EXPLORATIONS

Activity 6

Light Years Away

Concepts/Skills:

Scientific notation, problem solving skills

Calculator:

TI-30Xa SE or TI-34

Objectives:

Student develops models for a light year and compares numbers written in scientific notation and in "regular" notation.

Getting Students Involved

Discuss careers that students might think about entering. Help students identify disciplines in which scientific notation might be needed.

- Why do we need to know about scientific notation?

  Calculators can't display extremely large or extremely small numbers without using scientific notation.

- In what areas of work might one use scientific notation?

  Any science-related area; for example, space travel, astronomy, microbiology, medical research.

Making Mathematical Connections

Discuss strategies for solving problems like those in this activity. Begin with a simple example for which students can compute the answer using paper and pencil.

- If a car costs $25,000, how would you find the value of the 6 cars being carried on a transport truck?

  Multiply 6 and 25,000.

- Why would you multiply?

  You can think of 6 equal piles of $25,000, and instead of adding 25,000 six times, you can multiply. Multiplication is a faster way to do addition.

- How would you find the value of all the cars on 8 trucks?

  Multiply 8, 6, and 25,000.

- Why would you multiply these three numbers?

  Multiplying is faster than adding.

You can relate these problems to science by talking about *unit analysis* or *dimensional analysis*. In unit analysis, treat the units for each quantity as a fraction, and "cancel" units just like you would cancel common factors in numbers.

$$\frac{25{,}000 \text{ dollars}}{\text{car}} \times \frac{6 \text{ cars}}{\text{truck}} \times 8 \text{ trucks}$$

$$\frac{25{,}000 \text{ dollars}}{\cancel{\text{car}}} \times \frac{6 \cancel{\text{ cars}}}{\cancel{\text{truck}}} \times 8 \cancel{\text{ trucks}}$$

$$= 25{,}000 \times 6 \times 8 \text{ dollars} = 1{,}200{,}000 \text{ dollars} = 1.2 \times 10^6 \text{ dollars}$$

If necessary, review use of the EE key on the TI-30Xa SE and EXP key on the TI-34.

➠ Transparency Master E: Show Scientific Notation

Carrying Out the Investigation

You can use 3,000 miles as the approximate distance from New York to San Francisco, or you can have students look up the exact distance.

If students are not sure of how to begin, remind them of how they solved the sample problem about the cost of cars.

- How can you adapt the solution strategy for the "car problem" to solve these problems? — *Decide which numbers to multiply.*

Making Sense of What Happened

- Which answers surprised you the most? Why? — *Students may have expected either much smaller or much greater answers.*
- Do you think anyone in this class will ever travel to another galaxy? Why? — *Probably not, since spacecraft probably won't travel that fast.*

Continuing the Investigation

- Find the distances to several other stars and find out how long it would take a shuttle to reach each one from earth.
- Find the distances between our galaxy and the nearest other galaxy.
- Is it reasonable to believe that humans will ever travel to another galaxy?
- What would life be like if humans could travel at the speed of light?
- If you could travel at the speed of light, how long would it take you to get from home to school? How much later could you sleep every morning?
- Encourage students to investigate Einstein's theory of relativity to know what travel at such high speeds would really mean.

Solutions

1. 186,000 miles or 1.86^{05} miles
2. 11,160,000 miles or 1.116^{07} miles
3. 669,600,000 miles or 6.696^{08} miles
4. 1.60704×10^{10} miles
5. 5.865696×10^{12} miles
6. Keystrokes: **186000 × 60 × 60 × 24 × 365**
7. Chris just dropped the zeros on all the factors.
8. Keep track of the five dropped zeros and add them back on to Chris' answer.
9. 1,080 miles per year
10. About 172 years
11. 5.4312×10^{09} years (5,431,200,000 years)
12. 31 weeks
13. In 10 years, Chris flies 3,120,000 miles. This is about 5.32×10^{-07} of a light year.
14. 7.75 trips
15. 244,404,000 trips
16. 1.955232×10^{10} days or 53,568,000 years
17. 153,300,000 miles or 1.533^{08} miles
18. Answers will vary, depending on the age of the student. It would take about 153,051 years, so a 13-year-old student would be 153,064 years old.
19. A 13-year-old student would have 52 years to travel, so the super shuttle would have to travel about 51,507,692 miles per hour (about three thousand times as fast as the space shuttle).
20. A 13-year-old student would have 5 years to travel, so the super shuttle would have to travel about 535,680,000 miles per hour.