. They're called applets because they are smaller. But again this helps the student conceptualize on their own what the differences are between those different forms. The second student said "You just have to remember that the bigger the denominator the smaller the slice." Again making sense on their own they are thinking about pie and the slices. Again it wasn't the percent form. It wasn't the decimal form, which I may have went to first, but that student decided to use the circle graph and it made sense to them. Here's another explanation using the fraction form. Student one said "I knew I would set the top slider to eight for both numbers and then adjust the bottom slider to seventy-three or 100. Since 100 is larger than seventy-three, I knew without even doing it, that eight seventy-thirds was the bigger fraction." Again that's directly thinking about the fraction and the sliders and actually using that tool to help them better understand fractions. So that's just one applet I use with students and I'll show you another. With my 8th graders, we focus on our linear functions and now I'm going to show you an applet I use to go over linear functions to help them understand that better. We've talked about how linear functions can be written in the form y equals mx+b. Sometimes we use function notations which means f(x) equals mx+b. I have to introduce that f(x) equals mx+b, because the applet I'm about to show you, uses that notation. So let's see the applet. For those of you watching on video, if you scroll down, this is actually part of a nctm lesson. I like the tool and again it's a free resource but it is embedded into a lesson. I have not found a way to access this applet without going into the lesson but my students have not had a problem with it. I basically shape the screens on the computer so that what they see is the applet not the lesson so it hasn't tripped my students up at all. But how this applet works, I'll refer to this as Slider One. Slider One moves the point along the line. Again we can use it to talk about the Y intercept which we know that the X value is always zero. We can also use it to refer to the X intercept where the Y coordinate is always zero. The second slider, is connected to the slope as you will see. As I change that my line changes. If you do not want all the lines to appear, here it says show trace. The third slider affects your Y intercept. Here are some questions I ask my students using this tool. First question: When you change the value of M how does the graph change? The second slider affects your slope. So as I move it further to the right and my slope is becoming a higher number what is happening to my line? It is steeper. That is what I'm trying to get students to do – tell me that it's steeper. What about what happens when the slope is negative? If we move it toward the left it becomes a negative. What happens to our line? The direction it goes. It goes from the bottom right up to the upper left. That is important for the students to know which way that line will be pointing depending on the slope - if it's positive or negative. And the third slider here affects the Y intercept. So my next question I direct to students: When you change the value of B how does the graph change. Once again as we change B which is our point here we can see that it moves along the Y axis. I've had students say "you know it doesn't do anything. It just stays on that middle line. How can I move it off the middle line?" I say, "You know what?

That's what we want it to do. That's exactly what this is all about." The Y intercept is the point where it stays on the Y axis. But again this tool is helping them construct their own meaning. I can take them into a lab when I begin introducing slope and Y intercept and we can use this tool to help them better understand. And last I ask them: "In your own words, explain what M and B tell you about a linear graph." And again I'm looking for M to tell me how steep its going to be or what direction the line is going to be going in. M is the slope that's the term and it lets you bring out that in that conversation. That's the slope. What does the B tell you? Well B is the point where it hits the Y axis and it stays on that middle line all the time. That's called the Y intercept. And that number will always indicate where it will cross the Y axis. I'll show you some other applets that I use. This is the National Library of Virtual Manipulatives. So let's click on algebra grade band 9 through 12. Its called the algebra balanced scale. Now for folks in on solving equations and now we have a variable on each side of the equation. So let's say we set up the left side to be 3x + 2 and the right side to be 2x + 6. So now we're balanced. So we click continue. Now the question is what's our first step to solve this equation? Well I would subtract. It automatically defaults to add. So we're going to select subtract. And I'm going to select subtract 2 and then press go. And it subtracts 2 from each side. So now I'm going to subtract 2x from each side and it does allow you to type in the x as well and click go and so x=4. What this applet does not do, which as algebra teachers we should require our students is to show their steps. So on the side board as I'm doing this I'm actually writing the steps showing what it would look like in symbols so they will know what I expect when they go home and do their homework, what to do. And I'll show you one more. Okay. So now we're going to subtract two from each side and now we're going to subtract x from each side. Okay. Did everybody see that? And I have the value of x=1. Again this is a hands-on way to help students be able to construct their own meaning to the mathematics in a way that makes sense to them. It's colorful, it's hands-on, things students love and enjoy. Just to show you one other applet that I use with students. Its called grapher. In my algebra textbook there is a lesson on transformations. For example, if we start off with the parent function the square root of x. And what we are trying to see, if we make any changes to that equation, how will it affect its graph? So first let's graph the square root of x. As we can see it starts off at the origin zero, zero. What happens to the square root of x if we add two outside the radical sign or add three outside the radical sign. How will it affect the graph. So if we select graph and we see how its changed and we can have that conversation in class. Well what happens if you decide to add two underneath the radical sign? Will it have the same effect? Well let's see. And no it doesn't. This initial point here has moved to the left two. It did not move up. And again it's a unit we can talk about and this is a tool that I use in front of the class as I am talking about to demonstrate what we're doing – what happens to function as we change their equations. So that's just two tools that you can find in the National Library of Virtual Manipulatives. Now I'm going to show you how to navigate through two resource guides that I use. And again these are on your worksheet under neirtec. There will be time when we explore

for you to go to these sites to find them as well. That's http://www.neirtec.org/math/. Neirtec lists projects, readings, professional resources. They have other math applets and they have some professional development opportunities as well. I would like to show you one of the projects called mission algebra. And I'll just read what it says. It says: Mission Algebra is designed to provide guidance to district and school leaders in addressing the question "How can technology support teachers and students in getting students ready for Algebra I?" Now here in Mission Algebra they have classroom examples and I want to show you one of the classroom examples. If we arrow down, there's one called the Pythagorean Theorem Relationship. And when you go to this site you will be given what your students will be able to do. They'll talk about the skills, they'll give you an overview of the value of this technology, and then it gives you a look into a classroom. This is actually a dialog between a teacher and their student who has actually used the applet you see here. So we select more, focusing on the relationship of the Pythagorean theorem and we know that A squared + B squared = C squared. And so if you take the area of the squares on each of the legs they should fit inside the square of the hypotenuse. And this is a tangram. Again – hands on like a puzzle that students can actually go in even at home they can go in and actually move these pieces around to show you how that geometric proof actually works. But I want to show you what some of the students say about this. "That's cool! The tangram shapes can either make a large square the size of the hypotenuse or two small squares each the size of the legs." And the teacher said "what can you tell about the areas of the small squares compared to the large square. You can put the parts of the two small squares together to make the big square." Again, the students constructing their own meanings to the mathematics – and that's what we're after. So if you're looking for lessons that already incorporate technology its right here. That was Mission Algebra and that's under neirtec resource guide. It also offers reading. So the majority I've read are directed towards teachers. But again how you incorporate technology in mathematics so they have some here for you to read. Professional resources we'll actually be going to this site next. It's the other resource guide that I use. But it has selected web resources, internet-based lesson plans, and it lists some other sites as well that you can go to, to find resources. I will now take you to that other resource guide that I use and its http://illuminations.nctm.org. In Illuminations, it provides lesson plans, selected web resources, interactive math tools or applets - again the little computer applications that you can use to help students go on the computers. I-math's are actually lessons that have technology already incorporated into them. A lot of them are already student-directed. They're already set up for you. You can print out a worksheet and the whole bit and go from there. An inquiry on practice that includes videos, it has research and articles, it also has an interactive math dictionary that you can use as well. Again we are looking for resources that we can use to help our students better understand mathematics. I'll just show you a few of the selected web resources. Let's say grades 6 through 8. SWR stands for Selected Web Resources. Now if you select the grade band first as I did and then you select SWRs you can select based on the

contents standard and the process standard what type of web resources you want to see. We're dealing with algebra here today so we're going to select algebra. And you can find many resources. So this is an on-line activity for students. Here's a calendar to provide some problem-solving for your students. Figure this is also a wonderful sight that I have used at school as well. So I just want to show you there's a lot of different variations of the resources available to you by going to that selected web resource. And again, it has applets you can use, I-math investigations, inquiry and I won't go through all these because you'll have time to explore. But I just wanted to point out that they are here. Let's look at one grades 3 through 5. We have not looked at one yet. Let's look at an I-math. It says our on-line multi-media math investigations. All I-math are built around interactive math applets and some also include video clips. There are two lengths of I-math. You have single-day or multi-day. So here's one, where students are exploring geometric solids and their properties, communicating about mathematics using games. Now this is a multi-day. So this is more than one day, collecting representing and interpreting data using spreadsheets and graphing software. Here's one on distance speed and time relationships with simulations. And you have one exploring properties of rectangles and parallelograms. And again, this is another applet and you'll see some here where you can move this and talk about the different properties and which properties change other features and which not, again hands-on allowing students to get on the computer to construct their own meaning. So those are just some valuable resources that are available on the web. And again by going to these two resource guides you can find numerous resources that could be used in your classroom. Okay, now we've taken the time to go over the resource guides and now it's your time to go and explore further on your own. On the screen you should see a list of sites that you can go to, to find resources that can help your students in the classroom and have fun. They sure will learn as well.

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