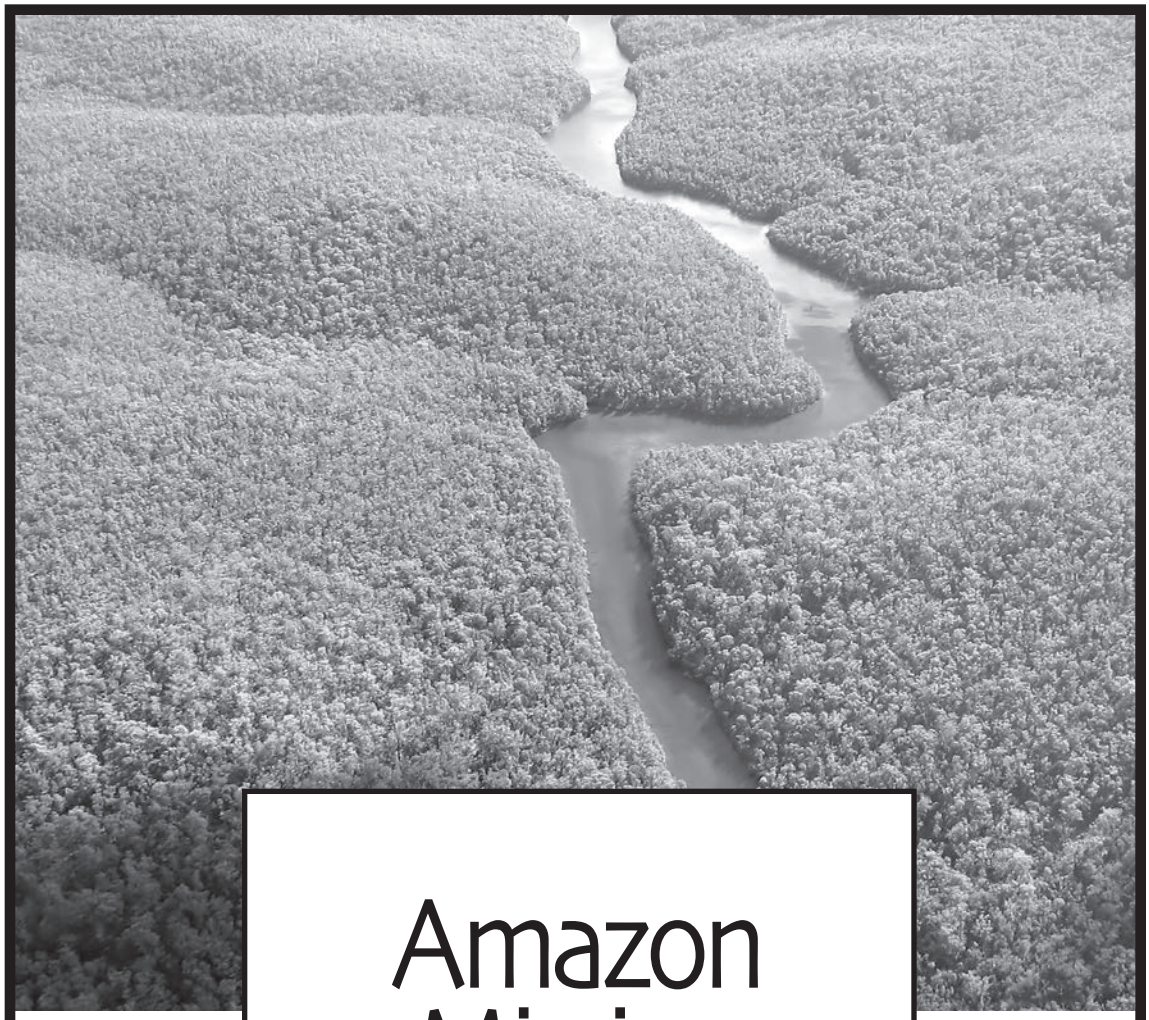

Amazon Mission

Building Math

Integrating Algebra & Engineering

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AMAZON MISSION OVERVIEW: STORY LINE AND LEARNING OBJECTIVES

	Design Challenge Overview	Students will:
DESIGN CHALLENGE 1: MALARIA MELTDOWN!	Students are responding to the needs of the Yanomami people in the Amazon. In their first challenge, they are to design a medicine carrier that can successfully transport malaria medicine. The carrier should keep the medicine within certain temperature constraints to protect it from heat, be rugged enough to prevent an egg from breaking when dropped, and be as low in cost as possible.	• calculate and interpret the slope of a line • graph a compound inequality • conduct two controlled experiments • collect experimental data in a table • produce and analyze a line graph that relates two variables • distinguish between independent and dependent variables • determine when it's appropriate to use a line graph to represent data • list combinations of up to five layers of two different kinds of materials • draw a three-dimensional object and its net • find the surface area of a three-dimensional object • apply the engineering design process to solve a problem
DESIGN CHALLENGE 2: MERCURY RISING!	As students arrive at the village, the Yanomami meet them with a new challenge—to design a water filter that can filter out at least 75% of the mercury in the freshwater near the mining operation. To do so, students research different sizes of Mercatrons, mercury-absorbing spheres. Students find which ones would meet the criteria of being low in cost and still effective at removing at least 75% of mercury from water. Students also calculate minimum and maximum flow rates for water and experiment with different factors that influence the flow rate.	• calculate the surface area of a sphere using a formula • solve a multistep problem • convert measurement units (within the same system) • use proportional reasoning • write a compound inequality statement • graph and analyze the relationship between two variables • determine when it's appropriate to use a line graph to represent data • design and conduct a controlled experiment • apply the engineering design process to solve a problem
DESIGN CHALLENGE 3: OUTBREAK!	The Yanomami are vulnerable to infectious diseases brought by outsiders. Students are challenged to select from a list of interventions to form a virus containment plan. Students conduct simulations of virus spread under different conditions, calculate percentage rate of infection with different combinations of interventions, and use their results to design a virus containment plan that would keep the percentage of infected villagers to no more than 25% for 30 days and be as low in cost as possible.	• identify and extend exponential patterns • generalize and represent a pattern using symbols • graph simulation data and describe trends • calculate compound probabilities • use a computer model • apply the engineering design process to solve a problem

CORRELATIONS TO TEXAS ESSENTIAL KNOWLEDGE AND SKILLS AND ITEEA STANDARDS *(CONTINUED)*

DESIGN CHALLENGE 1: MALARIA MELTDOWN!

Texas Essential Knowledge and Skills for Mathematics (Grades 6–8)[1]	Texas Essential Knowledge and Skills for Science (Grades 6–8)[1]	ITEEA Standards for Technological Literacy (STL)[2]
Grade 6 **8.** Measurement. The student solves application problems involving estimation and measurement of length, area, time, temperature, volume, weight, and angles. … **10.** Probability and statistics. The student uses statistical representations to analyze data. The student is expected to: **d.** solve problems by collecting, organizing, displaying, and interpreting data.	**Grade 6** **2.** Scientific investigation and reasoning. The student uses scientific inquiry methods during laboratory and field investigations. The student is expected to: **a.** plan and implement comparative and descriptive investigations by making observations, asking well-defined questions, and using appropriate equipment and technology. **c.** collect and record data using the International System of Units (SI) and qualitative means such as labeled drawings, writing, and graphic organizers. **d.** construct tables and graphs, using repeated trials and means, to organize data and identify patterns. **e.** analyze data to formulate reasonable explanations, communicate valid conclusions supported by the data, and predict trends. **9.** Force, motion, and energy. The student knows that the Law of Conservation of Energy states that energy can neither be created nor destroyed, it just changes form. The student is expected to: **a.** investigate methods of thermal energy transfer, including conduction, convection, and radiation. **b.** verify through investigations that thermal energy moves in a predictable pattern from warmer to cooler until all the substances attain the same temperature such as an ice cube melting.	**1F** New products and systems can be developed to solve problems or to help do things that could not be done without the help of technology. **1G** The development of technology is a human activity and is the result of individual and collective needs and the ability to be creative. **1H** Technology is closely linked to creativity, which has resulted in innovation. **2R** Requirements are the parameters placed on the development of a product or system. **2S** Trade-off is a decision process recognizing the need for careful compromises among competing factors.

[1]Copyright © Texas Education Agency, 2010.
[2]International Technology and Engineering Educators Association (ITEEA). 2007. *Standards for Technological Literacy: Content for the Study of Technology.* (Third ed.) Virginia.

"THE LAW FOR THE WOLVES" TEAM-BUILDING ACTIVITY *(OPTIONAL)*

Students work and communicate in teams during most of each design challenge. Some pilot teachers found it useful to do some team-building activities prior to the start of the unit. There is a different team-building activity in each of the *Building Math* books.

OBJECTIVE:

- Students read and discuss a poem about teamwork.

GROUP SIZE:

- whole class

SETUP:

- Make a copy of the poem excerpt on the next page for each student.
  OR
- Make a copy of the poem on a transparency to project on the board or wall with an overhead projector.
  OR
- Project the poem on the board or wall using a computer/LCD projector.

PROCEDURES:

1. Distribute copies of the poem or project the poem on the board or wall.
2. Read the poem together and discuss the following:
   - Why does the poet describe the law as "runneth forward and back"?
   - Why are there two parts to this law? How are they different?
   - Why is this law essential to the wolf's survival?
   - How is this poem related to teamwork?
3. Summarize: Each person has unique gifts and abilities to contribute to the group. Not only is the group strengthened because of your unique contribution, but you also grow as a person from being part of the group. You can often do more as a group than as an individual. Working together can bring out the best in each of you. Teamwork is not easy, though, because you will have to learn to share, negotiate, listen, and compromise; you may not always get your way.

THE LAW FOR THE WOLVES (ABRIDGED)

Rudyard Kipling

Now this is the law of the jungle,
as old and as true as the sky,
And the wolf that shall keep it may prosper,
but the wolf that shall break it must die.

As the creeper that girdles the tree trunk,
the law runneth forward and back;
For the strength of the pack is the wolf,
and the strength of the wolf is the pack.

AMAZON MISSION PREREQUISITE MATH SKILLS (*OPTIONAL*)

STUDENTS SHOULD BE ABLE TO			
MATH SKILL	1. MALARIA MELTDOWN!	2. MERCURY RISING!	3. OUTBREAK!
Make a line graph.	✓	✓	✓
Find the slope of two points on a line or curve.	✓		
List combinations.	✓		
Calculate the surface area of prisms, cylinders, and other 3-D objects.	✓		
Draw the net of common 3-D objects such as prisms, cylinders, cones, and so forth.	✓		
Use a formula to calculate surface area.	✓		
Represent lower and upper constraints as a compound inequality.	✓	✓	
Measure length (in metric units) using a ruler.	✓	✓	
Convert units within a measurement system and use proportional reasoning.		✓	
Recognize exponential patterns and represent them using symbols or variables as direct and recursive equations.			✓
Calculate compound probabilities.			✓

*** Bold text indicates key objectives.**

HOW TO USE THE WORKSHEETS

Use the following tips for review and reinforcement as needed.

1. Line Graph Activity (pages 5–9)
    - The goal of this activity is for students to:
        - make a line graph
        - identify independent and dependent variables
        - use convention to put the independent variable on the *x*-axis and the dependent variable on the *y*-axis
        - use range of data to set up scales on axes so that the data is well spread out
        - use equal intervals when setting up scales on axes
        - label the axes with data type and unit
        - label the graph with an appropriate title
    - Use Exercise 1 to guide students through the steps of constructing a line graph—particularly steps 2 and 3 (scaling the axes).
    - If students need additional guidance in scaling the axes, use the Line Graph Scaling Examples on pages 10–13.
    - Assign students to do Exercise 2 on their own or with a partner.

2. Converting Units Activity (pages 14–16)

    The goal of this activity is for students to convert units within a measurement system and use proportional reasoning.
    - Before distributing the problems, go through the activity with students.
    - Assign students to work through the problems on their own or with a partner.

3. Representing Patterns Activity (pages 17–20)
    - The goal of this activity is for students to recognize exponential and linear patterns, and represent them using symbols or variables as direct and recursive equations.
    - Go over Example 1 with students.
    - Assign students to work through the problems on their own or with a partner.

LINE GRAPH ACTIVITY

A line graph is a way to visually show how two sets of data are related and how they vary depending on each other. Line graphs are particularly effective for showing change over time, predicting what comes next, or estimating what happened in between data points.

HOW TO CONSTRUCT A LINE GRAPH ON PAPER

STEP	WHAT TO DO	HOW TO DO IT
1	Identify the variables.	a. Ask yourself, "Which of the variables did I control or vary?" These values (independent variables) are the ones that you measure or choose before conducting the experiment. b. The *x*-axis (horizontal) typically represents the independent variable. c. Ask yourself, "Which of the variables was affected as a result of the experiment?" These values (dependent variables) are the ones that you measure during the experiment that correlate one-on-one with the independent variable values. d. The *y*-axis (vertical) typically represents the dependent variable.
2	Determine a scale for each axis.	a. Your goal in determining a scale for the axes is to fit the entire range of data over the available space on the graph paper. b. Find the range of the data values (lowest to highest values). If necessary, round down the lowest data value and round up the highest data value to the nearest whole number or power of 10. Find the difference. c. Count the squares on the axis that you want to use to represent the range. It is fine to round down. If your data doesn't start at 0, subtract 1 from the number of squares. d. Determine the scale: data range to total number of boxes along the axis. i. If total number of boxes is greater than the data range: • (total number of boxes) ÷ range = *a* • *a* represents the number of boxes in between each whole interval value • round UP if necessary ii. If total number of boxes is less than the range: • range ÷ (number of boxes) = *b* • *b* represents the interval value of each box • round UP if necessary
3	Number and label each axis.	a. Mark the scale values on each axis. b. Label each axis with the type of data and unit.
4	Plot the data points.	a. Plot each pair of data values (independent-dependent pair) on the graph with a dot. b. You may have multiple sets of dependent-variable data. If so, use a different color to plot each set of data pairs.

ANSWER KEY

LINE GRAPH ACTIVITY

Exercise 1

1. Mileage; it is an "input."
2. Value; it is an "output."
3. *x* mileage (independent variable)
4. *y* value (dependent variable)
5. a. 0–120,000; 120,000
   b. 25
   c. 120,000, 25; data range is greater than number of boxes so 120,000 ÷ 25 = 4,800
   d. Every box is worth 4,800.
   e. *x*-axis should be labeled "Mileage" with appropriate units.

6–7. See sample graph; answers will vary.

Sample graph: