Got Slope?

I. UNIT OVERVIEW & PURPOSE:

The purpose of this unit is to allow students to graph linear equations in two variables from real world data involving tornados. Students will watch tornado videos, gather data, calculate slope, find the equation of the line, graph the equation of the line, perform same process for surrounding states, make predictions about future data, and construct a PowerPoint presentation.

II. UNIT AUTHOR:

Tina Nunley, Union High School, Wise County Schools

III. COURSE:

Mathematical Modeling: Capstone Course

IV. CONTENT STRAND:

Algebra

V. OBJECTIVES:

The student will graph linear equations in two variables, including: a) determining the slope of a line when given an equation of the line, the graph of the line, or two points on the line. Slope will be described as rate of change and will be positive, negative, zero, or undefined; and b) writing the equation of a line when given the graph of the line, two points on the line, or the slope and a point on the line.

VI. MATHEMATICS PERFORMANCE EXPECTATION(s):

MPE.19 Graph linear equations and linear inequalities in two variables, including

a) determining the slope of a line when given an equation of the line, the graph of the line, or two points on the line; describing slope as rate of change and determine if it is positive, negative, zero, or undefined; and

b) Writing the equation of a line when given the graph of the line, two points on the line, or the slope and a point on the line.

VII. CONTENT:

The student will graph linear equations in two variables, including: a) determining the slope of a line when given an equation of the line, the graph of the line, or two points on the line. Slope will be described as rate of change and will be positive, negative, zero, or undefined; and b) writing the equation of a line when given the graph of the line, two points on the line, or the slope and a point on the line. This content will be incorporated through mathematical modeling problems focused on the latest U. S. tornado statistics listed at www.spc.noaa.gov. Students will construct a homemade tornado, view videos of the latest tornadoes, provide visual linear representations of the statistics, and do a PowerPoint presentation on tornados.

VIII. REFERENCE/RESOURCE MATERIALS:

www.spc.noaa.gov
http://www.doe.virginia.gov/VDOE/Instruction/ESL/LEPmathResource.pdf
http://tornadovideos.co/
http://www.easyfunschool.com/article1205.html.

IX. PRIMARY ASSESSMENT STRATEGIES:

Lesson One Assessment: Students will receive a daily grade upon the successful completion of their homemade tornado. Students need to keep their data list since the data will be needed for lesson two.

Lesson Two Assessment: Students will receive a daily grade upon the successful completion of their graphs and answers to specified questions. Teacher needs to make sure that equations are graphed correctly, concentrating on x and y intercepts, and that answers to specific questions are accurate.

Lesson Three Assessment: Students will receive a daily grade upon the completion of their graphs and answers to specified questions. Teacher needs to make sure that equations are graphed correctly, concentrating on x and y intercepts, and that answers to specific questions are accurate.

Lesson Four Assessment: Students will receive a test grade upon the presentation of their PowerPoint on videos. PowerPoint needs to contain all data, all equations and their corresponding graphs, making sure that they are graphed and labeled correctly, pictures, and other pertinent information gathered in their research.

Lesson Five and Six Assessment: Students will receive a test grade upon the presentation of their PowerPoint presentations.

Strategies for Differentiation

- Focus on mathematical content rather than on linguistic form (simplify word problems without changing the math meaning)
- Language and content should be presented simultaneously
- Step by step instructions (orally and in writing) ask students to repeat aloud for the rest of the class.
- Pause between sentences or thought groups.
- Use gestures and visuals to help clarify the message.
- Repeat, rephrase, and paraphrase.
- Assess whether LEP students have mastered mathematical concepts rather than their English grammar and fluency.
  The accommodations are adopted from the following source.
  http://www.doe.virginia.gov/VDOE/Instruction/ESL/LEPmathResource.pdf

X. EVALUATION CRITERIA:

- Homemade tornado project will count as a daily grade. Students will obtain a grade of 100 for a functioning homemade tornado. Coordinate with an English teacher and have their one page reflection of videos count not only as a grade for your class but also as an English grade.
- Students will receive daily grades upon the successful completion of their graphs and answers to specified questions. Teacher needs to make sure that equations are graphed correctly and that answers to specific questions are accurate.
- Students will receive a test grade on their PowerPoint presentations. The PowerPoint needs to contain all data, all equations and their corresponding graphs, making sure that they are graphed and labeled correctly, pictures, and other pertinent information gathered in their research.

XI. INSTRUCTIONAL TIME:

The instructional time required for this unit will be approximately five to six 90 minute blocks.

Lesson 1 Tornadoes

Strand
Algebra

Mathematical Objective(s)

In this lesson, students will create their own tornado, view video clips of tornadoes, and gather statistical data over the past 10 years of tornado activity in their specific state. In addition, students will write a one page reflection on the videos that they have viewed. Coordinate with an English teacher and have their one page reflection count not only as a grade for your class but also as an English grade.

Mathematics Performance Expectation(s)

MPE.2 The student will collect and analyze data, determine the equation of the curve of best fit, make predictions, and solve real-world problems, using mathematical models. Mathematical models will include polynomial, exponential, and logarithmic functions.

MPE. 12 The student will transfer between and analyze multiple representations of functions, including algebraic formulas, graphs, tables, and words. Students will select and use appropriate representations for analysis, interpretation, and prediction.

MPE.19 Graph linear equations and linear inequalities in two variables, including
a) determining the slope of a line when given an equation of the line, the graph of the line, or two points on the line; describing slope as rate of change and determine if it is positive, negative, zero, or undefined; and

b) Writing the equation of a line when given the graph of the line, two points on the line, or the slope and a point on the line.

NCTM Standards

Grades 9–12 Algebra 1Expectations: In grades 9–12 all students should–

- generalize patterns using explicitly defined and recursively defined functions;
- understand relations and functions and select, convert flexibly among, and use various representations for them;
- analyze functions of one variable by investigating rates of change, intercepts, zeros, asymptotes, and local and global behavior;
- interpret representations of functions of two variables
- use symbolic algebra to represent and explain mathematical relationships;

- judge the meaning, utility, and reasonableness of the results of symbol manipulations, including those carried out by technology.
- approximate and interpret rates of change from graphical and numerical data.

Additional Objectives for Student Learning:

A.6 The student will graph linear equations and linear inequalities in two variables, including
a) determining the slope of a line when given an equation of the line, the graph of the line, or two points on the line. Slope will be described as rate of change and will be positive, negative, zero, or undefined; and

b) writing the equation of a line when given the graph of the line, two points on the line, or the slope and a point on the line.

A.11 The student will collect and analyze data, determine the equation of the curve of best fit in order to make predictions, and solve real-world problems, using mathematical models. Mathematical models will include linear and quadratic functions.

AII.9 The student will collect and analyze data, determine the equation of the curve of best fit, make predictions, and solve real-world problems, using mathematical models. Mathematical models will include polynomial, exponential, and logarithmic functions.

AFDA.3 The student will collect data and generate an equation for the curve (linear, quadratic, exponential, and logarithmic) of best fit to model real-world problems or applications. Students will use the best fit equation to interpolate function values, make decisions, and justify conclusions with algebraic and/or graphical models.

AFDA.4 The student will transfer between and analyze multiple representations of functions, including algebraic formulas, graphs, tables, and words. Students will select and use appropriate representations for analysis, interpretation, and prediction.

ES.13 The student will investigate and understand that energy transfer between the sun and the Earth and its atmosphere drives weather and climate on Earth. Key concepts include
a) observation and collection of weather data;
b) prediction of weather patterns;
c) severe weather occurrences, such as tornadoes, hurricanes, and major storms; and
d) weather phenomena and the factors that affect climate including radiation and convection.

Materials/Resources

- Two 2-liter plastic soda bottles per student* (Have students collect bottles two to three weeks in advance)
- Water
- Food coloring of your choice (optional)
- Glitter (optional)
- 3 x 5-inch index card or piece of thin cardboard per student
- Masking tape
- Duct or electrical tape
- A pair of scissors per student
- Computer lab so that each student has access to their own computer for research.

Assumption of Prior Knowledge

- The prior knowledge assumed by the lesson is the concept of weather from their earth science class.
- The relevant context from the real world drawn on in relation to slope and graphing linear equations is natural disasters.

Introduction: Setting Up the Mathematical Task

- In this lesson, you will investigate the power and outbreak of tornadoes in the United States.
- This lesson will take approximately 90 minutes of class time.
- Introduce the lesson by going to the website http://tornadovideos.com/ and showing two or three of the tornado videos to the class. This will take approximately 20 – 30 minutes. Teacher and students may want to discuss the power of tornadoes and the level of destruction.
- After viewing the videos, have students create their own tornado by following the attached instructions (located at the end of Lesson 1) for a homemade tornado. Students need to label their homemade tornado with a permanent marker. Construction and clean up will take approximately 20 – 30 minutes.
- Pose the question: How many tornadoes have touched down in Virginia throughout the past ten years?
- Take students to a computer lab. Students will need to access the following website: www.spc.noaa.gov. In search box, enter "U. S. tornado statistics." Click on link. Gather the data for the number of tornadoes that have been documented in Virginia since the year 2000. In a Word document, enter the data into a table that has been properly labeled. Students will need to save their document for tomorrow's lesson. Computer lab activity will take approximately 20 – 30 minutes.
- Near the end of class, once you see that all students have finished, pose the question: "By looking at your data table that you have constructed, is there a strong possibility of tornadoes in Virginia? Tomorrow we will graph our data and investigate our question."

- For Homework: Students will write a one page reflection on the videos that they have viewed and about what they have learned through the building of their own tornado. Students need to speculate about why this homemade tornado works. Coordinate with an English teacher and have their one page reflection count not only as a grade for your class but also as an English grade.

Monitoring Student Responses

Assessment

- Assessment for lesson one objective:
    - **Homemade tornado project**
        - Students will receive a 100 as a daily grade for a functioning homemade tornado. Students will be able to see the tunnel created by a tornado.
    - **Essay**
        - Students will write a one page reflection on the videos that they have viewed and about what they have learned through the building of their own tornado. Students need to speculate about why this homemade tornado works. Coordinate with an English teacher and have their one page reflection count not only as a grade for your class but also as an English grade.
        - The essay will count as a daily grade.

Strategies for Differentiation

The differentiation strategies might include but are not limited to the following list created specifically for ESL students. Teachers need to feel free to pick and choose from these to accommodate your specific classroom environment:

- Focus on mathematical content rather than on linguistic form (simplify word problems without changing the math meaning)
- Step by step instructions (orally and in writing) ask students to repeat aloud for the rest of the class.
- Pause between sentences or thought groups.
- Use gestures and visuals to help clarify the message.
- Repeat, rephrase, and paraphrase.
- Simplify the language used rather than the mathematical concepts taught (use known vocabulary and simple sentence constructions).
- Assess whether LEP students have mastered mathematical concepts rather than their English grammar and fluency.

The accommodations are adopted from the following source.
http://www.doe.virginia.gov/VDOE/Instruction/ESL/LEPmathResource.pdf

Homemade Tornado

This is a fun science experiment with the potential for generating a great deal of student interest. There are several variations of this available on the internet. This version is inexpensive and the students get to make it from scratch. Adapted from http://www.easyfunschool.com/article1205.html.

Supplies:

Two 2-liter plastic soda bottles per student* (Have students collect bottles two weeks in advance)
Water
Food coloring of your choice (optional)
Glitter (optional)
3 x 5-inch index card or piece of thin cardboard per student
Masking tape
Duct or electrical tape
A pair of scissors per student
permanent marker

Directions:

1. Wash out the soda bottles and remove their labels. This allow for better visibility.

2. Fill **one** bottle with water and add a teaspoon of the food coloring and a few pinches of glitter. The food coloring color and glitter doesn't really matter. They are used to make the tornado more visible.

3. Roll the index card width-wise so that it will fit in the mouths of the soda bottles. This will help keep the bottles aligned; however, all of the water does not flow from one bottle to the other. You may eliminate steps 4, 5, and 6. You will have to be careful when you swirl the bottles though.

4. Use masking tape to hold the end of the card in place.

5. Put the rolled-up card in the mouth of the bottle that contains the water.

6. Take the other soda bottle and place its mouth over the rolled-up card, pushing the bottle down so the mouths of both bottles are flush.

7. Tape the mouths of the bottles together with duct or electric tape, making sure that the seal between the two is as waterproof as possible.

8. Grab the bottles by their bases and turn the "tornado" upside down.

9. As the water begins to pour from one bottle to the other, gently swirl the bottles in a circular motion until the tornado forms.

*Note: You can use small plastic soda bottles, but they don't give quite the effect desired. Do not use the 3-liter bottles because they become quite heavy when the water is put in them.

Lesson 2 Tornado Graphing

Strand
Algebra

Mathematical Objective(s)
In this lesson, students will find the slope, graph, and write a linear equation of their tornado data that was collected during the previous lesson. Additionally, students will gather the same type of data for the surrounding states, performing the same calculations as they did with the data from Virginia.

Mathematics Performance Expectation(s)

MPE.2 The student will collect and analyze data, determine the equation of the curve of best fit, make predictions, and solve real-world problems, using mathematical models. Mathematical models will include polynomial, exponential, and logarithmic functions.

MPE. 12 The student will transfer between and analyze multiple representations of functions, including algebraic formulas, graphs, tables, and words. Students will select and use appropriate representations for analysis, interpretation, and prediction.

MPE.19 Graph linear equations and linear inequalities in two variables, including
a) determining the slope of a line when given an equation of the line, the graph of the line, or two points on the line; describing slope as rate of change and determine if it is positive, negative, zero, or undefined; and
b) Writing the equation of a line when given the graph of the line, two points on the line, or the slope and a point on the line.

NCTM Standards

Grades 9–12 Algebra 1Expectations: In grades 9–12 all students should–

- generalize patterns using explicitly defined and recursively defined functions;
- understand relations and functions and select, convert flexibly among, and use various representations for them;
- analyze functions of one variable by investigating rates of change, intercepts, zeros, asymptotes, and local and global behavior;
- interpret representations of functions of two variables
- use symbolic algebra to represent and explain mathematical relationships;
- judge the meaning, utility, and reasonableness of the results of symbol manipulations, including those carried out by technology.
- approximate and interpret rates of change from graphical and numerical data.

Additional Objectives for Student Learning:

A.6 The student will graph linear equations and linear inequalities in two variables, including
a) determining the slope of a line when given an equation of the line, the graph of the line, or two points on the line. Slope will be described as rate of change and will be positive, negative, zero, or undefined; and
b) writing the equation of a line when given the graph of the line, two points on the line, or the slope and a point on the line.

A.11 The student will collect and analyze data, determine the equation of the curve of best fit in order to make predictions, and solve real-world problems, using mathematical models. Mathematical models will include linear and quadratic functions.

AII.9 The student will collect and analyze data, determine the equation of the curve of best fit, make predictions, and solve real-world problems, using mathematical models. Mathematical models will include polynomial, exponential, and logarithmic functions.

AFDA.3 The student will collect data and generate an equation for the curve (linear, quadratic, exponential, and logarithmic) of best fit to model real-world problems or applications. Students will use the best fit equation to interpolate function values, make decisions, and justify conclusions with algebraic and/or graphical models.

AFDA.4 The student will transfer between and analyze multiple representations of functions, including algebraic formulas, graphs, tables, and words. Students will select and use appropriate representations for analysis, interpretation, and prediction.

ES.13 The student will investigate and understand that energy transfer between the sun and the Earth and its atmosphere drives weather and climate on Earth. Key concepts include
a) observation and collection of weather data;
b) prediction of weather patterns;
c) severe weather occurrences, such as tornadoes, hurricanes, and major storms; and
d) weather phenomena and the factors that affect climate including radiation and convection.

Materials/Resources

- A ruler per student
- Graph paper per student
- Colored pencils per student
- Notebook paper per student
- Graphing calculator per student
- Computer lab so that each student has access to their own computer for research.

Assumption of Prior Knowledge

- The prior knowledge assumed by the lesson is:
    - the concept of finding the slope of a line between two points,
    - finding the line of best fit by entering points into a calculator under STAT Edit
    - Using STAT Calc to find the line of best fit
    - Graphing points
    - Graphing the line of best fit
- The relevant context from the real world drawn on in relation to slope and graphing linear equations is natural disasters.

Introduction: Setting Up the Mathematical Task

- In this lesson, you will investigate the power and outbreak of tornadoes in the United States.
- This lesson will take approximately 90 minutes of class time.
- Introduce the lesson by going to the website http://tornadovideos.com/ and showing one or two different tornado videos to the class than was shown in the previous lesson. This will take approximately 10 - 20 minutes depending upon length of various discussions. Teacher and students may want to discuss the power of tornadoes and the level of destruction.
- Pose the question: What is the slope between the year and the number of tornadoes that touchdown in Virginia?
- The rest of the class time will be spent graphing and discussing the points researched yesterday, gathering new data, and graphing and discussing the new data.
- Students will need to gather their supplies and get their table of points out from the first lesson. Remind students that their work needs to be neat, labeled, and organized.
- Students need to label and mark the x axis and the y axis appropriately. Allow students to discuss as a class exactly what is appropriate for labeling each axis. Students need to list their reason(s) for the specific labeling of their coordinate system. Teacher needs to make sure that students understand why there would only be points in quadrant one. Students need to neatly graph their points in one specific color.
- Students need to calculate the slope between each pair of consecutive points and then the first and last point. Have students average the slopes.
- Students need to enter the points on their calculator and find the line of best fit.
- Students need to graph the line of best fit in a different color on the same graph paper as their points. They need to write the equation of the line above the line.
- Students need to compare their slope with the slope from the calculator. As a class, discuss the difference between the two values. Students need to list their reasons for the difference between the two values.
- Pose the question: Do the surrounding states have the same slope as Virginia?

- Take students to a computer lab. Students will need to access the following website: www.spc.noaa.gov. In search box, enter "latest U. S. tornado statistics." Click on link. Gather the data for the number of tornadoes that have been documented in Tennessee, Kentucky, West Virginia, and North Carolina. In a Word document, enter the data into a table that has been properly labeled.
- For each state, students need to calculate the slope between each pair of consecutive points and then the first and last point. Have students average the slopes.
- Students need to enter the points on their calculator and find the line of best fit.
- Students need to graph the line of best fit in a different color on the same graph paper as their points. They need to write the equation of the line above the line.
- Students need to compare their slope with the slope from the calculator. As a class, discuss the difference between the two values. Students need to list their reasons for the difference between the two values.
- Make sure that students graph the surrounding states equations with each state being a different color.
- Students need to list the slope for each state including Virginia's slope. As a class, discuss which states have parallel lines. Write those states down and give the algebraic reasoning of why those states have parallel lines.
- Students need to write down the state(s) that has (have) the least possibility of having a tornado and the algebraic reasoning for your answer(s).
- Students need to turn in their graphs and answers to questions for a daily grade.
- Near the end of class, once you see that all students have finished, pose the question: "Who can give me the name of the scale used to classify a tornado?" Tomorrow's lesson will research this name and investigate the slope of the line.
- Last 5 minutes, students need to put away their supplies, turn in their completed work, and clean up their work area.

Monitoring Student Responses

Assessment

- Assessment for lesson two objective:
    - **Graphs for equations of line for Virginia as well as surrounding states.**
        - Teacher will grade answers making sure that the student understands the concept and meaning of slope, that each state's line is graphed correctly, concentrating on the x and y intercepts and the slope of the line. Additionally, the teacher will grade the answers to the questions posed throughout the class time. The questions were as follow:

- ✓ Students need to list their reason(s) for the specific labeling of their coordinate system. Teacher needs to make sure that students understand why there would only be points in quadrant one.
- ✓ Students need to calculate the slope between each pair of consecutive points and then the first and last point. Have students average the slopes.
- ✓ Students need to graph the line of best fit for Virginia in a different color on the same graph paper as their points. They need to write the equation of the line above the line.
- ✓ Students need to list their reasons for the difference between the two values for slope.
- ✓ Students need to list the slope for each state including Virginia's slope. As a class, discuss which states have parallel lines. Write those states down and give the algebraic reasoning of why those states have parallel lines.
- ✓ Students need to write down the state(s) that has (have) the least possibility of having a tornado and the algebraic reasoning for your answer(s).
- ✓ Students need to turn in all typed data, all graphs, all answers to questions, and all calculations.
- ✓ The grade will be a daily grade.

Strategies for Differentiation

The differentiation strategies might include but are not limited to the following list created specifically for ESL students. Teachers need to feel free to pick and choose from these to accommodate your specific classroom environment:

- Focus on mathematical content rather than on linguistic form (simplify word problems without changing the math meaning)
- Step by step instructions (orally and in writing) ask students to repeat aloud for the rest of the class.
- Pause between sentences or thought groups.
- Use gestures and visuals to help clarify the message.
- Repeat, rephrase, and paraphrase.
- Simplify the language used rather than the mathematical concepts taught (use known vocabulary and simple sentence constructions).
- Assess whether LEP students have mastered mathematical concepts rather than their English grammar and fluency.

The accommodations are adopted from the following source.
http://www.doe.virginia.gov/VDOE/Instruction/ESL/LEPmathResource.pdf

Lesson 3 Fujita Scale Graphing

Strand
Algebra

Mathematical Objective(s)
In this lesson, students will find the slope, graph, and write a linear equation of the Fujita scale. Students will also gather information to begin the construction of their PowerPoint presentation on tornados. The PowerPoint will be finished in lesson 4.

Mathematics Performance Expectation(s)

MPE.2 The student will collect and analyze data, determine the equation of the curve of best fit, make predictions, and solve real-world problems, using mathematical models. Mathematical models will include polynomial, exponential, and logarithmic functions.

MPE. 12 The student will transfer between and analyze multiple representations of functions, including algebraic formulas, graphs, tables, and words. Students will select and use appropriate representations for analysis, interpretation, and prediction.

MPE.19 Graph linear equations and linear inequalities in two variables, including
a) determining the slope of a line when given an equation of the line, the graph of the line, or two points on the line; describing slope as rate of change and determine if it is positive, negative, zero, or undefined; and
b) Writing the equation of a line when given the graph of the line, two points on the line, or the slope and a point on the line.

NCTM Standards

Grades 9–12 Algebra 1Expectations: In grades 9–12 all students should–

- generalize patterns using explicitly defined and recursively defined functions;
- understand relations and functions and select, convert flexibly among, and use various representations for them;
- analyze functions of one variable by investigating rates of change, intercepts, zeros, asymptotes, and local and global behavior;
- interpret representations of functions of two variables
- use symbolic algebra to represent and explain mathematical relationships;
- judge the meaning, utility, and reasonableness of the results of symbol manipulations, including those carried out by technology.
- approximate and interpret rates of change from graphical and numerical data.

Additional Objectives for Student Learning:

A.6 The student will graph linear equations and linear inequalities in two variables, including

a) determining the slope of a line when given an equation of the line, the graph of the line, or two points on the line. Slope will be described as rate of change and will be positive, negative, zero, or undefined; and

b) writing the equation of a line when given the graph of the line, two points on the line, or the slope and a point on the line.

A.11 The student will collect and analyze data, determine the equation of the curve of best fit in order to make predictions, and solve real-world problems, using mathematical models. Mathematical models will include linear and quadratic functions.

AII.9 The student will collect and analyze data, determine the equation of the curve of best fit, make predictions, and solve real-world problems, using mathematical models. Mathematical models will include polynomial, exponential, and logarithmic functions.

AFDA.3 The student will collect data and generate an equation for the curve (linear, quadratic, exponential, and logarithmic) of best fit to model real-world problems or applications. Students will use the best fit equation to interpolate function values, make decisions, and justify conclusions with algebraic and/or graphical models.

AFDA.4 The student will transfer between and analyze multiple representations of functions, including algebraic formulas, graphs, tables, and words. Students will select and use appropriate representations for analysis, interpretation, and prediction.

ES.13 The student will investigate and understand that energy transfer between the sun and the Earth and its atmosphere drives weather and climate on Earth. Key concepts include

a) observation and collection of weather data;
b) prediction of weather patterns;
c) severe weather occurrences, such as tornadoes, hurricanes, and major storms; and
d) weather phenomena and the factors that affect climate including radiation and convection.

Materials/Resources

- A ruler per student
- Graph paper per student
- Colored pencils per student
- Notebook paper per student
- Graphing calculator per student
- Computer lab for research, one computer per student

Assumption of Prior Knowledge

- The prior knowledge assumed by the lesson is:
    - the concept of finding the slope of a line between two points,
    - finding the line of best fit by entering points into a calculator under STAT Edit
    - Using STAT Calc to find the line of best fit
    - Graphing points
    - Graphing the line of best fit
- The relevant context from the real world drawn on in relation to slope and graphing linear equations is natural disasters.

Introduction: Setting Up the Mathematical Task

In this lesson, you will investigate the Fujita scale used to determine and classify the strength of tornados.

- This lesson will take approximately 20 minutes of class time.
- Introduce the lesson by going to the website http://tornadovideos.co/ and showing one or two different tornado videos to the class than was shown in the previous lesson. This will take approximately 10 – 20 minutes depending upon length of various discussions. Teacher and students may want to discuss the power of tornadoes and the level of destruction.
- Pose the question: What is used to determine the strength of tornados? How do they classify tornados?
- The rest of the class time will be spent researching and answering the previous questions, graphing the Fujita scale, discussing the information obtained during their research, and begin the construction of their PowerPoint presentation on tornados.
- Students will need to gather their supplies and then go to the computer lab.
- Students need to write down the Fujita scale.
- Students need to label and mark the x axis and the y axis appropriately. Allow students to discuss as a class exactly what is appropriate for labeling each axis. Students need to list their reason(s) for the specific labeling of their coordinate system. Teacher needs to make sure that students understand why there would only be points in quadrant one. Students need to neatly graph their points in one specific color.
- Students need to calculate the slope between each pair of consecutive points and then the first and last point. Have students average the slopes. Discuss the slope.
- Students need to enter the points on their calculator and find the equation of the line.
- Students need to graph the equation of the line in a different color on the same graph paper as their points. They need to write the equation of the line above the line.
- Students need to compare their slope with the slope from the calculator. As a class, discuss the difference between the two values, if there is a difference. Students need to list their

reasons for the difference between why yesterday's slope values were not the same and today's slope values are the same.

- Students need to turn in their graphs and answers to questions for a daily grade.
- Near the end of class, the teacher may offer some extra credit by having students research the strength of a tornado and the distance the debris will travel. Students can graph their information, find the equation of the line, and find the slope.
- Last 5 minutes, students need to put away their supplies, shut down their computers and clean up their work area.

Monitoring Student Responses

Assessment

- Assessment for lesson three objective:
    - **Graphing the Fujita scale and finding the equation of the line.**
        - Teacher will grade answers making sure that the student understands the concept and meaning of slope, that the Fujita scale line is graphed correctly, concentrating on the x and y intercepts and the slope of the line. Additionally, the teacher will grade the answers to the questions posed throughout the class time. The questions were as follow:

        ✓ Students need to list their reason(s) for the specific labeling of their coordinate system. Teacher needs to make sure that students understand why there would only be points in quadrant one.
        ✓ Students need to calculate the slope between each pair of consecutive points and then the first and last point. Have students average the slopes.
        ✓ Students need to graph the line of best fit for the Fujita scale line in a different color on the same graph paper as their points. They need to write the equation of the line above the line.
        ✓ Students need to list their reasons for the difference, if any, between the two values for slope.
        ✓ Students need to list the slope for the Fujita scale line.
        ✓ Students need to turn in all typed data, all graphs, all answers to questions, and all calculations.
        ✓ The grade will be a daily grade.
    - **Make sure that the information for a PowerPoint presentation has been saved.**

Extension and Connections (for all students)

An extension for this particular lesson would be to recall the actual type of function created by using **ALL** points in the Fujita scale. Students would graph the step function on the same graph as their linear equation graph.

Strategies for Differentiation

The differentiation strategies might include but are not limited to the following list created specifically for ESL students. Feel free to pick and choose from these to accommodate your specific classroom environment:

- Focus on mathematical content rather than on linguistic form (simplify word problems without changing the math meaning)
- Step by step instructions (orally and in writing) ask students to repeat aloud for the rest of the class.
- Pause between sentences or thought groups.
- Use gestures and visuals to help clarify the message.
- Repeat, rephrase, and paraphrase.
- Simplify the language used rather than the mathematical concepts taught (use known vocabulary and simple sentence constructions).
- Assess whether LEP students have mastered mathematical concepts rather than their English grammar and fluency.

  The accommodations are adopted from the following source.
  http://www.doe.virginia.gov/VDOE/Instruction/ESL/LEPmathResource.pdf

Lessons 4 - 6 Putting the Pieces to the Puzzle Together: a PowerPoint Presentation

Strand
Algebra

Mathematical Objective(s)
In these lessons, students will gather information to begin the construction of their PowerPoint presentation on tornados. The PowerPoint needs to contain all graphs, equations of the lines, pictures and other pertinent information you obtained in your research. Students' presentations will count as a test grade. PowerPoint needs to contain all data, all equations and their corresponding graphs, making sure that they are graphed and labeled correctly, pictures, and other pertinent information gathered in their research. The PowerPoint needs to be no more than 15 minutes in length.

Mathematics Performance Expectation(s)

MPE.2 The student will collect and analyze data, determine the equation of the curve of best fit, make predictions, and solve real-world problems, using mathematical models. Mathematical models will include polynomial, exponential, and logarithmic functions.

MPE. 12 The student will transfer between and analyze multiple representations of functions, including algebraic formulas, graphs, tables, and words. Students will select and use appropriate representations for analysis, interpretation, and prediction.

MPE.19 Graph linear equations and linear inequalities in two variables, including
a) determining the slope of a line when given an equation of the line, the graph of the line, or two points on the line; describing slope as rate of change and determine if it is positive, negative, zero, or undefined; and
b) Writing the equation of a line when given the graph of the line, two points on the line, or the slope and a point on the line.

NCTM Standards

Grades 9–12 Algebra 1Expectations: In grades 9–12 all students should–

- generalize patterns using explicitly defined and recursively defined functions;
- understand relations and functions and select, convert flexibly among, and use various representations for them;
- analyze functions of one variable by investigating rates of change, intercepts, zeros, asymptotes, and local and global behavior;
- interpret representations of functions of two variables
- use symbolic algebra to represent and explain mathematical relationships;

- judge the meaning, utility, and reasonableness of the results of symbol manipulations, including those carried out by technology.
- approximate and interpret rates of change from graphical and numerical data.

Additional Objectives for Student Learning:

A.6 The student will graph linear equations and linear inequalities in two variables, including

a) determining the slope of a line when given an equation of the line, the graph of the line, or two points on the line. Slope will be described as rate of change and will be positive, negative, zero, or undefined; and

b) writing the equation of a line when given the graph of the line, two points on the line, or the slope and a point on the line.

A.11 The student will collect and analyze data, determine the equation of the curve of best fit in order to make predictions, and solve real-world problems, using mathematical models. Mathematical models will include linear and quadratic functions.

AII.9 The student will collect and analyze data, determine the equation of the curve of best fit, make predictions, and solve real-world problems, using mathematical models. Mathematical models will include polynomial, exponential, and logarithmic functions.

AFDA.3 The student will collect data and generate an equation for the curve (linear, quadratic, exponential, and logarithmic) of best fit to model real-world problems or applications. Students will use the best fit equation to interpolate function values, make decisions, and justify conclusions with algebraic and/or graphical models.

AFDA.4 The student will transfer between and analyze multiple representations of functions, including algebraic formulas, graphs, tables, and words. Students will select and use appropriate representations for analysis, interpretation, and prediction.

ES.13 The student will investigate and understand that energy transfer between the sun and the Earth and its atmosphere drives weather and climate on Earth. Key concepts include

a) observation and collection of weather data;
b) prediction of weather patterns;
c) severe weather occurrences, such as tornadoes, hurricanes, and major storms; and
d) weather phenomena and the factors that affect climate including radiation and convection.

Materials/Resources

- Computer lab for research, one computer per student

Assumption of Prior Knowledge

- The prior knowledge assumed by the lesson is:
    - The use of PowerPoint software.
    - The use of the Internet for appropriate researching.
- The relevant context drawn on in relation to slope and graphing linear equations is natural disasters.

Introduction: Setting Up the Mathematical Task

In these lessons, students will research tornados and construct a PowerPoint presentation on tornados.

- This lesson will take approximately three 90 minutes blocks, one block for research and the other blocks for classroom presentations.
- Introduce the lesson by going to the website http://tornadovideos.co/ and showing one or two different tornado videos to the class than was shown in the previous lesson. This will take approximately 10 – 20 minutes depending upon length of various discussions.
- The rest of the class time will be spent posing, researching, and answering the questions, constructing all the graphs for presentation, discussing the information obtained during their research, and begin the construction of their PowerPoint presentation on tornados.
- PowerPoint needs to contain all data, all equations and their corresponding graphs, making sure that they are graphed and labeled correctly, pictures, and other pertinent information gathered in their research.
- Remind students to include the Fujita scale in their presentation.
- Students need to label and mark the x axis and the y axis appropriately. Students need to neatly graph their points in one specific color.
- Students need to graph the equation of the line in a different color on the same coordinate system as their points. They need to write the equation of the line above the line.
- Students will give their classroom presentation on day 5 and if need be day 6.
- For an extra 15 points on their test grade, the teacher may have students research the strength of a tornado and the distance the debris will travel. Students can graph their information, find the equation of the line, and find the slope. Students must include all of this on the PowerPoint presentation.
- Last 5 minutes, students need to put away their supplies, shut down their computers and clean up their work area.
- During day 5 and day 6, each student will give their PowerPoint presentation.

Monitoring Student Responses

Assessment

- Assessment for lessons four, five, and six objective:

    - **PowerPoint presentation.**
        - Teacher will grade presentation making sure that the student understands the concept and meaning of slope, that each line for each state and the Fujita scale is graphed and labeled correctly, concentrating on the x and y intercepts and the slope of the line. Additionally, the teacher will grade the presentation on attractiveness, readability, attention getter, inclusion of all data, inclusion of pictures and pertinent information.
        - The grade will be a test grade.

Strategies for Differentiation

The differentiation strategies might include but are not limited to the following list created specifically for ESL students. Feel free to pick and choose from these to accommodate your specific classroom environment:

- Focus on mathematical content rather than on linguistic form (simplify word problems without changing the math meaning)
- Step by step instructions (orally and in writing) ask students to repeat aloud for the rest of the class.
- Pause between sentences or thought groups.
- Use gestures and visuals to help clarify the message.
- Repeat, rephrase, and paraphrase.
- Simplify the language used rather than the mathematical concepts taught (use known vocabulary and simple sentence constructions).
- Assess whether LEP students have mastered mathematical concepts rather than their English grammar and fluency.

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