Overview

Students will work in cooperative groups to solve a real-word problem by using 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.

Grade Levels: 4–6

Concepts

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

Materials

- TI-15 Explorer™ calculators
- *How Do you Lift a Lion?*
  Wells, Robert E. (Park Ridge, IL: Albert Whitman and Company, 1996)
- Paper, pencils
- Ruler
- Poster paper
- Meter stick or thin, but not pliable, board with meter stick
- 3 pencils taped together in a triangular prism shape or other object fulcrum
- Small toy lion (or other small bean-bag type animal)
- Stacking gram masses, or balls of clay or washers weighing about 1 – 5 grams each
- Student activity sheet

Assessment

Throughout the activities, questions are included for formative assessment. Student work samples should be used as a check for understanding. Have the students use the TI-15 to show their calculations.

Modified from Lifting a Lion, from A World of Mathematics: Activities for Grades 4, 5, 6 using the TI-15

Introduction

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 5 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 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
2. Have the students read the Problem page and paraphrase the problem. Make sure the students are clear on what the problem asks.
3. Discuss with students 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 Introduction to lift the 5-gram mass.
4. 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.
5. The presentation should include the mathematics used to predict how much weight it would take to lift the real lion.

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Evaluating the Results

1. After the presentations are made, have students examine the various solutions presented.

Questions for Students:

- *How are the presentations similar?*
- *How are the presentations different?*

2. Ask them to compare the numbers used.

Questions for Students:

- *Did all groups use the same numbers?*
- *Why do you think this is so?*

3. Ask them to determine the reasonableness of the results.

Questions for Students:

- *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.

Question for Students:

- *How does the weight of the load impact the amount of force needed to lift it with a lever?*

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SOLUTIONS

Student Activity

Name _____

Date _____

Lifting a Lion

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

In the first part of the activity, team members will make a chart showing the amount of work it takes to lift a toy lion with the fulcrum at various distances from the lion. Then they will predict the amount of work it will take to lift a real lion with the fulcrum at different distances. Students will write an explanation about their solution process. Answers will vary based on the explanations.

Using the Calculator

Using Proportions

Use the TI-15 calculator to solve this problem:
Ms. 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. Ms. Kleid knows there are 531 students at school. How can she predict how many ice cream cups in each flavor she needs?

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

Press	The display shows:
10 [n] 22 [d] Simp Enter	Answer: $\frac{5}{11}$

How does the result help Ms. Kleid?

Possible answer: The fraction is easier to calculate with, but it does not help her.

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2 Ms. Kleid decided that simplifying the fractions doesn't help at all. She needs to know what $\frac{10}{22}$ of 531 students is. Next she tries this:

Press	The display shows:
10 [n] 22 [d] [×] 531 [Enter]	Answer: $241\frac{8}{22}$

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

Press	The display shows:
[Simp] [Enter]	Answer: $241\frac{4}{11}$

Possible answer: Yes the answer makes sense because a little less than half of the students in Ms. Kleid's class preferred chocolate ice cream and 241 is a little less than half of 531. Ms. Kleid should round the fraction part up to the nearest one.

Does the simplified fraction help?

Possible answer: no

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

Answer: $193\frac{1}{11}$ students in the school prefer vanilla ice cream and $96\frac{6}{11}$ students prefer strawberry ice cream. Yes there are fractional parts. Mrs. Kleid should round the fractional parts up to the nearest whole number.

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