FROM ARITHMETIC TO ALGEBRA

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GRADES 8-10

OVERVIEW

The lesson is based on the use of videos, hands on activities and graphing calculators to provide students with experiences that will show the value of algebra as a mathematical tool. Raw data is gathered through a numerical process. This data serves as a foundation to create an algebraic expression (formula) using regression models found in graphing calculators. The linear model which involves the diameter and circumference of a circle, is used to: indirectly measure the circumference of various circles; estimate the thickness of a layer of oil in a circular container; and determine the circumference of a container so that the layer of oil is of specified thickness. Students should be guided to realize how an algebraic expression complements and expands the use of raw data to graphically represent a problem. This lesson also shows how a strictly mathematical model can be used to simulate solutions to real problems such as those faced by oil spill recovery teams.

KEDT EDUCATION TELEVISION SERIES

MATH VANTAGE: How do you get it? How do you show it? (Episode #113, 114)

LEARNING OBJECTIVES

Students will be able to:
*list at least three ways of gathering data
*identify purposes for which data is gathered
*gather or generate data
*identify the independent and dependent variables
*create algebraic models for sets of data
*graph the symbolic representation using a graphing calculator if necessary
*describe the role of algebraic models with respect to data and its graph

MATERIALS

Overhead projector
Overhead projector calculator
Screen
Transparencies
Overhead projector pens different colors

Chalkboard, chalk, and eraser
Circular glass containers (1 liter, 400ml.
and 50 ml. capacities)
Oil (half quart 30w motor oil)

(three students per group)
1 graphing calculator
1 set of activity work sheets per student
1 straight edge, measuring tape, tape
4 circular objects (container tops ranging from
4 to 10 centimeters in diameter)
3 sheets of graph paper
1 pencil and notebook paper

PREVIEWING ACTIVITIES

Show students models of various objects (car, house, airplane). Ask, "What is common to all of them?" (They are not the real thing.) "Why are they so easy to identify with the real thing?" (Because of the resemblance to the actual object that they represent.) "What did the builder or manufacturer have to have to make these models look realistic?" (Accurate and detail information.)

Write on the board y= 3x-1. Ask, " Does this expression have anything in common with the models just seen?" (This information is the basis for creating models of different objects.) As they view the video, collect data, and develop a symbolic representations of the data, they should become aware that "y=3x-1" is also a model, an algebraic model. A model that can be used to represent a real life problem or situation.

FOCUS FOR VIEWING

Now you will view a video that shows how information is collected. To give the students a specific responsibility while viewing say, "Make sure that at the end you are able to list least three different ways data is collected and how it is used. Also pay close attention to what a variable is, the different types, and their function."

VIEWING ACTIVITY

Begin the *Math Vantage* video tape where the title, *"Data: How do you get it?"* is shown. **Pause** tape where Ellen says, "How come I can't seem to get through the intersection before light turns red?" Have students list the three methods of data gathering described on the video. Also have them describe how each set of data is used.

- Survey - determine factors that will make a toothpaste appealing.
- Past records- to make a decision
- Observation- to determine conditions for traffic control.)

Resume the video and let them check their answers. Next let them view how observation and simulation are used for data gathering.

Pause when you see a split screen with a fish on one side with "independent'" written below and a minnow on the other side with "dependent" written below. Ellen says "Dependent variables are number and location of minnows." Discuss meaning of variables (factors that affect results). Have students identify the purpose of Yu's experiment and why predators are independent variables while the number of minnows and location are dependent variables.

Give students the following situations and ask them to identify the dependent and independent variables:
foot length and shoe size
weight and clothes size
d = 60 * t.

Have the first student in each group measure the diameter and the circumference of each circular object in their packet to within 1/2 of a centimeter. A second student is to record the measurements on the worksheet as they are made. The third student is to plot the points on graph paper.

Ask the groups to describe the alignment of the points. Now ask students to find the diameter and the circumference of each concentric circle in their packet. Next, ask students to estimate the circumference a wheel 25 cm. in diameter. Ask, "Do you believe the information found can be used to solve the related problems?" (No because of the gaps between plotted points.)

Say, " As you can see our model cannot handle the latest problems. You now will view parts of a video that shows how data can be displayed so that it can be used more effectively."

Start the ***MATH VANTAGE*** video *How Do You Show It* segment when Ellen is ready to drop the ball from a balcony and says, "Imagine you are studying the changing height of a bouncing ball." **Pause** the video after the screen shows three line graphs and Ellen says, ". . . or the increasing population of the world."

Discuss how the line graph relates to our problem. Have students identify the dependent and independent variables and the axis assigned to each one. (The independent variable is on the horizontal axis. The dependent variable is on the vertical axis.) Have students identify the variable on their graphs.

Fast forward the video to where Ellen is running on a treadmill and says, "Instead of miles per hour, let's talk about the weight you lift." **Resume playing** the episode. **Stop** the video after you see a scatter plot graph on the screen and Ellen says, "But I can see a positive correlation between how much I practice and how much I can lift."

Identify the use of variables and the difference between their graphs and our graphs.

Resume the video. **Stop** on the picture of Ellen finishing a run and a graph showing a negative correlation between running workout and time. Ellen is saying, "So, there is a negative correlation between the number of practices and the time to run the 110 meter dash." Discuss scatter plots and the completeness of the graphs shown.

POSTVIEWING ACTIVITY

Have students convert their scatter plot into a line plot. This can be done by drawing a straight line so that it will pass through or as close as possible to all the plotted points. Show students how this model can now be used to approximate the circumferences of the concentric circles. Ask, "What type of correlation does our model have and what does it mean?" (Point out that even though our model is now more useful it still does not help with our 25 cm. diameter circle.) Ask, "Why?" (Graphic model is not large enough.) Now guide students in creating an algebraic representation of the problem by using a graphing calculator. Make sure an appropriate window is selected. Use the new graph to answer the question of the 25 cm. circle. Also use the algebraic representation to compute the circumference or diameter of any given circle. Have students estimate the circumferences of the circles on the work sheet. Ask them if it is possible to estimate the circumference of a circle of diameter .0005 from the graph. Use the model to determine the thickness of a layer of oil. Discuss the value of algebra as a model for data representation.

For homework, students are to go home and measure the height (without shoes) and arm span of everyone in their household. They are to record this information on the worksheet provided. In class the following day students are to develop an algebraic model that can be used to relate arm span to height.

ACTION PLAN

Take a field trip to an endangered species refuge, and ask how they determine the past and future growth of the specie in question.

Take a field trip to a grocery store. Choose an item for which there are different sizes. Record the size and price of each item and draw a scatter plot. If the relation is linear create an algebraic representation and use it to predict prices for different sizes.

Have a finance counselor from a local bank come to the class and explain the growth of money. Have him show some of the equations used to picture this growth.

EXTENSIONS

Science

Have each student grow a bean plant and record its growth from the time it breaks ground until it blooms. Plot this growth on a time, height graph. Next have them use the regression models in the graphing calculator to develop a symbolic representation of this phenomenon.

Medicine

Have the school nurse bring a growth chart and explain it significance. Have students take information from the chart and create a symbolic model.

Math

Use the CBL (Calculator Based Laboratory) to gather information about a person's walking speed. Determine a person's walking and/or running speed over a short period of time. Find a symbolic representation for this action.