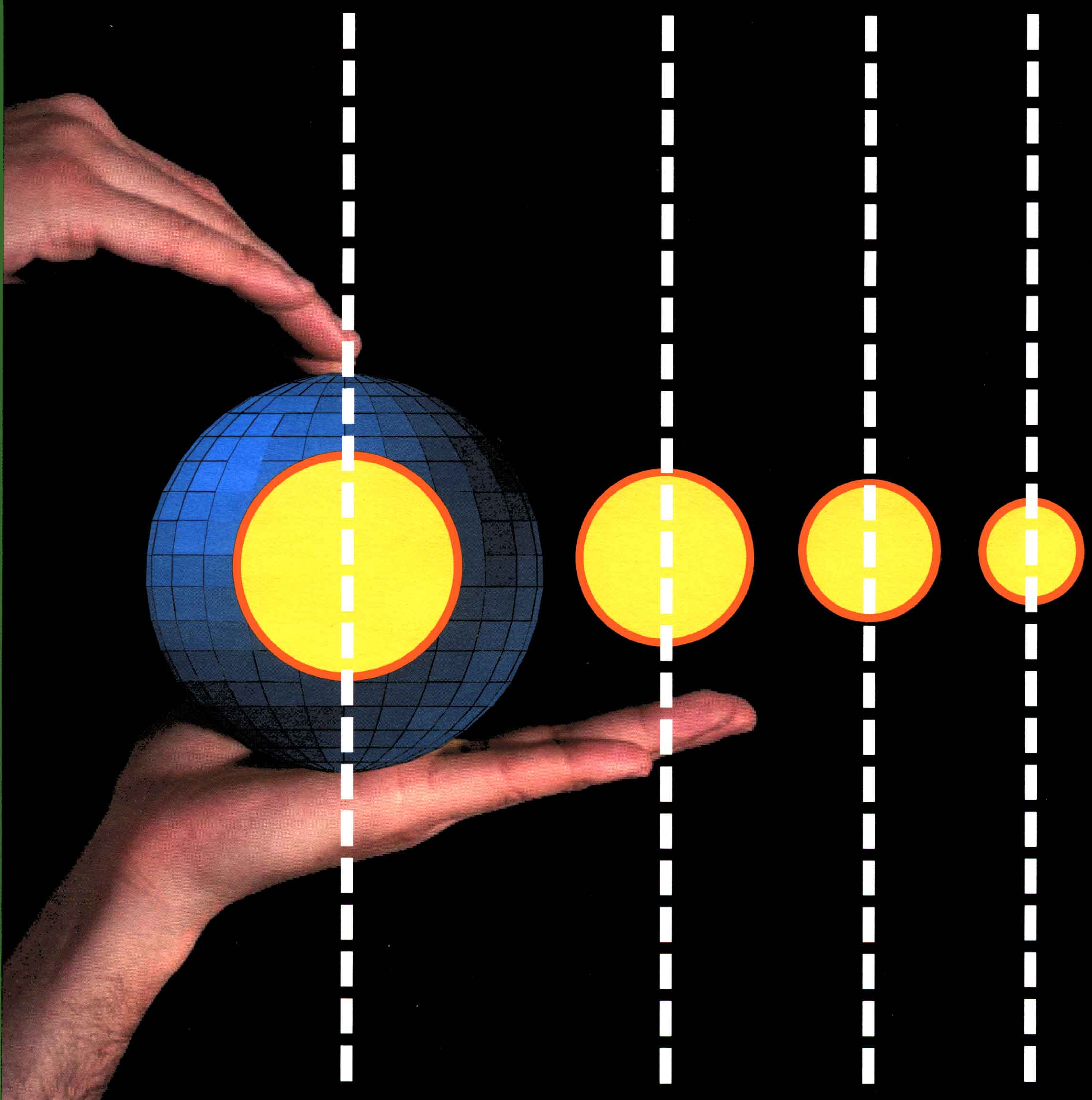
Math Reader

MATH EXPERIMENTS



Vol. 2.6 March 2000

Math Reader

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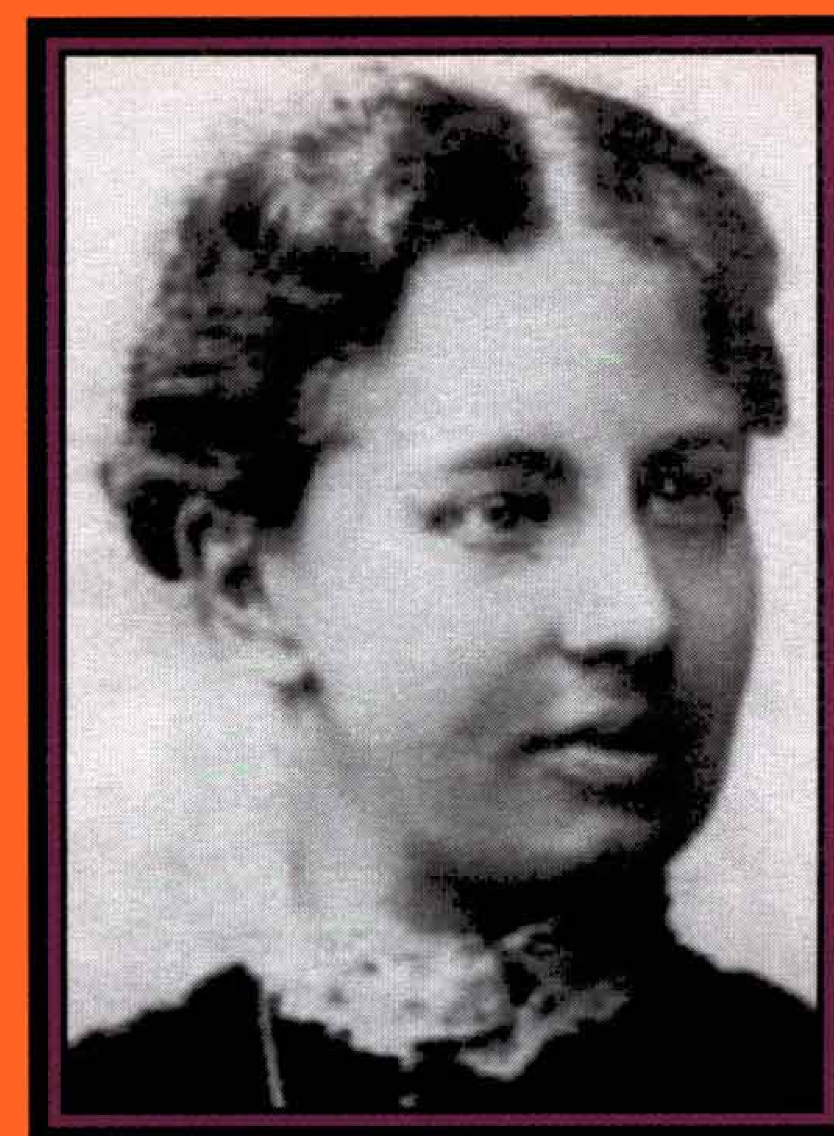
SWT

Sonya Kovalevsky

by Jean Davis



Sonya Korvin-Krukovsky (sometimes referred to as Sofia Kovalevskaya) was born in Moscow, Russia on January 15, 1850. Her parents were well-educated members of the Russian nobility. She was educated as a child by tutors and showed an interest in mathematics at a young age.

Her introduction to calculus came in a very interesting and unusual way. The children's bedroom at her family's country estate was temporarily wallpapered with old calculus papers. During naptime, Sonya would lie in her bed for hours trying to make sense of the strange words and symbols. Later, when she studied this branch of mathematics, she understood the ideas very quickly because the symbols and equations were like old friends.

Sonya struggled her whole life to win permission to study mathematics. Her father was against it, but was persuaded by one of her teachers to give her private lessons. Women in Russia were not allowed to study at university, so the only way Sonya could attend college was to go to another country. Her father, however would not give her permission to travel, and unmarried women could not travel by themselves. So, at age 18, Sonya married Vladimir Kovlevsky, and in 1869 they both went to Germany to study.

Sonya studied first in Heidelberg, then in Berlin with one of the leading mathematicians of the day, Karl Weierstrass. She became his best student and in 1874, with his recommendation, she was awarded a doctorate from the University of Gottingen. This was a little unusual because she had never attended classes there.

Women in her time were not allowed to hold teaching positions at European universities, so for the next nine years Sonya virtually abandoned mathematics. But her

(continued on p.7)

Jean Davis teaches math at Southwest Texas State University

PROBLEMS OF THE MONTH

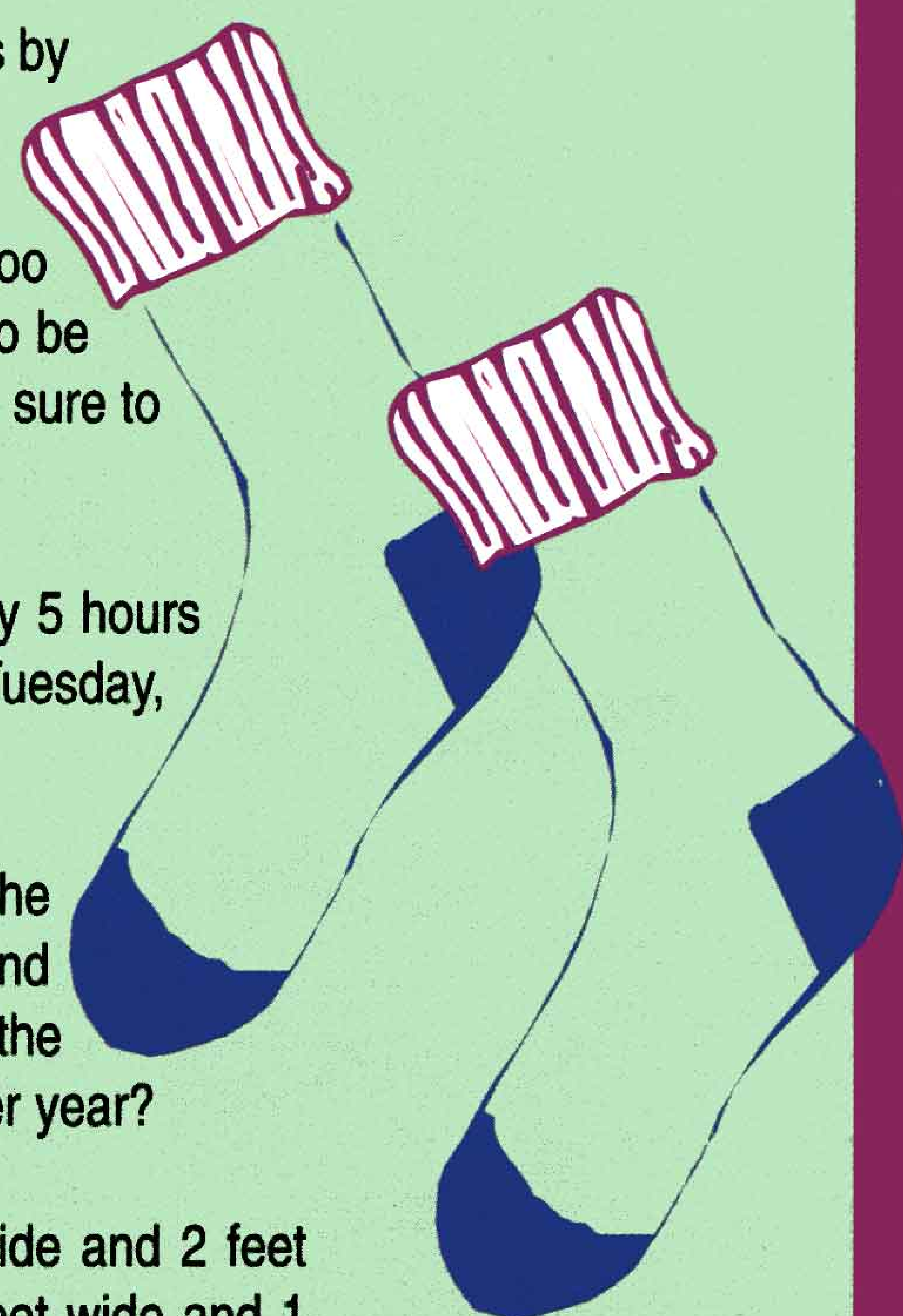
1. What are the next 4 numbers that follow the pattern?
3, 7, 6, 10, 9, 13, 12, __, __, __, __

Send us your solutions! Every month, we will publish the best solutions on our website: www.mathexplorer.com. If we print your solutions, we will send you and your teacher free **Math Reader** pens!

2. Given any four points, what is the largest number of straight lines that you can draw so that each line goes through at least 2 points?

3. How many numbers between 2 and 222 have the digit 2 in them?

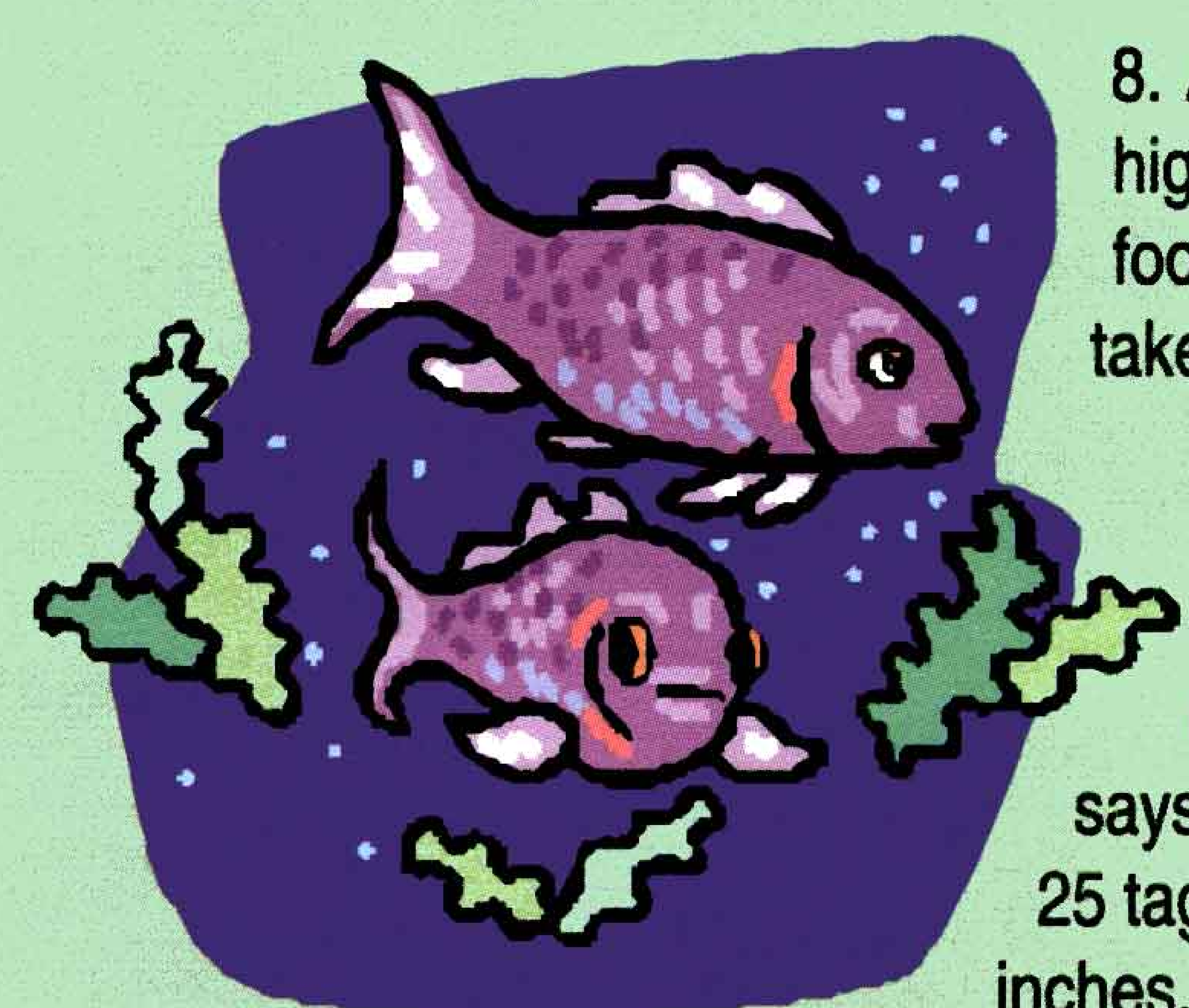
4. A small table top is covered with 20 square tiles which are each 6 inches by 6 inches. What is the area of the table top in square feet?



5. A drawer contains 8 red socks, 8 blue socks and 10 black socks. If it is too dark to see the colors, how many socks must you take from the drawer to be sure to have two of the same color? How many socks must you take to be sure to have 2 blue socks?

6. Peter is ill. He has to take medicine A every 8 hours, medicine B every 5 hours and medicine C every 10 hours. If he took all three medicines at 7 A.M. on Tuesday, when will he take them altogether again?

7. A county in South Texas has averaged 31 inches of rain per year for the last 100 years. During the last 3 years it has rained 40 inches, 18 inches and 28 inches respectively. How many inches of rain must there be this year in the county in order for the average over the 4 years to be 31 inches of rain per year?



8. A blue box is 4 feet long, 3 feet wide and 2 feet high. A green box is 10 feet long, 2 feet wide and 1 foot high. Which box has the most volume? Which box takes more wood to make?

9. INGENUITY: A farmer has a big pond. He does not know how many big fish (longer than 12 inches) are in the pond. A friend, who is a biologist, says she can estimate the number of fish. She releases 25 tagged fish into the pond that are each longer than 12 inches. After a week, she uses a net to catch fish in many spots around the pond. She catches 40 long fish and 10 of them are tagged. How many long fish does she estimate there are in the pond? Why did she wait a week after releasing the fish to catch her sample of fish?

WOULD YOU LIKE

by Eugene Curtin

Once upon a time there were two brothers, Mike and Mark, who were almost identical. They had exactly the same proportions. Only Mark was 5 feet tall and weighed 100 pounds, and Mike was 50 feet tall and weighed...well, what do you think he weighed?

Perhaps you think Mike will do well in sports, but first of all let's think about whether Mike will even be able to get out of bed in the morning. How would his feet feel if he stands up?

The great scientist Galileo, who lived from 1564 to 1642, realized that math could be used to figure out some of the problems that a giant like Mike would face. To see how math is relevant, we need to start with area and volume.

Remember that for a rectangle,

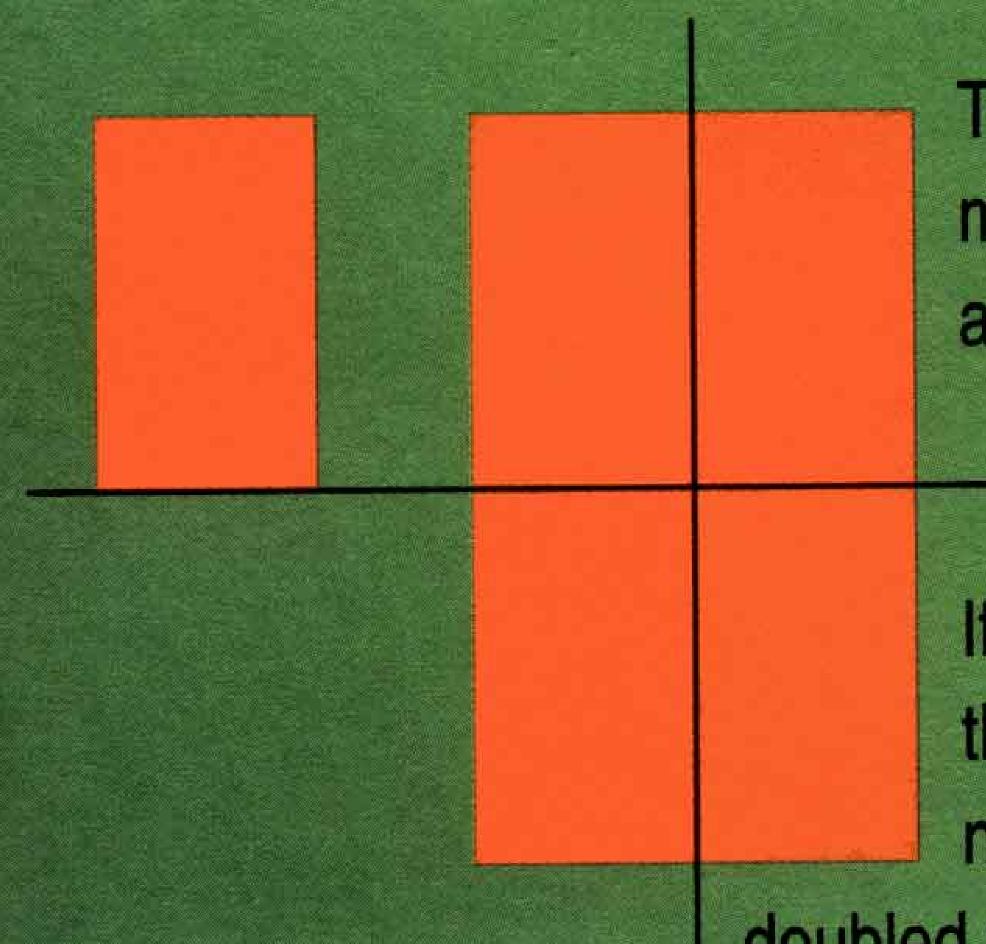
Area = Length x Width

and that for a rectangular prism,

Volume=Length x Width x Height.

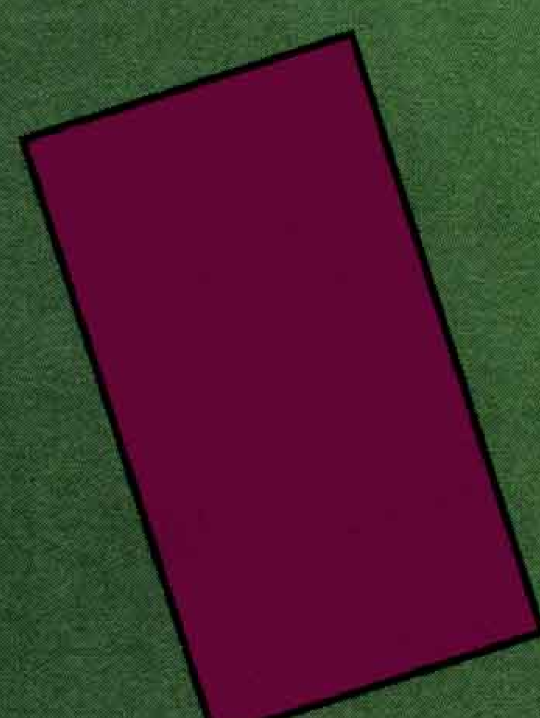
Length, width and height are called dimensions.

What is the area of a rectangle with length 6 centimeters and width 4 centimeters? And what is the area of a rectangle with the same shape, but whose length is twice as long?



To get the same shape, you must multiply the width by 2 also. We call this *scaling* the rectangle by a factor of 2.

If you worked this out, then you might have noticed that when you doubled the dimensions the area got multiplied by 4. The first rectangle has area 24 square centimeters and the second has area 96 square centimeters. 24 x 4 =96. What hap[illegible] to the area if you scale by a factor of 3?



Try some different examples of re[illegible] scale factors. Perhaps you dis[illegible] following rule:
If you scale a rectangle by [illegible] R, then the area gets multiplied [illegible]

Now try to discover [illegible] principle for volumes. Start wi[illegible]ox of length 3 centimeters, [illegible] 2 centimeters and height 2 centime[illegible] What are the dimensions of a box wi[illegible] same shape but twice as high? How [illegible]y times larger is the volume of the bi[illegible]ox? Try the same problem with [illegible]ent numbers until you discover a pattern.

If you scale a rectangular prism by a factor of R, then the volume gets multiplied by R^3.

It has been known since Archimedes' time that these scaling principles apply to objects of any shape, not just rectangles and rectangular prisms. Check out how they work for some

TO BE A GIANT?

regular shapes for which you can find area and volume formulas. Can you see how the principles apply to the circle, the sphere and the cylinder? In fact the principles even apply to irregularly shaped objects like Mike and Mark.

Mike is 10 times as tall as Mark, so we have to scale Mark by a factor of 10 to get Mike. His volume is 10^3(or 1,000) times that of the 5-foot Mark. The weight of a person is roughly proportional to his volume, so Mike will weigh about 100,000 pounds!

What about the pressure on Mike's feet? Well the area of the bottom of his foot is 10^2(or 100) times the area of Mark's feet. But they have to support 1000 times as much weight. Even if we do not know the area of Mark's feet, the formula

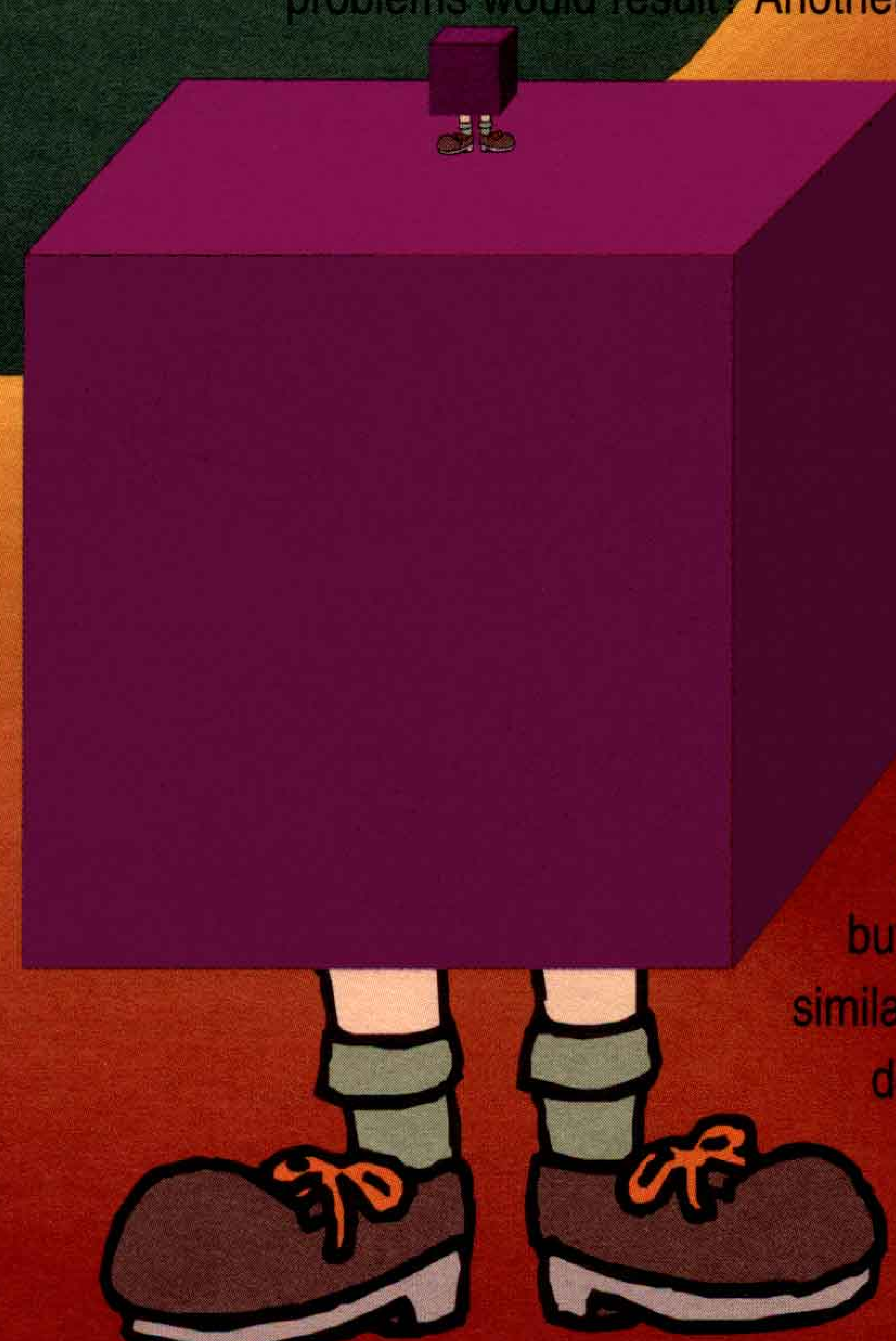
$$\text{Pressure} = \frac{\text{Weight}}{\text{Area}}$$

allows us to compare the pressure on Mark's feet and on Mike's feet.

Mike's Pressure = Mike's Weight/Mike's Area
= 1000 x Mark's Weight/ 100 x Mark's Area
= 10 x Mark's Weight/ Mark's Area
= 10 x Mark's Pressure

This explains one of the problems for a giant like Mike. His feet are made of the same material as ours, but have to withstand 10 times as much pressure. Mike is in danger of breaking his legs if he gets out of bed!

There are many problems with scaling a person, a plant, an animal or indeed any physical structure. Scientists since the time of Galileo have been pondering these problems. Think about the animal kingdom. There are some giant birds (ostriches), but they don't fly! There are no insects the size of elephants. Why not? Why are elephants the shape they are? We have been thinking about the problems of scaling up. What if you scaled yourself down to the size of an ant. What problems would result? Another interesting thing to think about is why the problem of scale may not be as drastic in the ocean. A whale and a dolphin are of vastly different sizes, but have quite similar shape and design.



The author, Eugene Curtin, teaches math at Southwest Texas State University, and is a 2-time chess champion of the state of Texas.

Puzzle Page

Math Readers: We want to print your work! Send us original math games, puzzles, problems, and activities. If we print them, we'll send you and your math teacher free **Math Reader** pens.

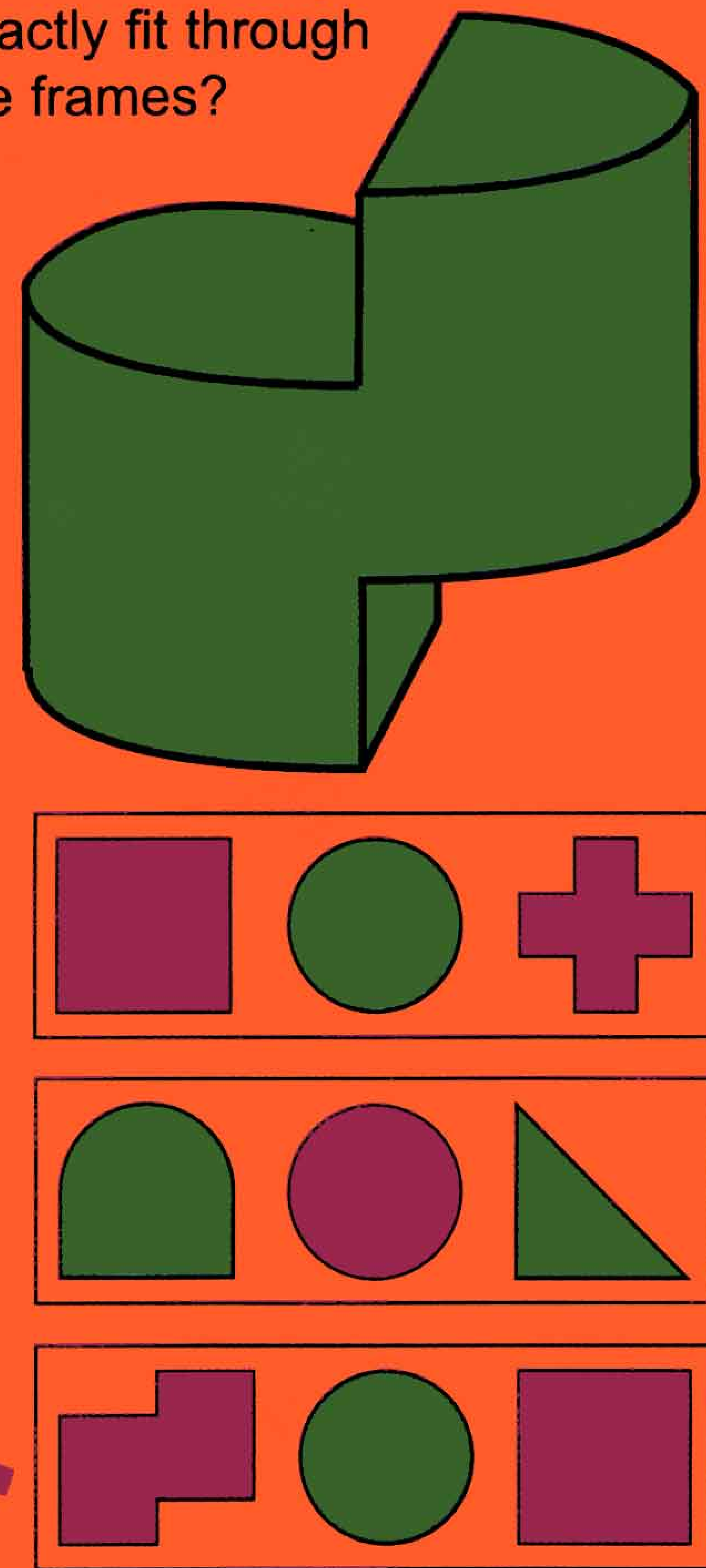
Word Search

Forwards or backwards, up, slanted, or down. Where can the words in this puzzle be found?

AREA
LENGTH
WIDTH
HEIGHT
PRESSURE
WEIGHT
ORBIT
PATTERN
LINE
DIGIT

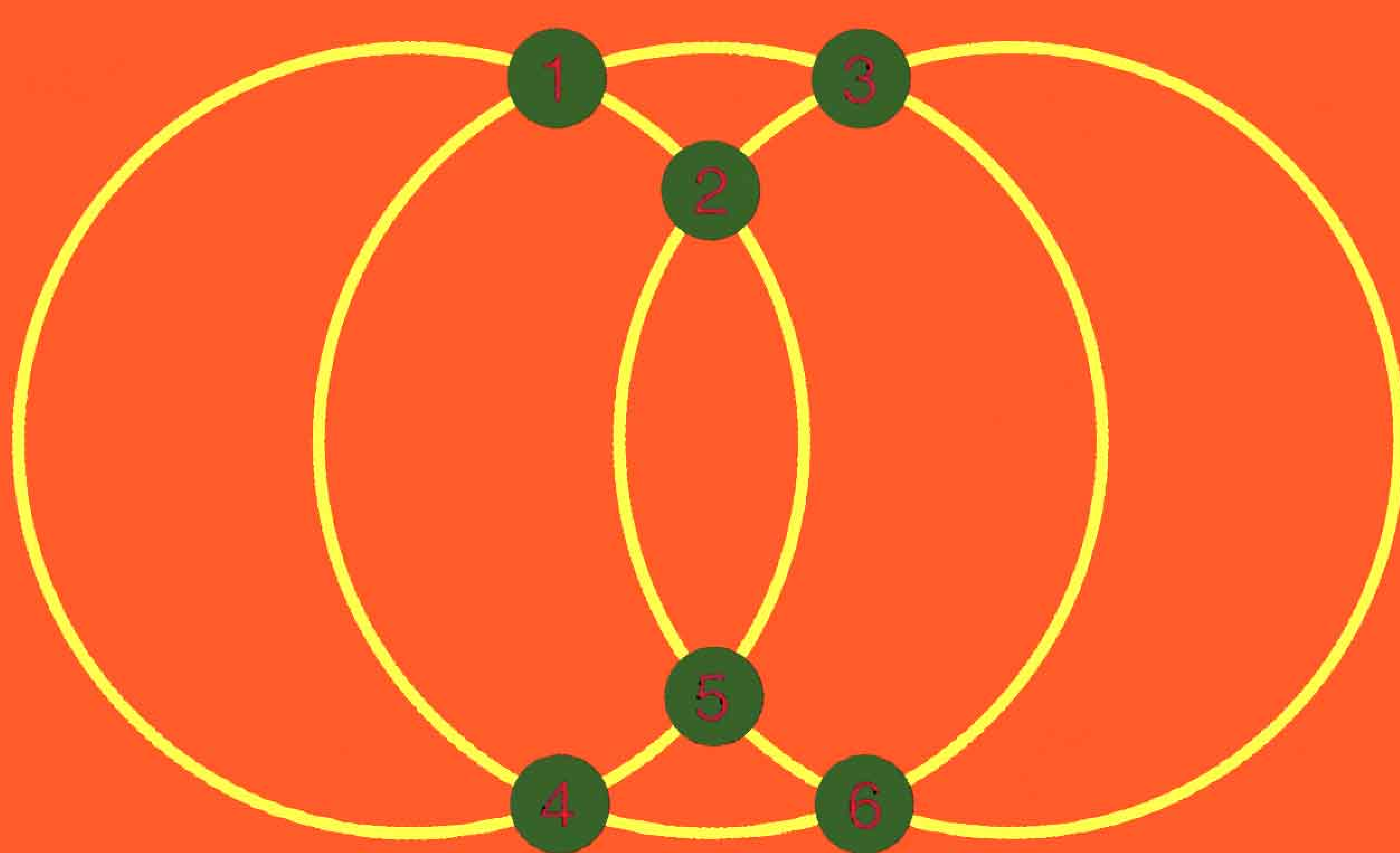
S	S	X	L	E	E	D	A	H	S	H	S	E	B
W	T	E	I	E	L	A	I	V	E	E	P	R	T
Z	H	T	V	S	R	E	E	N	Q	E	A	U	R
T	H	G	I	E	H	R	N	U	R	O	E	S	P
S	U	E	N	I	P	A	E	G	S	I	R	S	J
C	E	A	R	I	A	N	M	L	T	E	I	E	E
X	W	R	F	T	T	H	C	I	R	H	N	R	Z
L	I	E	O	E	T	L	G	P	T	I	N	P	T
E	D	A	T	E	E	I	O	I	L	G	R	W	I
P	T	R	R	M	R	I	C	R	E	L	E	L	B
R	H	V	O	A	N	L	G	N	N	I	L	A	R
Q	E	E	D	U	T	I	N	G	G	M	O	W	O
D	I	T	I	G	I	D	T	H	A	P	C	R	M
Z	E	N	I	L	I	E	T	E	S	S	U	F	I

Which frame below will this object exactly fit through? Can you draw an object that will exactly fit through the frames?



Outta This World!

A new solar system is formed. It contains six suns revolving in three overlapping orbits. We have numbered the suns one through six, but there is a better way to number them. Try to number them so the total of any four suns within one orbit will equal 14.



Bulletin Board

Words of Wisdom

"Each problem that I solved became a rule which served afterwards to solve other problems."
-- Rene Descartes

Check it out!

Great website for math puzzles: Kids' Web Fun With Math website at: http://www.luc.edu/schools/education/csimath/kidsweb.htm

Did you know?

The average snowflake weighs 1/300 of a gram.

If "sept-" means 7 (as in septagon), and "oct-" means 8 (as in octagon), why is September the ninth month and October the tenth month? Hint: you might have to do some "roamin".

Sonya Kovalevksy (cont'd)

finest work still laid ahead of her. Her former teacher sent her papers to read and letters that encouraged her to work on her mathematics. In 1883, she was invited to teach at the University of Stockholm in Sweden. In 1888 she was awarded the prize of the French Academy of Sciences for a paper she had written. Her work was judged to be so good that the prize was increased from 3000 to 5000 francs.

Sonya Kovlevsky was without doubt the finest female mathematician prior to 1900. She died of influenza at the height of her career on February 10, 1891, at the age of 41.

References: The History of Mathematics 4th Edition, David M. Burton
www-groups.dcs.st-and.ac.uk/~history/mathematicians
A History of Mathematics, Victor J. Katz

Dear **Math Readers,**

Science and mathematics seem inseparable, with mathematics serving as the language of science. Just as mathematics can help to explain scientific ideas, science can encourage new mathematical development. It is an exciting partnership and we hope you will enjoy this issue's scientific connection.

Remember to send us any ideas, solutions or comments. We enjoy hearing from you!

Sincerely,

Hiroko K. Warshauer

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