EXPLORATIONS

Activity 2

Lifting a Lion

Concepts/Skills

- Multiplication
- Division
- Ratio
- Measurement
- Problem-solving
- Work
- Force
- Energy
- Simple machines

Materials

- TI–15 calculators
- *How Do You Lift a Lion?* by Robert E. Wells, Christy Grant (Editor), Albert Whitman & Co.; ISBN 0807534218
- Ruler
- Meter stick or thin but not pliable board with meter stick attached with tape
- 3 Pencils taped together in a triangular prism shape or other object for fulcrum
- Small toy lion (or other small bean-bag type animal)
- Balance
- Stacking gram masses, or balls of clay or washers weighing about 1 – 5 grams each
- Paper, pencils

Overview

Students will work in cooperative groups to solve a real-world problem presented by the book: *How Do You Lift A Lion?* Using a toy lion and a lever, students will discover how much work is needed to raise the toy lion. They will use proportions to determine the force needed to lift a real lion.

Focus

Read the first section of the book *How Do You Lift A Lion?* by Robert E. Wells to the students. Discuss with the students the parts of a lever shown in the book. Demonstrate making a lever by using a 12-inch ruler with a pencil as a fulcrum. (Note: Do not use the meter stick for the demonstration since doing so will reveal part of the solution.) Place a 5-gram mass (load) at one end of the ruler. Place the pencil (fulcrum) at the 6-inch mark. Have students guess how much weight it will take to lift the five grams. Place masses on the other end of the ruler until the 5-gram mass is lifted. Move the pencil to another location closer to the 5-gram mass. Have students predict how much weight it will take to lift the 5-gram mass. Place masses on the other end of the ruler until the 5-gram mass is lifted. Repeat the process with the fulcrum in two other locations. Write the information in a chart and have the students look for patterns.

Presenting the Problem

1. Review the four steps of problem solving with the students:
   - understanding the problem
   - making a plan
   - carrying out the plan
   - evaluating the solution

   Have the students read *The Problem* page and paraphrase the problem. Make sure the students are clear on what the problem asks.
2. Discuss with students the information on *The Problem* page. Make sure they understand how to create a lever with the meter stick or board and pencils. Remind them of the procedures used in the focus to lift the 5-gram mass.
3. If groups have difficulty with the problem, use the *Things to Consider* page. This page provides guiding questions to help the students complete the problem-solving steps.
4. The presentation should include the mathematics used to predict how much weight it would take to lift the real lion.

Evaluating the Results

1. After the presentations are made, have students examine the various solutions presented.
   - *How are the presentations similar?*
   - *How are the presentations different?*
2. Ask them to compare the numbers used.
   - *Did all groups use the same numbers?*
   - *Why do you think this is so?*
3. Ask them to determine the reasonableness of the results.
   - *Did each group answer the question?*
   - *Do the numbers used make sense?*
   - *Did all of the groups consider all of the variables?*
4. Ask them to evaluate how each group used the calculator to solve the problem.
5. Ask them to extend their thinking.
   - *How does the weight of the load impact the amount of force needed to lift it with a lever?*

Student Activity

Name _____

Date _____

Activity 2

Lifting a Lion

The Problem: How much effort will it take to lift a lion with a lever?

Lifting a real lion would be a difficult and dangerous task. So you are going to lift a small toy lion instead. You will use a meter stick as the lever and 3 pencils as the fulcrum. Using the information you gather, your team will predict how much work it will take to lift a real lion.

The Facts

- The position of the fulcrum makes a difference in how much effort it takes to lift an object.
- Effort can be measured in terms of weight, such as grams or ounces.
- Proportions can help compare different things, such as comparing a toy lion to a real lion.
- An average full-grown adult lion weighs between 265 and 500 lbs.
- An average full-grown adult lion is between 8 and 10 feet in length.
- One pound is equal to about 454 grams.
- One kilogram (1000 grams) is equal to about 2.2 pounds.

The Task

1. Your team will create a chart showing the following information:
   - The amount of work it takes to lift the toy lion with the fulcrum 50 cm from the toy lion
   - The amount of work it takes to lift the toy lion with the fulcrum 25 cm from the toy lion
   - The amount of work it takes to lift the toy lion with the fulcrum 75 cm from the toy lion
   - The predicted amount of work it will take to lift a real lion using a 100 foot lever with the fulcrum 25 feet, 50 feet, and 75 feet from the lion

2. Each person on the team will write an explanation of the team's solution. This explanation will answer these questions:
   - How did you measure the amount of work it took to lift the toy lion? Did the position of the fulcrum make a difference? Why do you suppose that happened?
   - How did you calculate the amount of work it would take to lift a real lion? How did knowing the weight of the toy lion help you in your calculations?
   - If you were going to lift a real lion, where would you place the fulcrum? Why?

Things to Consider

Understanding the Problem

Read *The Problem* page, and then answer these questions.

- How much weight did your teacher lift with the 12-inch lever?
- How much mass was used to lift the load?
- What difference did the placement of the fulcrum make?

Making a Plan

Before you make your plan, answer these questions.

- How will you keep the masses on the lever?
- How will you keep the toy lion on the lever?
- How will you use the information from the toy lion to answer the questions about the real lion?
- The weight for the real lion is a range. What number will you use when you calculate the amount of force needed to lift the lion?

Carrying Out the Plan

Before you begin planning your presentation, answer these questions.

- What does your presentation have to include? Do you have all of the necessary information? What other calculations do you need to make?
- How will you display your information? What type of chart could you make to display the information? What calculations are needed to make your predictions for the real lion?

Evaluating the Solution

- Did you answer the question? How do you know?
- Does your answer make sense? If you move the fulcrum away from the load, does it take more or less effort to lift the lion? Did this happen with all of the different loads?
- Did everyone in the group write an explanation?

Using the Calculator

Name _____

Date _____

Lifting a Lion: Using proportions

Miss Kleid is helping plan the refreshments for Field Day. She wanted to know everyone's favorite ice cream flavor so she could order enough ice cream. She surveyed her class. Out of her class of 22 students, 10 students preferred chocolate ice cream, 8 preferred vanilla, and 4 preferred strawberry. Miss Kleid knows there are 531 students at school. How can she predict how many ice cream cups in each flavor she needs?

1. Miss Kleid decides she needs to know the fractional part of her class that likes each flavor. Since there are 22 students in her class, $^{10}/_{22}$ like chocolate, $^{8}/_{22}$ like vanilla, and $^{4}/_{22}$ like strawberry. She decides to simplify the fractions.

Press:	The display shows:
10 [n] 22 [d] [Simp] [Enter]	

How does the result help Miss Kleid?

2. Miss Kleid decides that simplifying the fractions doesn't help at all. She needs to know what $^{10}/_{22}$ of 531 students is. Next she tries this:

Press:	The display shows:
10 [n] 22 [d] [×] 531 [Enter]	

Does this answer make sense for the number of people in the school who like chocolate ice cream? How do you know? What should Miss Kleid do about the fraction part? What would happen if she simplified the mixed number?

Press:	The display shows:
Simp Enter	

Does the simplified fraction help?

3. Try the other two fractions and multiply them by 531 to predict the number of students who will prefer vanilla or strawberry ice cream. Do you have fractional parts? What should Miss Kleid do with the fractions to make sure there is enough ice cream for everyone?