

# **LESSON DESIGN**

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## Lesson: The Big Dig!

To be completed in 3 block- schedule of 80 minutes each.

Essential Question:

How do Archeologists and Forensic Scientists determine the height, build and age of a person based upon the lengths of major bones such as the humerus, radius or tibia?

Objectives:

- To solve a “real” problem that is connected to students’ interest and is also integrated with other curriculum areas like archeology, science and global studies.
- To see the practical aspect of mathematics, both inside and outside the classroom.
- To help students gather data, analyze data and communicate mathematically through sharing with and working with other students in a group project.
- To awaken students’ curiosity about mathematics and make connections and draw inferences between mathematics and other disciplines.

This project is intended to provide students with experience in the following activities:

- Graphing linear equations
- Identifying independent and dependent variables
- Creating a geometric model of a real situation
- Using the TI-83 plus graphing capabilities
- Using Excel spreadsheet to organize information from a graph
- Considering the limitations of a mathematical model (such as if the model relates to children as well)
- Interpreting slope in a real context
- Using various features of a graph to answer questions about a real situation

Materials needed:

- Tape measures
- Graph paper
- TI-83 plus graphing calculator
- Microsoft Excel®

INPUT:

1. To get the students to be familiar with the location of each bone.
  - a. tibia- the inner and thicker of two bones from the knee to the ankle
  - b. humerus- the bone from the shoulder to the elbow
  - c. radius- the bone from the wrist to the elbow
2. The formula for calculation
  - a. Male
$$H = 32.2 + 24t$$
$$H = 29.0 + 3.0h$$
$$H = 31.7 + 3.7r$$
  - b. Female
$$H = 28.6 + 2.5t$$
$$H = 25.6 + 3.1h$$
$$H = 28.9 + 3.9r$$
3. Directions for how to begin the project:
  - Measure the length of your radius bone to the nearest half inch  
OR boys measure boys and girls measure girls
  - Collect the data for class and display the results using Excel spreadsheet for calculating and displaying information

- Find the mean, median and mode for the data you collected for both male and female
- Write a short paragraph of your finding.

Assessment:
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Students should be able to answer some of these questions

1. Since the height depends on the length of the bones, therefore, what is the independent variable and the dependent variable?
2. Do we know what is the reasonable range and domain? i.e “How tall are people?”
3. How can we tell which is the shortest of the three bones? By determining which one has the least X value for a given Y value.
4. They should find out how tall they are and find their height on the vertical axis so that when they draw a horizontal line it can help them to review the equation of a horizontal line ( $y = a$  constant).
5. They should find a point on the vertical axis that is 5 inches less than their present height and draw a horizontal line across the graph, and determine which of the three bones grew the most while your height increased 5 inches. Which one grew the least?

They should be looking at the changes in X for a fixed change in Y values. Which one has the greatest change? This leads to the concept of slope.

6. On the graph, which two lines are nearly parallel? This leads to the concept of same slope for parallel lines in the equation  $y = mx + b$ . Rate of change is therefore tied to the concept of slope here.
7. In this model, is there a significance in the y-intercepts? Does the values of Y where the lines cross the y- axis mean anything? No, because that will make the length of bones 0 which is impossible.
8. What happens if we change the units of measure? How would the model remain the same?
9. Which method graphical or algebraic will give a more accurate length for the humerus? It only depends on if the students use a graphic calculator with a trace function, otherwise the algebraic method might be better.

NCTM Standards:

These are major key ideas espoused here:

Key Idea 4: Modeling/ multiple Representation

Key Idea 5: Measurement

Key Idea 7: Pattern/ Functions

Homework:

Because this is a 3– day block schedule project of 240 minutes total, there should be a benchmark deadlines for students to show their work in progress daily. They should share their insights with other students. Did they learn any shortcuts for doing graphs and spreadsheets? Have any mathematical ideas become more obvious?

Scoring Rubric:

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| 3 points | Appropriate types of graphs and charts were chosen. The scales are accurate. The graphs and charts are well – labeled and contain accurate formulas and calculations. The spreadsheet is easy to follow. Your reasoning and explanations are correct and clearly expressed. |
| 2 points | Student’s spreadsheet, graphs and formulas are correctly chosen and used. There are minor errors in scale or computation. Reasoning and explanations are essentially correct, but may contain awkward or unclear passages.  |
| 1 points | Some graphs or formulas are correct. Computations and scales contain errors. Explanations are barely adequate.  |
| 0 points | Major elements of the project are incomplete or missing.  |

