INTERACTIVE

FUN²

INNOVATIVE

TEACHER'S ACTIVITY GUIDE

INSPIRE

MathAlive!
Presented By
Raytheon
™

MathAlive! **is produced by Evergreen Exhibitions and developed in collaboration with National Aeronautics and Space Administration (NASA), National Council of Teachers of Mathematics, MATHCOUNTS, National Society of Professional Engineers, Society of Women Engineers, and MathMovesU.**

Raytheon supports math and science education through MathMovesU.

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INTRODUCTION:

Welcome to ***MathAlive!*** The activities in this Teacher's Activity Guide can be used before or after your visit to the exhibit. They are designed for teachers, community group leaders and museum educators who work with upper elementary and middle school-aged students. The Guide is organized into six sections that match the theme areas of the exhibit: Adventure Sports, Environment, Style/Design, Entertainment, Gaming, and Robots/Space.

The activities take an inquiry approach to learning and have the flexibility to be adapted to younger and older students. They are written with a casual style, addressing students directly, requiring only supplies that are easy and inexpensive to obtain. The chart on the following page shows the links between the activities, the math content and the related component from the national "Principles and Standards for School Mathematics." We have also included a brief overview of the exhibit itself to prepare for your visit and support your follow-up activities.

We hope you and your students enjoy the ***MathAlive!*** activities. Please visit our website www.mathalive.com for further information about the exhibit and related events and resources in your community, and also visit www.mathmovesu.com to access a wide range of resources for math-related online games, events, competitions, scholarships and more.

MathAlive! *is made possible by Raytheon. It is developed in educational collaboration with the National Council of Teachers of Mathematics (NCTM), National Aeronautics and Space Administration (NASA), MATHCOUNTS, National Society of Professional Engineers (NSPE), and the Society of Women Engineers (SWE).*

OVERVIEW OF MATH CONTENT IN THE *MATHALIVE!* ACTIVITIES

CHOOSING ACTIVITIES BY GRADE LEVEL

The activities prepared for this guide are designed around the NCTM Math Content Standards for grades 3-5 and 6-8. They offer teachers flexibility, using an inquiry approach with open-ended questions – some basic, some high level. They are designed to enhance classroom math curriculum. We recognize that in a 6th grade class, there may be some students at a 4th grade level and some at an 8th grade level; therefore, we have not assigned a specific grade to each activity, but invite teachers to choose and adapt what works best with their students.

ACTIVITY/EXHIBIT AREA	MATH CONCEPTS	NCTM MATH STANDARD COMPONENT
ADVENTURE SPORTS		
1. Fly as High as Kobe	ratios, proportions	Algebra
2. Design Challenge	2- and 3-dimensions	Geometry
ENVIRONMENT		
3. H_2Ohhhh!	volume, percentages	Measurement
4. What a Million Looks Like	powers of 10, base-10 number system	Number & Operations
STYLE/DESIGN		
5. Tessellate or Not?	angles, vertices	Geometry
6. Fibonacci Flowers	number theory, number patterns	Number & Operations
ENTERTAINMENT		
7. Got Rhythm?	equations, fractions	Algebra and Number & Operations
8. 24 Frames per Second	perceived motion is a function of speed	Data Analysis & Probability
GAMING		
9. Secret Code	math rules and functions	Algebra and Number & Operations
10. Spin the Wheel	fractions, probability	Data Analysis & Probability
ROBOTS/SPACE		
11. Pick Your Pixel	scale, scale models	Measurement
12. Design a Robot Arm	engineering and math	Data Analysis & Probability

Visit http://www.nctm.org/standards/content.aspx?id=16909 for more details about each of these national “Principles and Standards for School Mathematics” content areas for grades 3-5 or 6-8.

MathAlive!... About the Exhibit

Designed to be one of the most interactive and inspiring exhibitions exploring the world of mathematics ever to tour.

MathAlive! is designed to inspire, to spark the imagination, to reveal not only math at work, but the endless possibilities of math. Primarily designed for kids in grades 3-8, the exhibition brings to life the real math behind what kids love most – videogames, sports, fashion, music, robotics, and more – and creates interactive and immersive experiences that bring to life the math at work in each, whether in design, application or use.

In this 5,000 square foot exhibition, visitors will ride snowboards in a 3D experience, design (and play) their own videogames, capture their 360-degree images in a unique interactive, jump into a fractal dance party, even design a custom skateboard for "pop" - the quick, snapping motion that allows a board to do the best tricks. Through nearly 40 unique, interactive experiences, the exhibit takes math from its native form into the applied worlds of design, engineering, technology and science.

They'll explore and operate simulations of NASA's latest robotics, including the Robonaut 2 and the Curiosity Rover. Around a large-scale futuristic bridge they learn how engineers work to make a city hum while taking on different engineering roles to design a more sustainable infrastructure.

The institutional partners will be available to support host museums, with varying types of events, competitions and activities throughout the live schedule, helping host museums turn entire cities into 'math towns' with rich calendars of activities throughout the run of the exhibition. From special live competitions to STEM career events, the supplemental resources, media, materials, funded events and programming will support museums in bringing math meaningfully and effectively into their larger experience.

This innovative exhibit responds to the national movement toward greater focus on STEM development and STEM career awareness, and inspiring kids to make math a priority, reaching them in that window of vulnerability when math gets more challenging and kids begin to lose interest.

The exhibition is designed to help math teachers answer the age-old question: "Will I ever use all this math they're teaching us?"

Visitors are accompanied by fun and quirky virtual guides, and along the way they'll meet and hear professionals, visionaries and inspiring personalities talk about math in their work across fields kids are most interested in exploring. The exhibit addresses all math strands and subjects for upper elementary and middle school, and neatly aligns with standards for educator planning.

HIGHLIGHTS OF THE EXHIBIT BY SECTION

OUTDOOR ACTION... ADVENTURE SPORTS

- *Boardercross…* Snowboard Experience
- *Get a Grip…* Rock Climbing
- *Measure Up…* Scatter Plot
- *It's a Stretch…* Arm Span
- *Ramp it Up…* Build a Skateboard with POP
- *Pedal to the Peak…* Mountain Bike Challenge
- Featured Personality: Eric "Tuma" Britton, professional skater/instructor

BUILD YOUR WORLD... ENVIRONMENT

- *Bridge to the Future…* The Engineered City
    - o *Power Play…* Energy
    - o *Test the Waters…* Water
    - o *Easy on the Gas…* Transportation
    - o *Going Viral…* Communications
- Featured Personality: Rondi Davies, geologist and champion marathon swimmer

FUTURE STYLE... STYLE AND DESIGN

- *Style Revolution…* 360-degree Photo Shoot
- *Make it Fit…* Tessellations
- *Nature's Numbers…* Nature's Patterns
- *Shadow Play…* Shadows
- Featured Personality: Neri Oxman, architect and designer, MIT Media Lab
- Featured Personality: Daniel Ferguson, Imax film director and screenwriter
- Featured Personality: Ajay Kapur, musician and computer scientist

KICKIN' IT... ENTERTAINMENT

- *Mix it Up…* Giant Musical Instrument
- *Flicker Fusion…* Make a Movie
- *Step Up...* Dance Motion
- *3D Mapping...* Game Developer

GAME PLAN... VIDEOGAMES AND OTHER GAMES

- *Game Developer*
- *Crack the (Binary) Code*
- *Flip It…* Probability
- *Game Box Kids*
- Featured Personality: Robin Hunicke, game developer
- Featured Personality: Michael Mateas, game developer

ROBOTICS AND SPACE

- *Space Walk…* NASA Robot
- *Curiosity Rover*
- *Future Robots…* Robot Artifact Display
- *Picture This…* Hubble Telescope
- Featured Personality: Dennis Hong, robotics engineer
- Featured Personality: Robin Murphy, robotics engineer
- Featured Personality: Kathryn Gray, student and supernova searcher
- Featured Personality: Robonaut 2

RESOURCE CENTER

- *Play…* Sum of All Thrills, MathMovesU.com
- *Explore…* Math Programs, Competitions, etc.
- *Connect…* Local Events, Activities Center

EXHIBIT THEMES, CONCEPTS AND ACTIVITIES

Following, for select interactives, are main ideas and supplemental ideas to help students and groups get the most out of the visit.

For a detailed explanation of the exhibit, by interactive, please refer to "EDUCATORS' REFERENCE GUIDE FOR THE MATHALIVE! EXHIBITION," which outlines:

- ***INTERACTIVE DESCRIPTION***
- ***MAIN IDEA***
- ***MATH AT WORK***
- ***STANDARD/STRAND***
- ***CURRICULA CONNECTION***
- ***SOURCES***

SPORTS – OUTDOOR ACTION

Boarder Cross *(Race others on a snowboard ride)*

Main Idea: This interactive gives visitors a better understanding of angle size and provides concrete comparisons of different sized angles. The idea of "acute" angle is emphasized.

Ramp It Up *(Design a skateboard to perform the best tricks)*

Main Idea: Two variables can be manipulated and tested in combination in order to get closer to the optimal effect.

Get a Grip *(Combines rock climbing with relationship between height and arm span)*

Main Idea: There may be a correlation between two variables; this relationship can be seen on a mathematical representation called a scatter plot.

Ideas for the Visit: Encourage students to document their two measurements. Whose measurements of arm span and height are the closest? Whose have the biggest gap between them? What might account for the variation?

Pedal to the Peak *(Jump on a mountain bike and compete by adjusting speed, time and distance)*

Main Idea: Line graphs can show changes in distance and speed over time. These two graphs are interrelated.

Ideas for the Visit: Keep the focus of this activity on "graph matching" (rather than going as fast as possible) by calling students' attention to how closely they stay on the path.

ENVIRONMENT – BUILD YOUR WORLD

Bridge to the Future: Making a city run efficiently is like putting together a complicated puzzle with many pieces that have to fit, including transportation, energy, communications and water (discover engineering around a giant futuristic bridge by making the same kinds of choices engineers make)…

Easy on the Gas… Transportation: Mathematics enables us to simultaneously consider several "what if" questions about the impact of several variables.

Power Play… Energy: Examining real-time graphs of electrical use provides engineers with immediate mathematical information that is used to maintain the functioning of the grid in emergencies.

Ideas for the Visit: Ask students to predict which variables might make the biggest differences in terms of energy savings. Also ask them which variables might be easiest to influence through public service announcements.

Ideas for the Visit: Ask students to "tell the story" of the graph that they see unfolding.

Going Viral… Communications: Exponents are a key way of expressing the size of numbers, and provide a way to simplify calculations involving very large and very small numbers.

Test the Waters… Water: Very small numbers can be expressed in multiple ways, using the notions of "parts per million" decimals and scientific notation.

STYLE AND DESIGN – FUTURE STYLE

Style Revolution *(Step onto a photo stage, pose and have your image captured in 360 degrees, using the same freeze-motion technique made famous in contemporary action movies)*

Main Idea: There is an inverse relationship between the number of cameras taking photos and the size of the angles between the cameras.

Make it Fit *(Create patterns that repeat without gaps or overlaps, combine different shapes to create new patterns)*

Main Idea: Identifying the attributes of certain two-dimensional shapes, which in combination, tessellate or fit together without any overlaps or gaps.

Ideas for the Visit: Encourage students to create their own tessellations with different combinations of shapes. A variation of this activity can be continued with pattern blocks once students return to the classroom.

Natures Numbers *(Explore extraordinary shapes, found in nature, created with mathematical foundations)*

Main Idea: Some number patterns can be represented by a ratio that has interesting geometric properties.

Ideas for the Visit: Encourage students to find as many examples of the golden ratio as they can in the panels in this interactive. Where else might they expect to see the golden ratio in nature?

Other interactive experiences in this area: Recycled Material (art configured to create design shapes), Shadow Play

ENTERTAINMENT – KICKIN' IT

Mix it Up *(Manipulate a giant, funky musical machine to explore the relationship of math to rhythm and pitch to frequency in music)*

Main Idea: Fractions play a vital role in understanding music.

Ideas for the Visit: Challenge students to find as many combinations of notes as they can to make a 4-beat measure (e.g., 4 sixteenth notes plus 2 quarter notes plus 2 eighth notes).

Fractal Dance Motion *(Watch yourself dancing in video that shows how mathematical functions can be used to create moving color effects)*

Main Idea: Transformations in real time. Move your body and watch the changes on screen.

Flicker Fusion *(Create a perfect animation by choosing the optimum frequency of rotation and flashing light, using a real technique mastered for latest animated movies)*

Main Idea: The idea of frequency is explored, both with respect to number of light flashes per second and to number of times a platform rotates. This is a particular type of ratio, namely the number of flashes per second.

GAMING – GAME PLAN

Game Developer *(Manipulate the math of 3D graphing as you create movement in videogame design)*

Main Idea: Graphing can happen in three-dimensional space, using positive and negative numbers on the X, Y and Z dimensions to locate and move an object.

Crack the Code *(Solve the code using different number systems)*

Main Idea: There are different number systems used for different purposes: binary, or base 2, is commonly used in computer programming.

Ideas for the Visit: Encourage students to be codebreakers: Ask one student to write a binary numeral that represents a base 10 numeral between 1 and 100. Other students "break the code" by translating to the base 10 system.

Flip It *(Fun coin flipping station lets you test the laws of probability)*

Main Idea: Coin flipping is an important context for understanding independent events: The probability of a coin coming up heads remains ½ no matter how many times it is flipped.

Ideas for the Visit: Within a minute, every student in the class can flip a coin 10 times and record the results to make his or her own distribution. Does this distribution resemble a bell curve?

Other interactives in this area: Game Box Kids

ROBOTICS AND SPACE

Space Walk - NASA Robotics *(NASA programs its robots to accomplish many tasks, all relying on mathematical graphing and coordinates - experiment by manipulating robotics at work in a simulated space environment)*

Main Idea: The coordinate system is a clear way of locating objects in 2D space.

Curiosity Rover *(Program next-generation Mars rovers to navigate the Mars landscape)*

Main Idea: Programming a robot involves carefully planning a sequence of steps. In programming, mathematical language is used to make communication clear and efficient.

Ideas for the Visit: Students enjoy practicing "commands" by directing each other to physically move a certain number of steps and turn in a given direction. Put a target on the floor and encourage them to "program each other" while they wait for a turn to program the Curiosity Rover.

Hubble *(Experiment with "sampling" and mathematical formulas that lead to extraordinarily detailed images captured in space)*

Main Idea: The greater the number of images, the more that "noise" or variation can be minimized.

Also in this area: Robonaut 2, Future Robots Display, FIRST Robotics champion robots

FLY AS HIGH AS KOBE

78”… Kobe Bryant’s height (6’ 6”)
+38”…How high Kobe can jump
116”

You will need: a roll of paper at least 10 feet long, tape, two colored markers, measuring tape, lots of friends to measure, a space outside with room to jump

(Note: This activity can also be done using self-stick notes which you attach to the wall when you jump.)

HEIGHT	JUMP HEIGHT	RATIO

1. Use the measuring tape to find and label the 116” mark and the 78” mark on the roll of paper. Write “Kobe’s height” at 78” and “Kobe’s jump” at 116” high.

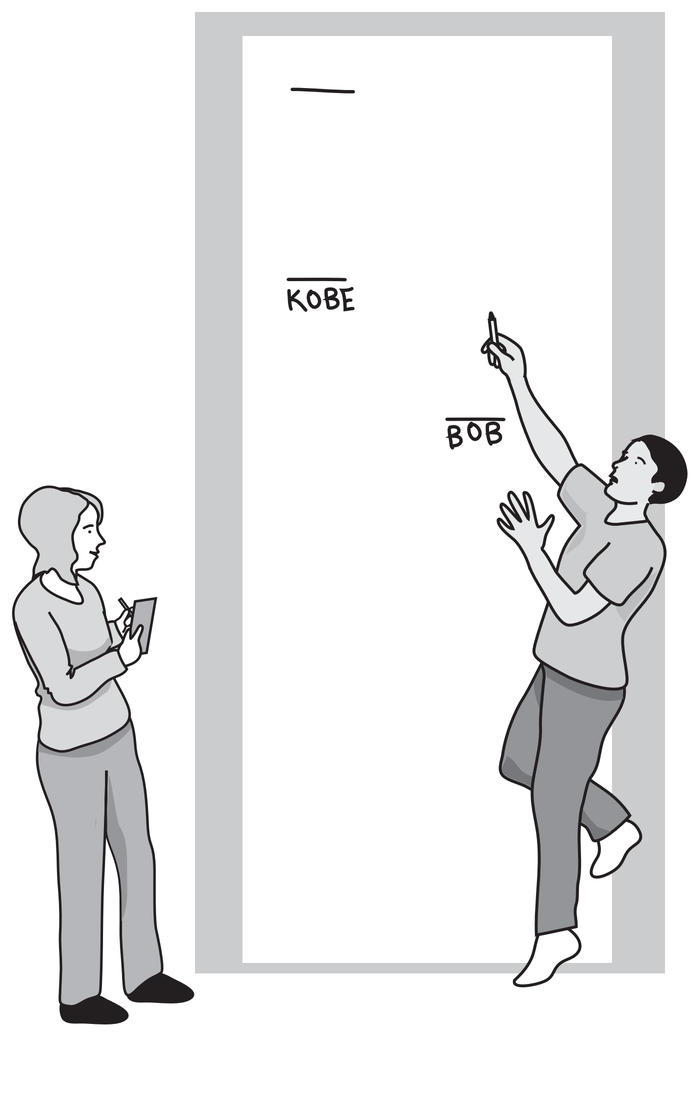
2. Find a wall outside or in a gym that is at least 10 feet high. Tape the paper on the wall with the bottom of the paper at the floor.

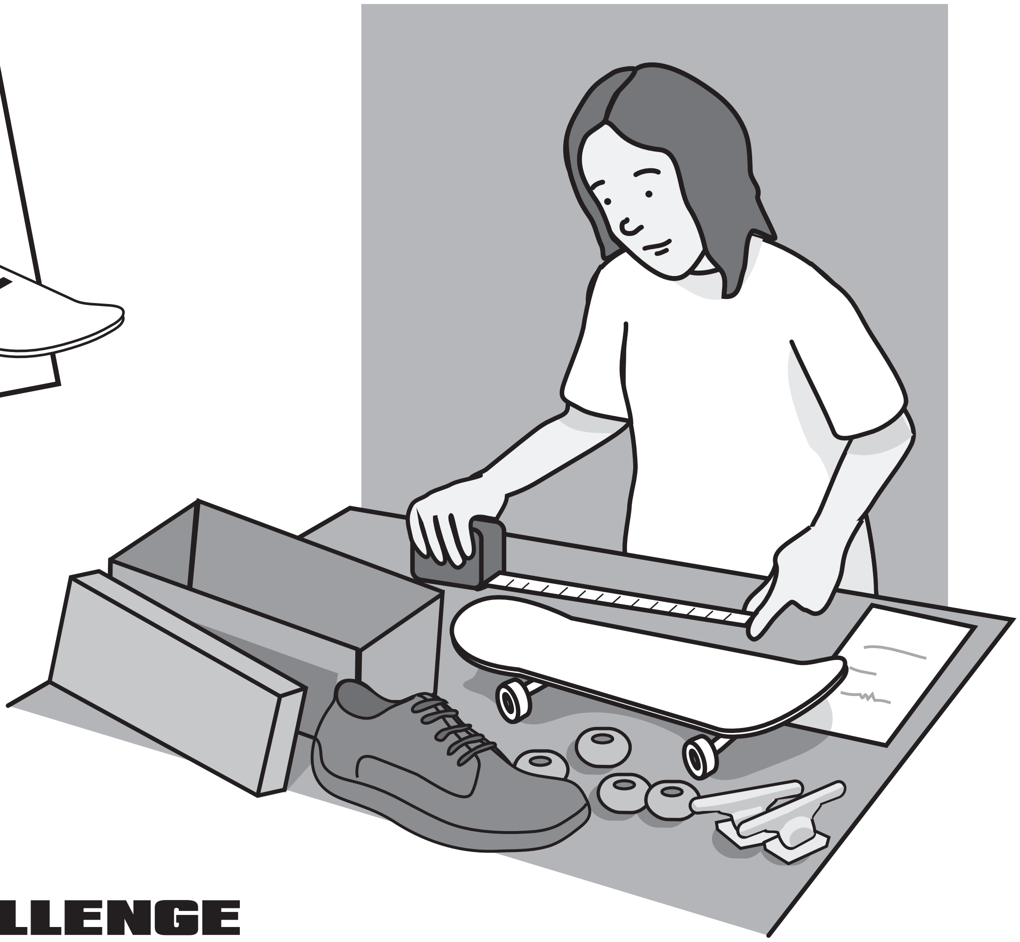
3. Measure your height and your friends’ heights and mark them on the paper with your first colored marker. Record the “actual heights” on a data table with three columns – height, jump height, and ratio.

4. Now, face the paper with your toes near the wall and hold the second colored marker in your hand. Reach above your head and jump straight up as high as you can, so that the marker leaves a spot on the paper. Have your friends do this too and record everyone’s “jump heights” on the table.

5. Compare how tall Kobe is with how high he can jump. (Hint: What is the ratio of his height to how high he can jump?) Now find the ratio of your own height to how high you can jump. Do it for your friends too. Who’s got the best “stats” and how do you know? Is anyone’s ratio of height to jump as good as Kobe’s? If you know someone’s height, can you estimate how high he or she can jump?

What’s the Math?
Math is often about comparing things, including things that don’t start out the same. Your height isn’t the same as Kobe’s, and your jump isn’t as high. But to see if you’re as good a jumper as Kobe, you can use ratios or proportions.





DESIGN CHALLENGE

You will need: paper, pencil, computer with Internet, the worksheet below

(The rest of this activity will be in the form of a worksheet that can be duplicated.)

You are the CEO of an international skateboard manufacturer. You pride yourself on customizing your skateboards to your clients' specific requests. This isn't always easy!

First, go online or visit your local skateboard shop to get information about optimal skateboard size, wheel size, typical skateboard weights, and dimensions. Then, see if you can solve the problems below:

1. One of your clients wears a size 14 men's shoe. What dimensions would you choose for the best skateboard for him?

2. A company wants their logo to go on the skateboard. It is a circle with an 18 cm radius. Draw the skateboard design you would propose for them, indicating the length and width of the board.

3. One client wants very large wheels on her skateboard. What would be the largest size wheels you could recommend for her and why? Explain to her the relationship between the size of the wheel and the speed of the skateboard.

4. Your shipper has a weight limit of 50 pounds per box. He will build the box any size or shape you like, so long as what goes in it doesn't weigh more than 50 pounds. Estimate the weight and dimensions of your company's average skateboard. Then determine how many would total the right weight for one of the shipper's boxes. Finally, specify the width, length and depth of box that you would like.

What's the Math?

Designing and shipping skateboards requires measurement and geometry, both 2-dimensional, for the artwork and 3-dimensional for the boxes.

H_2OHHHH!

You will need: water, clear plastic cups, marking pen, dirt, small gravel, food coloring, measuring cups and spoons, cotton balls, coffee filters, nail, paper, pencil

1. Use the measuring cup to gradually fill a clear plastic cup (cup #1) with water, one ounce at a time, marking lines on the cup as you go.

2. Dump out some of the water so that cup #1 is only partially full. Add a mixture of gravel, dirt and food coloring. Be careful not to overflow the cup. Draw a line on cup #1 showing the dirty water level. Record the volume of dirty water in the cup.

3. On a second cup (cup #2), mark the same dirty water level line.

4. Use the nail to poke a hole in the bottom of a third cup (cup #3). Use the coffee filter and cotton balls to design a filter that will remove the gravel, dirt and food coloring from the water.

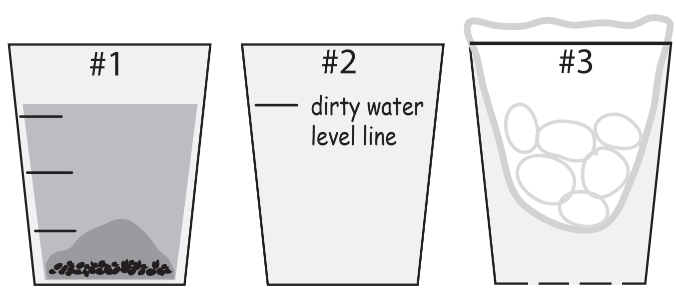
5. Place cup #3 over cup #2 and pour the dirty water from cup #1 through your filter. Mark the new clean water line on cup #2. Use the measuring cup to determine the new volume of water in cup # 2 after the water passes through the filter. What percentage of your original volume do you still have? Why?

6. Is the water in cup #2 clear? What adjustments can you make to improve your filter?

7. Write a recommendation about how much unpurified water you would need to start with if you were responsible for using this system to filter water for one hundred people to safely drink for one day after a natural disaster. (Note: You will need to research how much water per day each person would need.) Explain the math behind your recommendation.

What's the Math?

To determine how much water to purify, you need to measure change in volume and use percentages.



WHAT A MILLION LOOKS LIKE

You will need: You name it! Pennies, buttons, toilet paper, candy, cash register tape, digital cameras, marshmallows, and toothpicks have all been used for this activity; or, of course, you can come up with an idea of your own. Read on…

1. Your Challenge: Create an illustration to give someone an instant idea of what 100 looks like. Your illustration must use area, length or height to help others visualize how big 100 is. Wait. There's more…

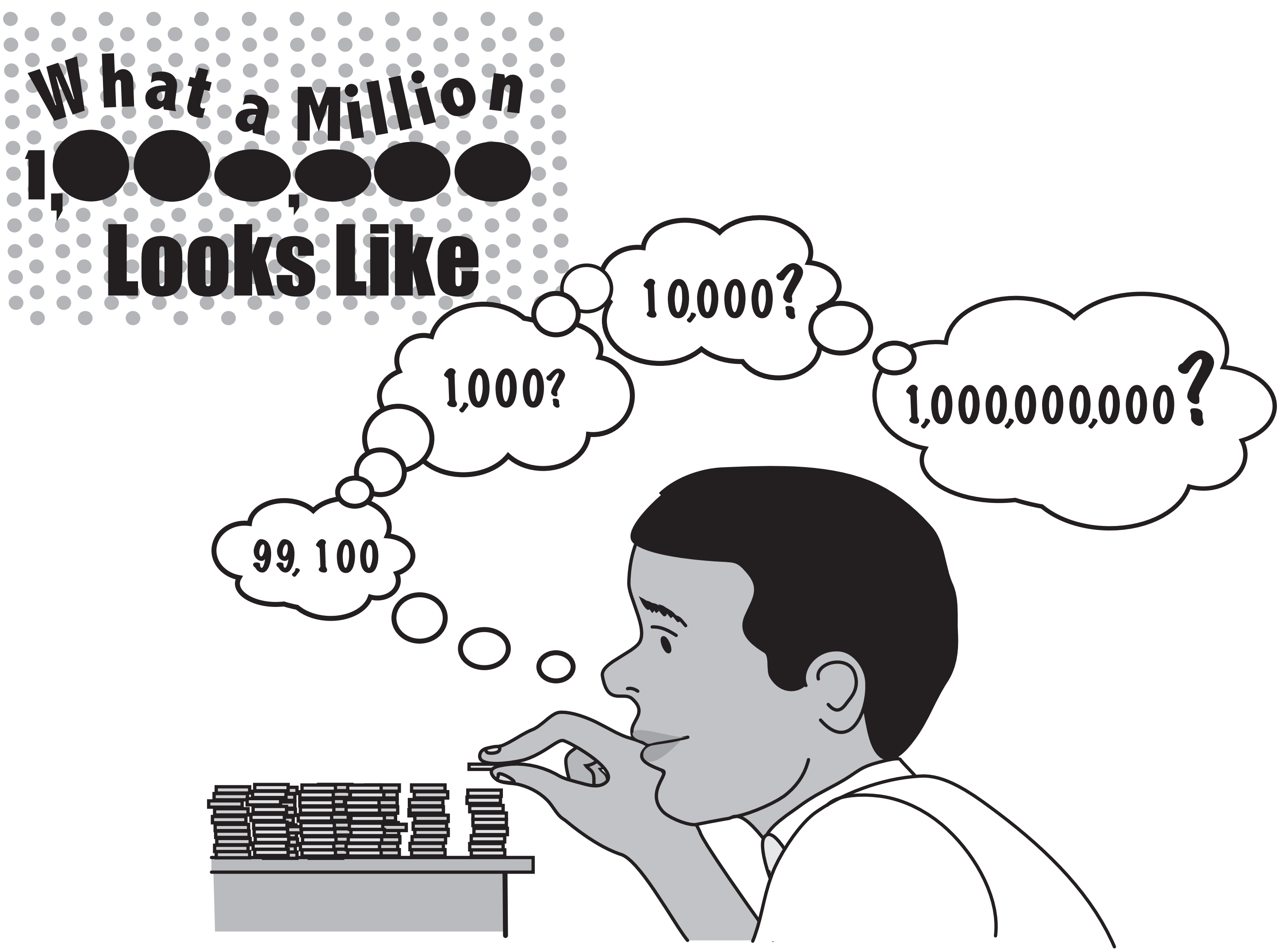
2. Use what you've already constructed and expand it to create an illustration of what 1,000 looks like. Your illustration must use area, length, height or weight. And…

3. Then use powers of 10 to make another expansion of your design. Show clearly what 10,000 looks like, using area, length, height, volume or weight. And, finally…

4. If you dare, do one more expansion to show how big 1,000,000 is.

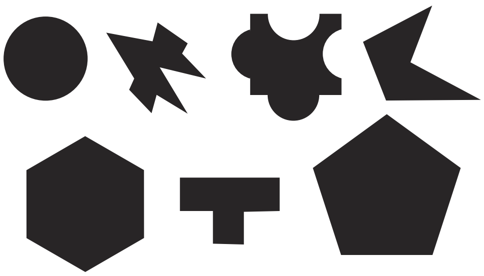
What's the Math?

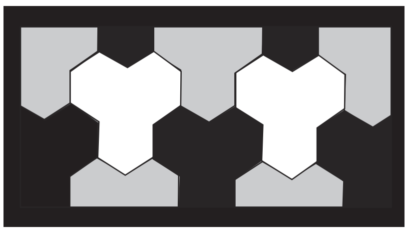
To create your illustrations, you are working with Powers of 10 and studying the structure of the Base-10 Number System.

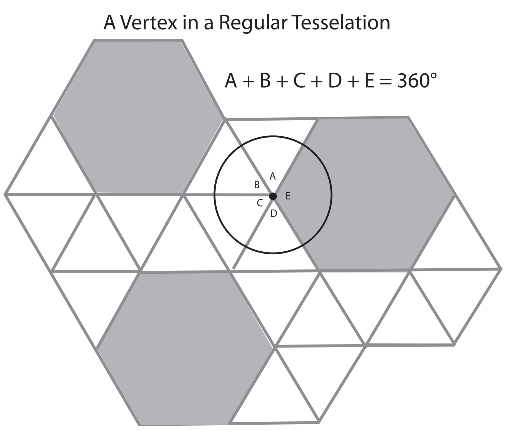


TESSELLATE OR NOT?

You will need: pencil, paper, glue, scissors, multiple copies of shapes cut from the patterns shown here







1. Tessellation may not be a word you hear every day, but it's something you see every day. It's when a lot of shapes fit together in a repeating pattern and fill the space without leaving any gaps. It's a checkerboard full of squares or a honeycomb full of hexagons, but it doesn't have to be only those shapes.

2. What shape can you tessellate? Experiment with copies of the shapes shown here. What tessellates and what doesn't? Why?

3. Choose the shape you want to work with, trace around it and cut out lots of copies. Piece the shapes together like a checkerboard. Remember, you can't leave any open spaces. The shapes have to match up exactly.

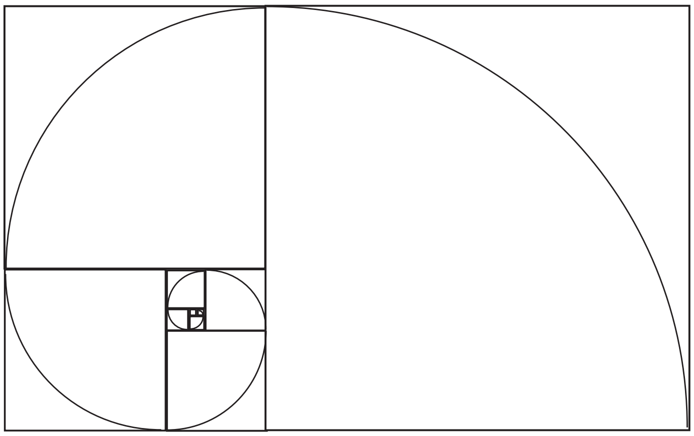
4. When you are happy with your design, check the points at which all the shapes come together. What do you notice about the angles?

5. Can you tessellate more unusual shapes? Sure! The artist M.C. Escher is famous for tessellating a whole page of green, red and white reptiles. What will you try?

What's the Math?
In a regular tessellation, the total of all the angles at the vertex – the point where the shapes come together – has to be 360 degrees. That can't happen just at one place in your design; it has to happen at each and every vertex.

FIBONACCI FLOWERS

You will need: drawings of flowers shown here, magnifier, computer with internet and printer, photocopier, poster board, scissors, glue, markers



This spiral is made by connecting squares that are the increasing sizes of the Fibonacci sequence.

1. **0, 1, 1, 2, 3, 5, 8, 13, 21, 34**. That's the start of the Fibonacci sequence. Each new number is the sum of the previous two. So what would your next number be?

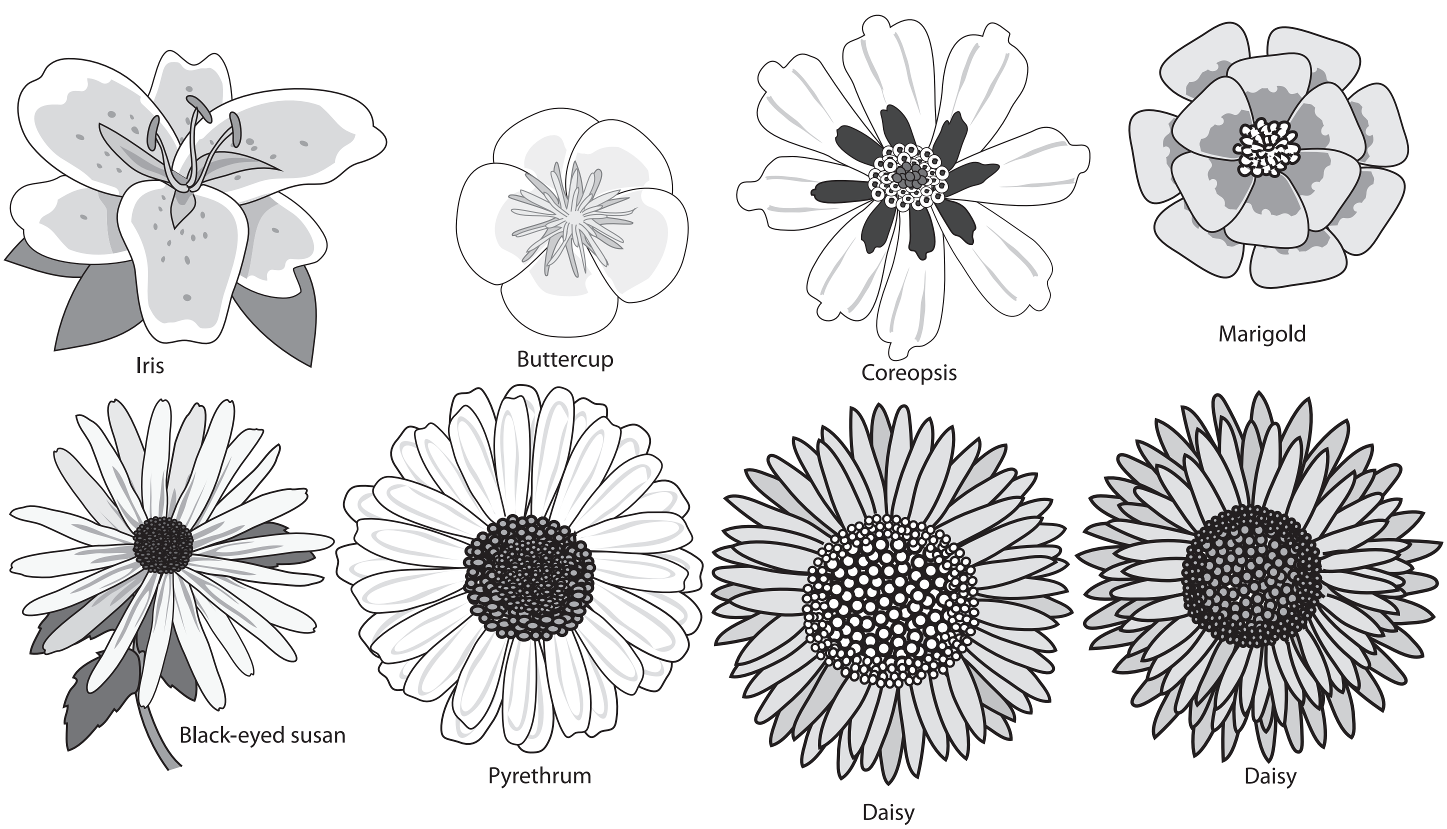
2. Fibonacci patterns are found throughout nature. Can you find the Fibonacci sequence in the drawings in this activity?

3. Now it's your turn to find Fibonacci – this time in photos. Using the internet or library books, grab your magnifier and look for other Fibonacci patterns. How many petals do the flowers have? How are the leaves or branches arranged on the stems? Record your results.

4. With a photocopier or computer and printer, make copies of the patterns you find and put them together to create a Fibonacci collage, explaining the sequence in each example.

What's the Math?

Your Fibonacci collage is a visual example of number theory and number patterns. If you count the number of petals on different types of flowers, you will find that each flower's number corresponds with one of the numbers of the Fibonacci sequence.



GOT RHYTHM?

You will need: your hands for clapping, your fingers for snapping, your toes for tapping, any musical instruments you have handy, at least four friends to make music with you, sample sheet music and key shown here

Whole note **Half note** **Quarter note** **Eighth note** **Sixteenth note**

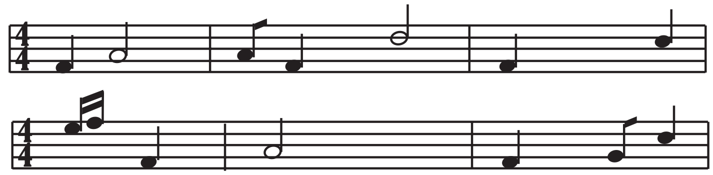
This music is in 4/4 time. That means that each measure includes notes in different fractions in multiples of the 4, that all add up to 1.

1. Don't worry. You don't have to read music or be a good singer to do this. You just need to know a little bit about fractions.

2. Decide among yourselves who will hum whole notes, half notes, quarter notes, eighth notes and sixteenth notes. Every time the whole note person hums once, the half note person has to hum twice, the quarter note person four times,…. You get the picture.

3. Practice for a while so that everyone gets used to the different speeds. Now try adding other sounds or instruments. You can sing or play any tune you like, or stay on the same note the whole time, so long as you stick to the correct speed.

4. Your sheet music is divided into measures with lines on either side. Write an equation for each measure. How do the different speeds/fractions of notes add up?



A measure of music could have just one whole note, or 16 sixteenth notes, or any combination that adds up to 1.

5. Fill in the missing notes in the measures above so that each totals the correct amount. Write an equation to go with each measure.

What's the Math?
In order to compose or read music, you need to understand equations and fractions.

24 FRAMES PER SECOND

You will need: 3-inch-square pad of at least 24 self-stick notes, pencil, old paperback book, stopwatch

1. Think of an object that's easy for you to draw. If you could make your drawing move, what would you have it do?

2. Place the stack of self-stick notes on the table with the sticky edge to the top. You will be drawing your "flipbook" from the back to the front.

3. Draw your object on the last note in the pad, a picture *after* it has stopped moving.

4. Lay the second-to-last note on top of the one you just drew. Trace the part of the object that isn't moving. Then draw the moving parts in a slightly different position.

5. Repeat the process until you have 24 notes. Your top note should be the object before it starts to move.

6. Pick up the stack of notes and flip the pages rapidly from back to front. What happens? How does it change if you flip slower or faster?

7. A movie – like the object in your flipbook – only appears to move. It is actually still pictures called frames, usually going by at 24 frames per second. Our brains put it all together. Using the stopwatch to keep time, how long does it take you to flip all 24 frames?

8. Design an experiment to test what speed is too slow or too fast for your flipbook. You will need to draw (or photocopy) more pages to get accurate times. To make a larger flipbook, you can draw your moving object in the corner of the pages of an old paperback book.

What's the Math?

Perceived motion is a function of the speed of flipping your flipbook or the speed that frames go by in a movie. If you flip too fast, the image is blurred; too slow and the movement is jerky.

SECRET CODE

You will need: paper, pencils, an idea for a secret code, friends to play the game

1. Everyone who is playing gets a piece of paper and pencil. At the top, write each player's name with two columns under it, one "input" and one "output."

2. Now the fun part – what is your code going to be? Shhhh. Don't tell anyone. Here are some examples. If someone says "4" and your code is to double it, you would answer "8". If someone says "4" and your code is to match it with the letter order of the alphabet, you would answer "D". If someone says "4" and your code is to add 3, you would answer "7".

The Math Rule: You need to have a rule or system for your code that's possible for your friends to figure out! (Think about it. What good is a code that no one can use?)

3. Once everyone has chosen codes, you're ready to start the game. Each person gets a turn being the Coder. Everyone else tries to figure out that person's code. Go around your circle of friends, giving each person a chance to say a number. Record the answers on your chart. If you think you know the code, you can stop the game at any time and guess. If you're right, you become the next Coder. Good luck!

What's the Math?

Your code works because of its basis in mathematical rules and functions.

SPIN THE WHEEL

You will need: scrap paper, pencil, card stock, scissors, paper clip, ruler, colored markers, graph paper

1. To make your spinner, start by cutting a circle out of cardstock. Save the spinner for step three. Now use the scrap paper to draw different circles the same size as your spinner.

2. Divide each circle into different sizes of pie shapes. What does a circle look like with 4 equal size pie pieces? What about 3? Label each pie piece with its fraction. For example, in a pie divided into 4 equal pieces, each piece will be labeled ¼.

3. Cut out a variety of different sizes of pie pieces and arrange them on your spinner. Make sure every part of the spinner is filled by a pie piece. (Hint: All of the fractional pieces must add up to 1.)

4. Use the ruler and pencil to trace the different sizes of pie pieces you have chosen on to your spinner. Label the pieces with their correct fraction. You can color the sections, too, if you like.

5. Place the paper clip on the spinner. Put the point of the pencil through the paper clip and position it in the center of the circle. Flick the paper clip with your finger to make it spin. What section of the spinner do you think it will land on most often? Why?

6. Each time you spin, record where the paper clip landed. Choose the best way to use graph paper to show your results and what those results mean.

What's the Math?

Your spinner activity is a visual representation of fractions, which demonstrates probability.

PICK YOUR PIXEL

You will need: three pieces of graph paper with different sizes of squares, pencil

Note: If you only have one size of graph paper, you can create papers with bigger or smaller squares using a photocopier that can enlarge images.

1. Start with the graph paper with the largest squares. Using up as much of the page as you can, number the squares going up the side of the paper, starting with 1. Number the squares going across the paper, also starting with 1. Each square now has its own number: square 1, 1 is in the upper left corner, square 1, 2 is next to it, etc.

2. Draw something on the graph paper inside the section you have numbered. In the drawing, include some squares that are partially colored in, some that are fully colored and others that are white.

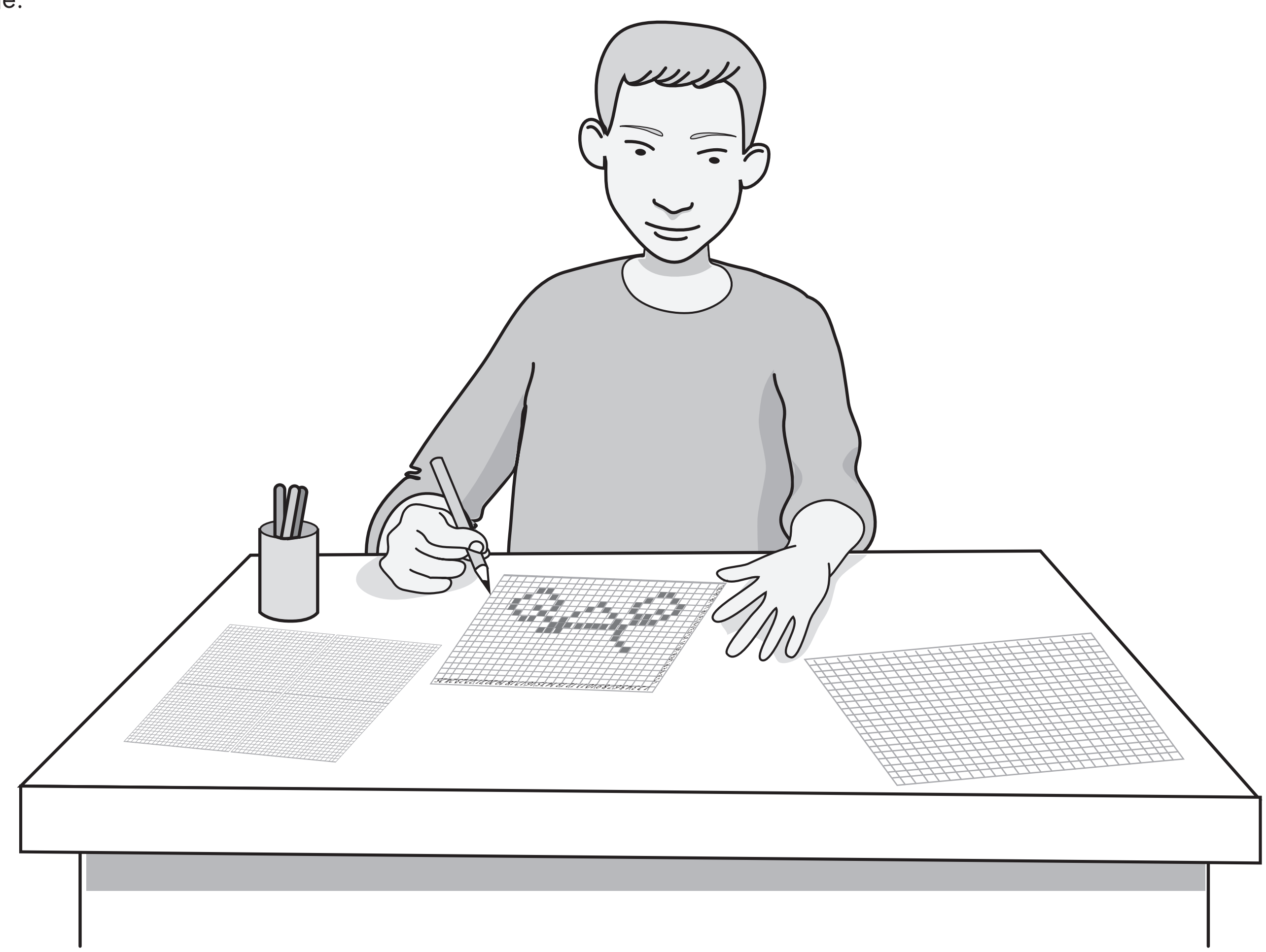
3. Using the second piece of graph paper with the smaller squares, number the same amount of squares as you did on the first piece of paper, both up and down and across the page.

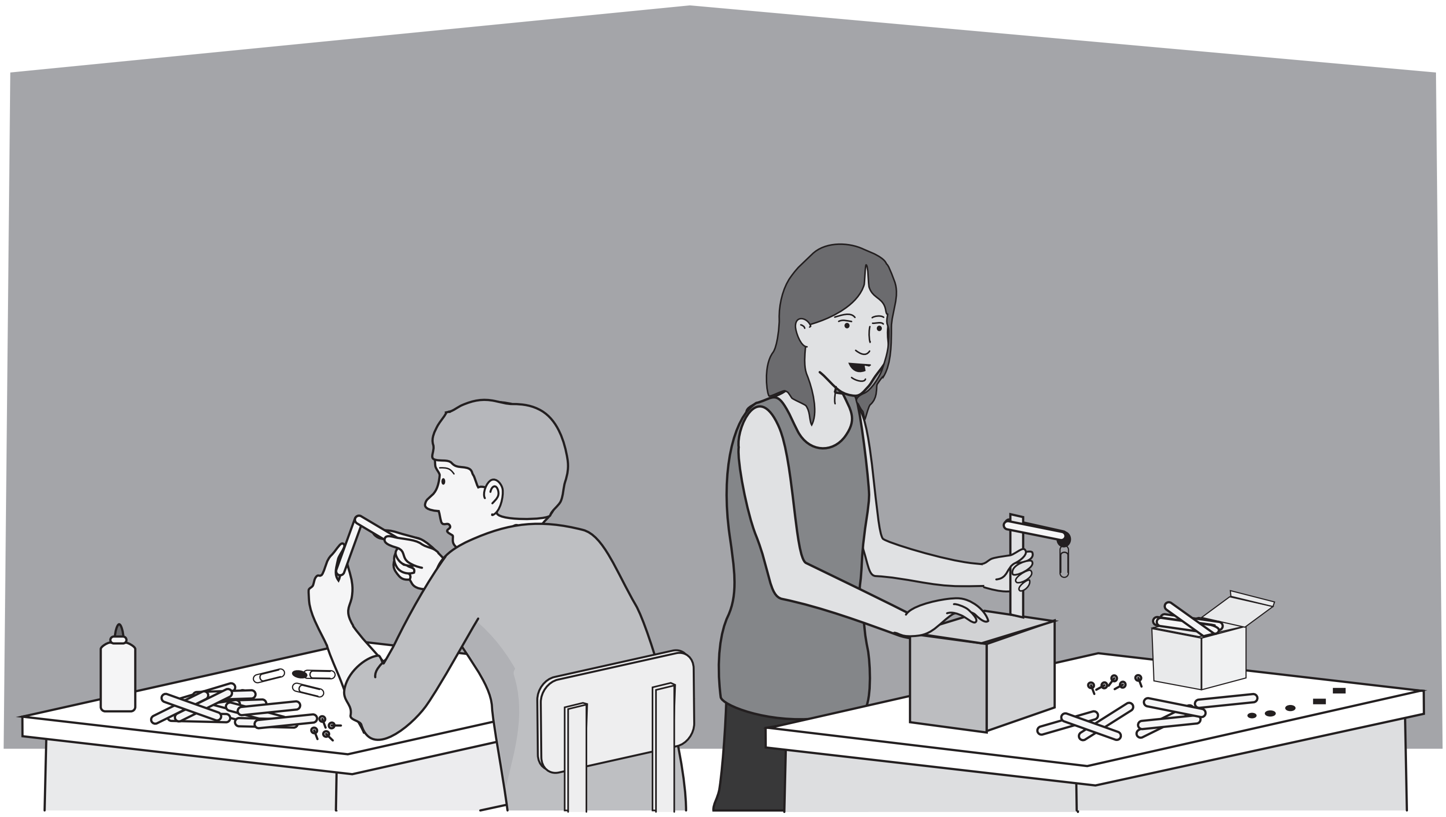
4. Fill in the squares on the second piece of paper with the same designs that are on your first drawing. Make sure you match up all the numbered squares correctly. Square 1, 1, will look the same and be in the same spot on both pieces of paper.

5. Compare the two drawings. What do you notice? What would happen if you used graph paper with even smaller squares? Or much larger squares?

6. Here are some other fun ways to grow or shrink images: Draw a grid on a cartoon picture and transfer the cartoon to a larger grid, filling in the squares as you did before, to make a bigger cartoon. You can also photocopy an illustration several times, using either the reducing or enlarging feature, to see how it changes.

What's the Math?
If you understand scale and scale models, you can accurately shrink or grow an image keeping all its proportions the same.





DESIGN A ROBOT ARM

You will need: popsicle sticks, scissors, nail, brads, ruler, pencil, paper, glue, magnets, paper clips, a friend

1. Design a robot arm that can pick up paper clips, using only the supplies listed above. There isn't a right way or wrong way to do this. It's up to you. Have your friend design a robot arm too, different from yours. Don't watch each other while you're working!

2. Experiment with different arrangements of the popsicle sticks. How do the lengths of the different segments of sticks affect your design? What geometric shapes do the sticks form? Measure and record the lengths of the sides of the shapes.

3. Practice picking up the paper clips and adjust your designs to make the robot arm work better.

4. Carefully observe the steps you follow to use your robot arm. Make a list of these steps – an instruction sheet for your robot arm. Have your friend make a list too.

5. Now trade robot arms and instruction sheets with your friend. Operate this new robot arm using only the instructions you have been given. What does it take to make good instructions?

What's the Math?

Engineers use math as a form of communication. As an engineer designing a robot arm, you need an understanding of measurement and geometry.

RESOURCES

For more information regarding activities that bring math alive, visit the following websites:

mathmovesu.com

mathcounts.org

spacemath.gsfc.nasa.gov/

illuminations.nctm.org

figurethis.org

mathwire.com

http://mixinginmath.terc.edu/

For more resource listings and websites, visit www.mathalive.com

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