STEM Quick Challenges

Kindergarten

Quick Challenge: Parachute
Grade: Kindergarten

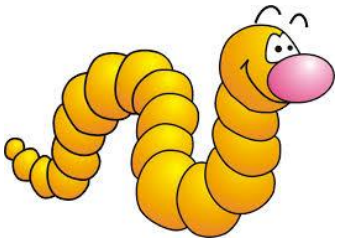
Standard: PS.6.K.3 Demonstrate the effects of the force of gravity on objects

Task: Design a parachute that will safely carry a toy figure to the ground (from 7 feet) without crashing.

Materials: Toy figure, tissue paper, rubber bands, string, paper clips, tape

Questions:

1. What adaptations were made along the way?
2. If you could start over, what would you change?
3. How did you adjust the parachute to fall straight to the ground?
4. What difficulties did you run in to?



Can you save Wilson?
Grade: Kindergarten

Standard:

PS.6.K.1 Demonstrate spatial relationships, including but not limited to over, under, left and right.

Quick Challenge: Wilson is a worm (gummy worm) who is trapped on top of his boat (clear plastic cup) and needs his life preserver (gummy lifesaver). Wilson's preserver is stuck under the boat but he needs it to survive. Can you help Wilson get his life preserver from under the boat and on him using only 4 paper clips?

Method:

1. Wilson (the gummy worm) is placed on top of his boat (plastic cup turned upside down) with his preserver (a gummy lifesaver) placed under the cup.
2. Students are to work together in groups or pairs to help Wilson get his preserver from under the cup and onto his body.
3. Students may use 4 paper clips to touch Wilson, his boat and preserver. They may not directly touch Wilson, his boat or preserver with their hands.

Materials:

- Small clear plastic cups
- Gummy worms
- Gummy lifesavers
- Paper clips (enough for 4 for each group)

Marble Madness
Grade: Kindergarten

Unit: STEM

Math:
CCSS.MATH.CONTENT.K.CC.C.6- Identify whether the number of objects in one group is greater than, less than, or equal to the number of objects in another group, e.g., by using matching and counting strategies.

Scenario: Hansel and Gretel are needing to go see their grandmother in the woods but they are going to get lost if they don't use something to find their way back! They use marbles to help them remember their way. But, they only have a certain amount of marbles. We need to find out who has the most marbles so we can use theirs!

Challenge: Students will get together in groups and will need to find out what cup has the most amount of marbles, the least, and if they got the same amount of marbles.

Questions:

1. Before counting the marbles in each cup brainstorm which cup will have more, less, or if they are equal.
2. Are the cups equal? If not, what cup has less, what cup has more?

Materials:

-Marbles -Cups

Discussion:

Was your brainstorm idea correct? Explain.

1st Grade

Strongest Structure Wins

Grade 1

Learning Standard: CCSS. MATH.CONTENT.1.G.A.1

Distinguish between defining attributes (e.g., triangles are closed and three-sided) versus non-defining attributes (e.g., color, orientation, overall size); build and draw shapes to possess defining attributes.

Used as a hook:

Students will be introduced to a new unit with the narrative text *Building our House* by Jonathan Bean.

Which paper column can hold up the most books?

1. Students will make three shapes out of the construction paper provided.
2. Students will make a triangle, square and circle and tape the sides together for extra support.
3. Once students have completed their shapes they will place books on top of each shape to test their strength.
4. The shape that holds the most books wins the challenge.

Materials:

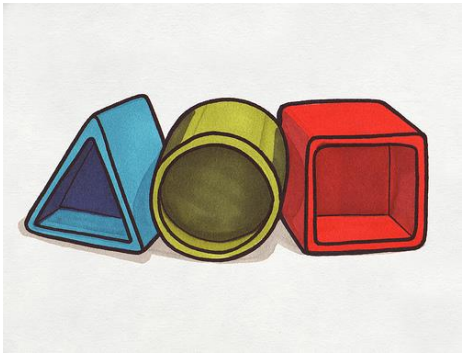
-tape

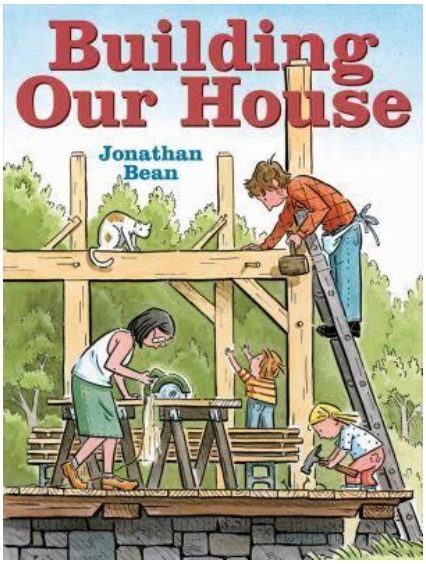
-scissors

-construction paper

-books

The activity relates to the book by introducing what structures are most efficient in building a strong house. The goal of the challenge is to figure out what structure is the strongest.





Shape Up! Quick Challenge
Grade 1

CCSS.MATH.CONTENT.1.G.A.1
Distinguish between defining attributes (e.g., triangles are closed and three-sided) versus non-defining attributes (e.g., color, orientation, overall size); build and draw shapes to possess defining attributes.

Quick Challenge:

1. Students will work in individually.
2. Each student will be provided with 3 pieces of construction paper, 1ft masking tape and books.
3. In 10 minutes, the students will build 3 different shapes with the construction paper and tape and will use the books to test which shape is the strongest and can hold the most weight.
4. Students will share with their peers which shape they found to be the strongest.

Materials:

- 3 Pieces of Construction Paper
- 1ft Masking Tape
- Books

Content Outline:

Following the quick challenge, the teacher would make columns on the board and let each student put a post-it note under which shape they found to be the strongest. After making the columns, the teacher would make a bar graph from the results and discuss shapes and allow students to draw and build different shapes. Discussion could lead to talking about two-dimensional shapes.

Larger STEM Challenge:

Using the shape the class found to be the strongest, build a structure out of keva blocks that can support the weight of 10 books without falling over.

Grade 1

Standard

PS.7.1.5- Demonstrate methods of producing static electricity.

Quick Challenge

- Students will work as a member of a small team using a balloon to see what they can pick up with static electricity. They will determine what items worked best to rub the balloon against, as well as what items the balloon easily picked up. Students will see how static electricity works before they learn about *what* makes it work.

Methodology

- Teacher will provide a blown up balloon to each team.
- Instruct the class that they will rub the balloon against the carpet, their hair, t-shirt, etc.
- Each team will have a bag of items they must test to see if the balloon is able to pick them up using the static electricity created by the rubbing.

Student Feedback

- What created the strongest static electricity? (i.e. hair, carpet, wall, etc)
- What items could the balloon pick up? What could it not pick up? Did some items get picked up easily and some were more difficult?
- Did your source of static electricity (shirt, hair, wall, etc) affect what you could pick up?
- Why do you think some items were harder to pick up?

Content Outline

This quick challenge will lead students into learning more about static electricity, and eventually creating their own item to test against static electricity. They will learn why certain things hold on and others do not.

Hook for STEM

Students will learn about static electricity on their way to learning about magnetism, as they will form an understanding of how some things hold on to others without a force that we can see. They will determine what repulses, attracts, and holds static electricity and magnetism, as well as distinguish differences between the two.

Materials

- Balloon

- Large safety pin
- Napkin
- Cheerios
- Pipe cleaner

Demonstrate Earth and Moon Orbiting the Sun
Grade: 1st

1st grade Science Standard: ESS.10.3.2 Demonstrate the orbit of Earth and its moon around the sun.

Methodology: Tell the students that as Earth orbits the sun it also spins on its own axis. One complete spin is 24 hours, one day. One complete orbit around the sun is 365 days, one year. Viewing the Earth from the top, looking at the North Pole, it spins counterclockwise. Show students the picture. P1

The moon orbits the Earth in a counterclockwise direction viewed the same way from above at the Earth's North Pole. The moon goes completely around the Earth in about 28 days, close to a month. The moon also has an axis around which it spins. It spins in a counterclockwise direction and this takes 28 days so one full spin takes as long as one full orbit. Show students the picture. P2 not to scale.

This means the moon will go around the Earth a little more than 12 times (12 months in a year) during the time the Earth completes one orbit around the sun (one year). Show students the picture. P3 not to scale.

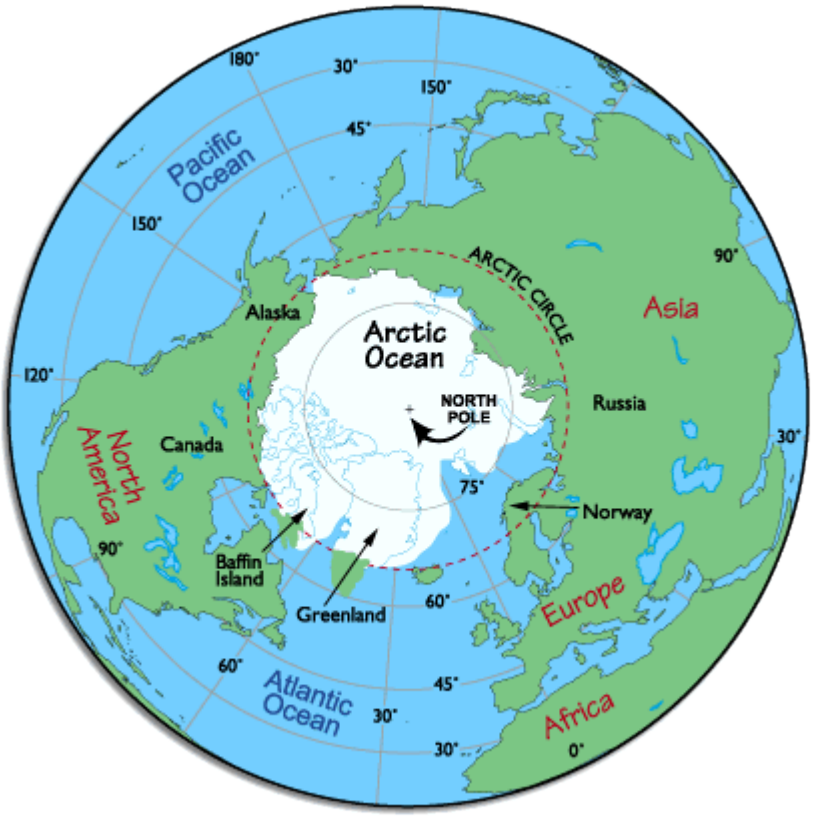
Materials:
Pictures P1, P2, P3
Grapefruit (Earth)
Cutie (Moon)
Wooden skewers
Paper towels
Flashlight
15 students at least
Name of each month on a piece of paper

Quick Challenge: One student will hold a flashlight in the middle of the room representing the sun. Another child will skewer the grapefruit on the axis to hold and spin for Earth. Another child will skewer the cutie on the axis to hold and spin for the moon. Paper towels can be held around skewers to catch any juice. Have 12 students stand in a circle around the sun an equal distances apart. They represent the twelve months and can each hold a month paper going in order. Now turn off the lights so they are in dark outer space with the sun glowing in the middle. The Earth with the moon orbiting around it will orbit the sun. The moon will make one complete spin and orbit in-between each student (month). The student with the Earth will be asked to spin quickly to approximate the days going by. Ask the rest of the class to count along as the months go by.

Content Outline and Student Feedback: Ask students questions about what they demonstrated.
What is the moon orbiting? –Earth
What is the Earth orbiting? –Sun
What direction are the axis spins of the Earth and Moon? –Counterclockwise
What direction do the Earth and Moon orbit? –Counterclockwise
How many times does the moon go around the Earth in a year? ~ 12 times
How many times did the moon spin on its axis in that year? ~ 12 times

During that year how many times does Earth go around the sun? -1 time
How many times did the Earth spin on its axis in that year? -365 times
Help students to answer the questions and see that they have the correct ideas.

STEM Challenge: Now have a larger unit on Earth and Space Science, objects in the universe. This can include the original standard as well as demonstrating how the planets orbit the sun, and relating Earth's rotation to the day/night cycle. Have students get with a partner to design their own model of the solar system that accurately demonstrates the placement and orbit of the planets around the sun. Paying special attention to Earth and the moon to be able to describe the relationship of orbits here and how the Earth's rotation has day and night cycles. This stem challenge will expand upon the knowledge and experience gained in the original quick challenge and add new features from related STEM standards.



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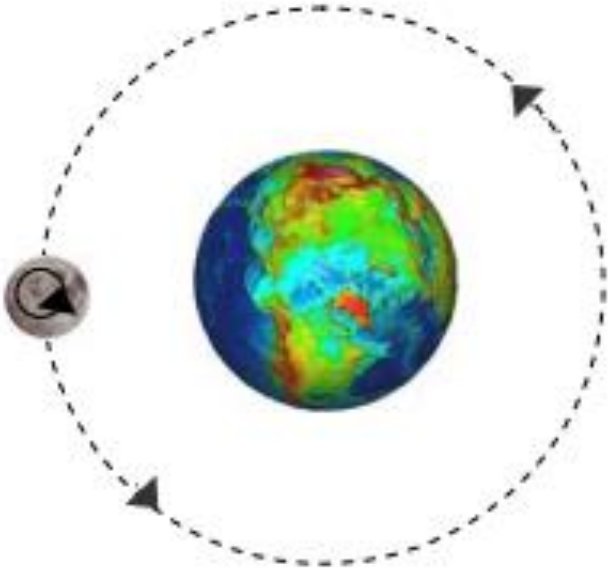

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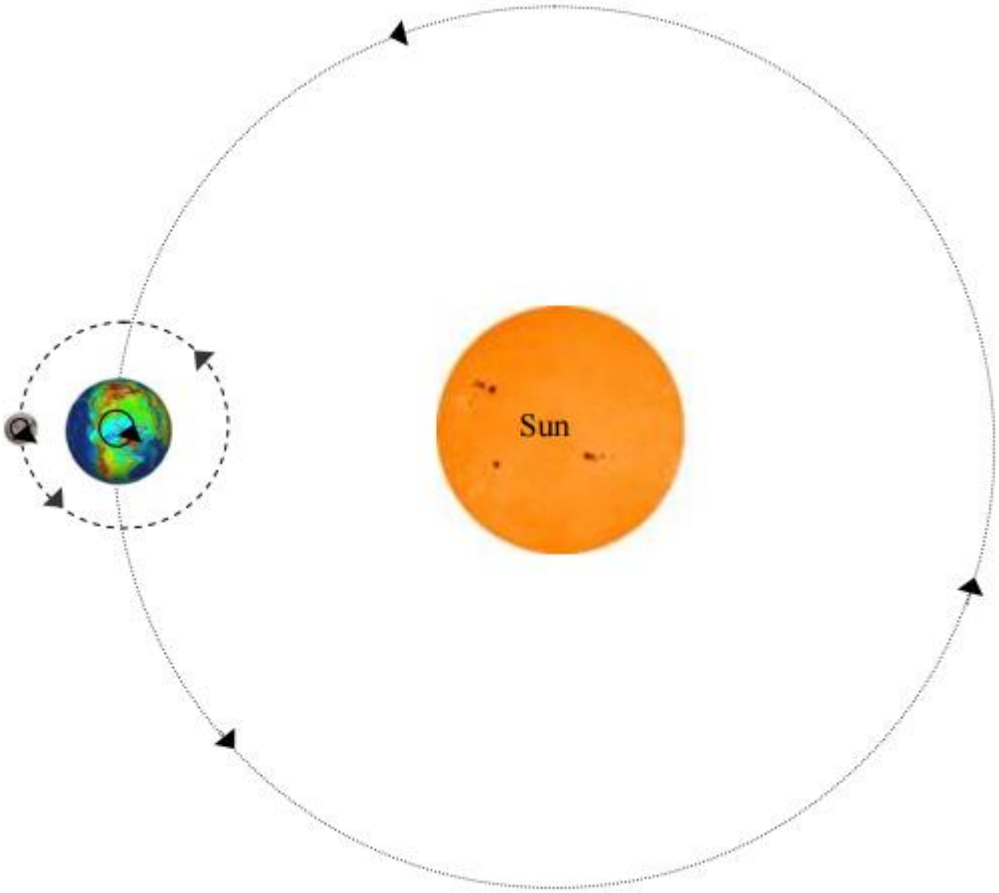
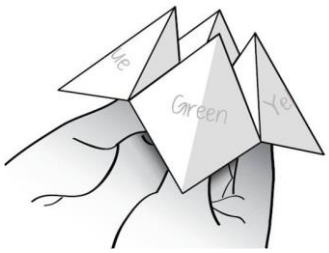


P3

2nd Grade

Fortune Tellers

Grade: 2



Quick challenge to focus on math standard:

CCSS.MATH.CONTENT.2.G.A.1

Recognize and draw shapes having specified attributes, such as a given number of angles or a given number of equal faces. Identify triangles, quadrilaterals, pentagons, hexagons, and cubes.

1. Students will follow the given step by step directions of making an Origami Fortune teller.
2. Students will need to be able to recognize shapes that are being described to continue their fold.
3. Once the Origami has been made, students will focus on the shapes that have been made and their attributes of each.

Quick challenge used as a hook:

Students will be introduced to a new unit with the narrative text *The Fortune- Tellers by Lloyd Alexander.*

Materials Needed: 1 piece of paper

<u>Directions</u>

It is very important to follow the step by step directions. You have 15 minutes to complete the Challenge.

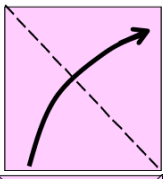
1. Fold the square from corner to corner, making a triangle.
2. Fold the triangle from corner to corner, making a smaller triangle.
3. Unfold everything and you'll have a square of paper with an X crease.
4. Fold one corner to the center of the square (where the X crosses).
5. Repeat with the other three corners and you'll end up with a smaller square.
6. Flip your little square over to the side where the folded flaps are.
7. Fold one of the corners to the center of the square (where the X crosses).
8. Repeat with the other three corners and you'll end up with an even smaller square.
9. Fold and unfold the bottom edge of the square up to the top. (folding the square in half)
10. Fold and unfold the other half of the square.
11. Push the four corners of the square together in the center and then slide 4 fingers into the flaps of your fortune teller, creasing the folds back so your fingers fit in nicely. You'll be able to move the flaps with your fingers like little puppets.
12. Use your imagination to fill out your completed Origami Fortune Teller.

Larger STEM Challenge:

Students will draw and describe the attributes of each shape that was made in the Origami Fortune Teller. This will make sure the students have a full understanding of what the different shapes are and why they are different.

Step by Step Directions Using Pictures

1.



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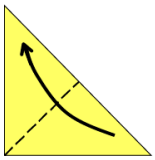

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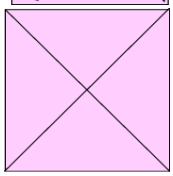

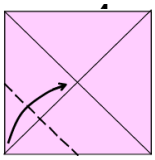

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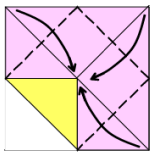

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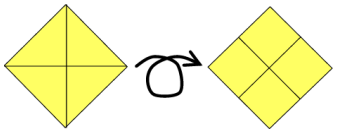

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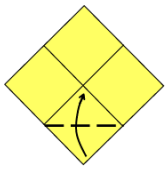

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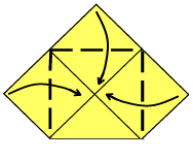


9.

10.

11.

12.

STEM Quick Challenge
Grade: 2

Standard: *CCSS.MATH.CONTENT.2.G.A.1*

Recognize and draw shapes having specified attributes, such as a given number of angles or a given number of equal faces.1 Identify triangles, quadrilaterals, pentagons, hexagons, and cubes.

Quick Challenge: You and your friends are playing ball outside. You accidently get the ball stuck in the tree. You must create a tower to climb in order to get the ball out of the tree. It is almost dinnertime, so you have very little time to complete this challenge!

Methodology:

1. Each student will be given 20 pieces of spaghetti and a few handfuls of mini marshmallows.
2. Students will be given 10 minutes to create the tallest tower they can. Students receive one point for every inch of their tower (tower must be able to stay up on its own).
3. Students receive bonus points for every shape used in the tower.
    a. Triangle - 1 point
    b. Square/Quadrilateral - 2 points
    c. Cube - 3 points
    d. Pentagon/Hexagon - 6 points
4. The teacher will use a tape measure to measure each student's tower and record it on her clipboard.

*Do not explain the shapes to the students before this quick challenge. Use this as "pre-test" to learn what the students already know.

Student Feedback: The teacher will measure, record, and add any bonuses up for each student. The teacher will then write the final number for each student on a post-it note and place it on the student's desk. The teacher will explain to the class that they will do this again after a few days of learning and the number on their desk will only go up.

Content Outline: As a class, discuss the five shapes listed in the standard. Have the students practice drawing them on paper. Then use marshmallows and pieces spaghetti to create 2D models of each shape. Each student will create a chart listing the shape, the number of sides, and the number of vertices (number of marshmallows used) each shape has.

Larger STEM Challenge: Students will repeat the activity but this time with partners. They will be given 30 minutes and more materials than the first time. With their new knowledge of shapes, students must utilize at least one triangle, one quadrilateral, one cube, and one pentagon and/or hexagon in their tower. Bonus points (same points as above) will be given when a shape is used more than once.

3rd Grade

Area and Perimeter Quick Challenge
Grade 3

CCSS.MATH.CONTENT.3.MD.D.8

Solve real world and mathematical problems involving perimeters of polygons, including finding the perimeter given the side lengths, finding an unknown side length, and exhibiting rectangles with the same perimeter and different areas or with the same area and different perimeters.

Quick Challenge:

1. Students will be divided into groups of 3 or 4.
2. Each student will be given a sheet of graph paper.
3. Each student will draw a shape with an area of 20 square units, but with each team member having a different perimeter.
4. Students may color their shapes if time allows.
5. After quick challenge is complete and time is up, the teacher will check to see if the students' work is correct.

Materials:

- Graph paper
- Markers

Content Outline:

Teacher would move on after this quick challenge to address area and perimeter in real world and mathematical problems. Could also begin measurements.

Larger STEM Challenge:

Each student will be assigned a certain area. They will then have to design their own structure that meets the area requirement, calculate the perimeter, and then build it using Legos.

In Class Quick Challenge
Grade 3

Quick Challenge to focus on science standard

Learning Standard: PS.6.3.3 Determine the impact of the following variables on pitch:

- Length
- Mass
- Tension
- State of matter

1. Students should divide into groups of two.
2. Students will work together to build a guitar out of a tissue box, paper towel roll, and rubber bands.

The goal of this challenge should be for students to learn the effects that length and tension have on pitch by making a working guitar.

Methodology: The teacher will introduce the lesson to the students by explaining what is expected during the activity. The teacher should explain that they will have an empty tissue box, paper towel roll, and rubber bands to make a guitar. Testing would be simple, the guitar would have to make three different pitches, and the students would have to describe why the rubber bands make different pitches.

Student Feedback: Students will fill out an engineering design loop about their experience and write a summary about how they were successful at making different pitches.

Content outline: Pitch, tension, length

Larger STEM Challenge: A larger STEM challenge that could be done would be that the students have to successfully create an intro to a commonly known song. Example: Twinkle Twinkle Little Star

4th Grade

Index Card Towers
Grade 4

Quick Challenge focusing on math standard

Learning Standard: PS.6.4.2
Investigate the relationship between *force* and *mass*.

1. Students will build a tower at least 10 inches tall out of index cards.
2. Student will be given no more than 10 inches of masking tape.
3. Student will have exactly 10 minutes to build the tower.
4. The tower must be built to withstand a small stuffed animal.

Materials Needed

- Index cards
- 10 inches of tape
- Stuffed animal

Quick Challenge used as a hook

Students will be introduced to a new unit dealing with the relationship between force and mass.

1. Students will build a keva tower that can withstand 50 pounds of weight.
2. Students will build a tower at least 8 inches tall.

The goal of this challenge should be to make the structure as strong as possible and be tested by placing weight on the structure until it collapses.

Maps, Measurement, and Scales Quick Challenge
Grade: 4th Grade

CCSS.MATH.CONTENT.4.MD.A.1.

Know relative sizes of measurement units within one system of units including km, m, cm; kg, g; lb, oz; l, ml; hr, min, sec. Within a single system of measurement, express measurements in a larger unit in terms of a smaller unit. Record measurement equivalents in a two-column table

STL Standard #9 Engineering Design and 3-5 Benchmarks C-E

Quick Challenge:

1. Students will work in partners to complete the map.
2. Each student will be given a piece of scrap paper to do conversions and each partnership will get a piece of ¼" graphing paper.
3. Students will follow these directions:
    - Draw a city using scales and measurement (km, m, and cm). Your house is at the center of the city. The grocery store is 2.5 km directly north of your house. The library is 250 meters west of the grocery store. Your best friend Sarah lives three doors down from you, which is 100 meters east. The hospital is 3.75 km south of your house and the gas station is 200,000 cm east of that. Add your own police station and school based on where you think they should go and label their distance in centimeters. Students will be given: (1 kilometer= 1000 meters 1 meter= 100 cm) and the scale (every 2 squares is 500 meters).
4. Each group will submit their complete map together and must agree.

Materials:

- 1/4" Graphing paper
- Scrap paper
- Pencils

Content Outline:

- Students would further expand on this math knowledge and Standard #9 with other STEM content with an informational lesson.

Larger STEM Challenge:

- The lesson will conclude with students building a model of a city that is the strongest standing using the limited materials provided. Students will learn measurements, scales, distance, proportions, and ratios while expanding on what they did in their quick challenge to put their cities to the test. Students must work in groups and figure out the best plan for the larger challenge as well as creating their own scale for the city.

Quick Challenge
Grade: 4

Standard:

CCSS.MATH.CONTENT.4.G.A.3: Recognize a line of symmetry for a two-dimensional figure as a line across the figure such that the figure can be folded along the line into matching parts. Identify line-symmetric figures and draw lines of symmetry.

Challenge:

Students will work in pairs. They will first be given the strict definition of symmetry, without much context or explanation. They will be given one piece of paper, measuring 8.5" x 11." They will also be given scissors and a ruler. Students are to discover a hard-edged shape with the most lines of symmetry. Students will have a time constraint of 10 minutes to complete the task.

Phrasing for Students:

Symmetry is defined as "the quality of being made up of exactly similar parts facing each other or around an axis." Knowing this definition, work with your partner to come up with a shape with the most lines of symmetry. The shapes can only have straight edges, however. You will have one piece of paper measuring 8.5" x 11," a ruler, and a pair of scissors. You only have 10 minutes, so work quickly and efficiently!

Methodology:

- Materials needed:
    - Plain 8.5" x 11" sheets of paper (enough for each pair of students to have one piece)
    - Scissors (enough for each pair of students to have one pair of scissors)
    - Rulers (enough for each pair of students to have one ruler)
- Concepts to Reinforce:
    - The definition of "symmetry."
    - For the challenge, the shapes they design must only have straight edges.

Student Feedback:

Once the time is up, have the pairs sit in a circle, and present their shapes. When presenting, students should make sure to state the number of lines of symmetry their shape has, and how to prove it. Through a group discussion/presentation method, students can receive immediate feedback both from the teacher and their peers.

Content Outline:

After the challenge, the students would be introduced to some concepts of symmetry, including a more in-depth definition of symmetry and how to tell if a shape has any symmetrical aspects.

- Symmetry: the quality of being made up of exactly similar parts facing each other or around an axis
- To identify shapes with symmetry, you can perform a number of tests, including folding, drawing lines, and measuring.

Larger STEM Challenge:

After tying in history and art to STEM concepts by discussing ancient European architecture, and how much of it uses the "golden ratio," and is symmetrical, students will be placed on teams for a challenge to build their own structure out of blocks that follows the same patterns. Students could use architectural structures already in existence as a model and reference, but the task would be to create an entirely new structure (fitting the parameters), for a purpose that is unique and creative.

Line of Symmetry
Grade: 4th

Learning Standard: *CCSS.MATH.CONTENT.4.G.A.3*

Recognize a line of symmetry for a two-dimensional figure as a line across the figure such that the figure can be folded along the line into matching parts. Identify line-symmetric figures and draw lines of symmetry.

Materials:

- Paper
- Pencil
- Scissors

Quick Challenge:

1. Students will be given a partner.
2. Students will use the given materials to create four different shapes for each group.
3. After all four shapes have been created; the students will draw the line of symmetry on each shape
4. Students will sort their shapes into two groups, group one being the group that has a line of symmetry and group two being the shapes without a line of symmetry.
5. Students will present their shapes to the class.

Purpose of this Quick Challenge:

The goal of this challenge is to allow the students to see that not every shape has a line of symmetry. After completing this challenge, students will understand that some shapes have a line of symmetry while others do not.

Content Outline: After students complete this challenge, the teacher would address any questions about symmetry that the students have and discuss the shapes they built in their groups. If the students made shapes that didn't display lines of symmetry, the teacher could explain why those shapes don't have lines of symmetry.

Larger STEM Challenge

In order to extend this challenge, students would be given a partner and they would build a town out of Legos that is only made of shapes that display a line of symmetry. Students would be given 10-15 minutes to build their town. This would allow the students to learn that symmetrical figures are all around us.

Miscellaneous Quick Challenges

Investigate the relationship between force and mass

Quick Challenge: Your challenge is to take 45 pennies and make an archway using those pennies. There has to be at least two pennies that are suspended by other pennies and not just stacked on top of each other. Also the start of the two pillars has to be 2 inches apart.

Methodology: All the teacher will need is pennies for this quick challenge. IF money is needed then they can ask each student for fifty cents to get rolls for pennies for this challenge. You could make the challenge more difficult by adding/taking away pennies from the amount they are allowed to use or by spreading the distance between the two starting points.

Student feedback: After everyone has tried this challenge, have an open discussion with the class to see if they have learned what was needed. What the students should take from this challenge is the idea of using counter balances to separate the two towers.

Content Outline: The idea of doing this quick challenge is to show the best way an archway is designed. This quick challenge would come before a class day about building bridges so they would understand the idea of how a counter balance worked when building bridges. They could then use this information to build a bridge and see whose bridge would be the strongest.

Quick Challenge Assignment- Parachute Challenge

Standard:

- *PS.6.K.3:* Demonstrate the effects of the *force of gravity* on objects

Quick Challenge:

- Design and build a parachute that will safely carry a toy figure to the ground. This includes attaching the parachute to the toy figure. The parachute may be any size. It should fully open and safely carry the toy figure to the ground without crashing. The toy must be attached in a harness, not taped to the parachute.

Methodology:

- Materials: Toy figures, tissue paper, small plastic garbage bag, string, rubber bands, paper clips, clear or masking tape, and container for group supplies.
- Preparation: Each group will get the following inside their container: 1 toy figure, 2 meters of string, 1 sheet of tissue paper or 1 small garbage bag, roll of tape, 2 rubber bands, and 2 paper clips.
- Instruction: Explain the task to students by giving them a criteria worksheet that details the task. Ask any questions students may have. Ask students to consider the following: How does the parachute work? How many strings are attached to a parachute? What is the shape of a parachute? What must be considered in making a parachute? How is an object attached to a parachute?

Student Feedback:

- Students will not be graded on their parachute. Instead, groups will take turns testing their parachute in front of the class and will explain why they chose the design of their parachute. The class will hold a discussion about each parachute, offering ideas of what could have been done differently to enhance the performance of the parachute or simply what the group did well.

Content Outline:

- Gravity

Larger STEM Challenge:

- Can you build a car, powered by gravity that can travel at least 100 cm without turning? Students will craft a car using cardboard sheets and/or empty cardboard tubes, straws, assorted scrap paper, misc. craft items (beads, buttons, pipe cleaners, etc.), scissors, tape, glue, ramp, and tape measure.
- Activity with ramps, marbles, and gravity!

Coordinate Conundrum

Standard: ***CCSS.MATH.CONTENT.4.G.A.3***

> Recognize a line of symmetry for a two-dimensional figure as a line across the figure such that the figure can be folded along the line into matching parts. Identify line-symmetric figures and draw lines of symmetry.

Quick Challenge:

> Students will be given a coordinate grid. They will be given 8 clues that will allow them to correctly place letters at certain points on the grid using lines of symmetry.

Methodology:

> Each student will be given a grid with the 10 letters printed and the 8 clues below. The 10 letters will also be written (or taped) to the board. Teacher will draw large grid on board while students work on their individual challenges. When finished, students will raise hands to place a letter on the correct spot on the board and explain why they placed that letter there.

Student Feedback:

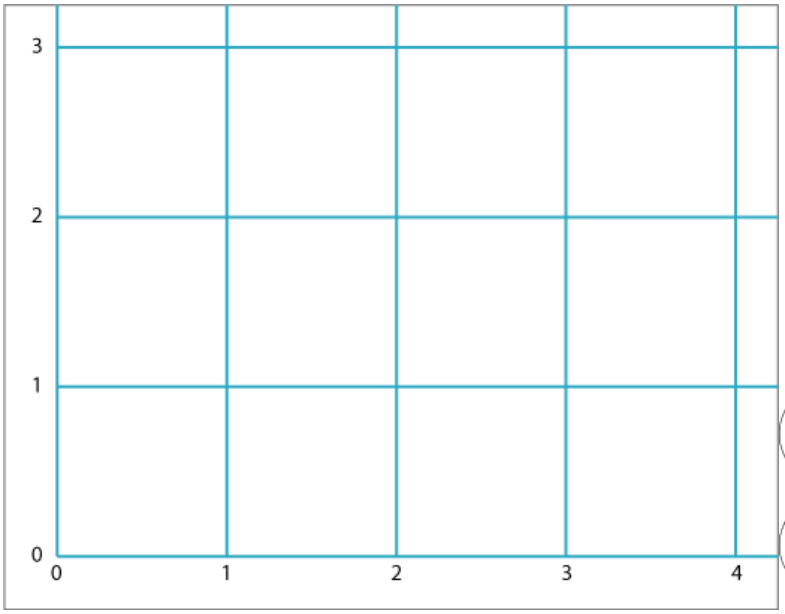
> By having the students help you correctly place the letters on the grid, they are showing their understanding of symmetrical lines and shapes.

Content Outline:

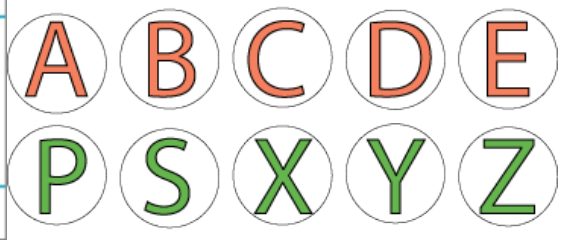
- Students will discuss major ideas concerning lines of symmetry
- Students will draw a large letter on the back of their paper and find all of the ways to fold that letter symmetrically
- Larger STEM challenge will be introduced
- Students will identify objects with NO lines of symmetry

Larger STEM Challenge:

> Students will create a large 3D grid (PVC and nails at each increment) and place 2D and 3D objects from around the classroom within the coordinate system to identify lines of symmetry. They must identify how many lines of symmetry are present in each.



Can you position these ten letters in their correct places according to the eight clues below?



Clues:

1. The letters at (1,1), (1,2) and (1,3) are all symmetrical about a vertical line.
2. The letter at (4,2) is not symmetrical in any way.
3. The letters at (1,1), (2,1) and (3,1) are symmetrical about a horizontal line.
4. The letters at (0,2), (2,0) have rotational symmetry.
5. The letter at (3,1) consists of just straight lines.
6. The letters at (3,3) and (2,0) consist of just curved lines.
7. The letters at (3,3), (3,2) and (3,1) are consecutive in the alphabet.
8. The letters at (0,2) and (1,2) are at the two ends of the alphabet.

Magnetic Links

Standard: PS.7.1.6 Classify materials as magnetic or nonmagnetic

Quick Challenge: In pairs, using the items in the bag, the students will use magnetic and non-magnetic materials to produce the longest chain possible.

Materials: A combination of magnetic and non-magnetic materials. I used magnets, paper clips, bobby pins, a screw, a rubber band, paper, and string.

Methodology: After the students have made their chains, have them measure it.

Student feedback: They will measure the chains they have made and then classify the materials into magnetic and non-magnetic.

Content outline: This activity explores the use of magnetic and ferromagnetic materials together to form a single unit. It allows creativity to include the non-magnetic materials in the chain. It also ties in the use of measurement.

Larger STEM Challenge: Larger activities could include the explorations of what makes materials magnetic and how magnets work such as building a chain that utilizes magnets and magnetic objects that will hold paper on a paperclip at the bottom.

Pendulum Painting

Standard: PS.6.K.3. Demonstrate the effects of the force of gravity on objects

Quick Challenge: Pendulum Painting – Construct a pendulum and paint a picture with it. This will require complete teacher guided instruction and assistance.

Methodology: In a quick STEM activity mixed with art, students build a pendulum with a foam or paper cup, string, tape, water, and paint, and paint a picture with their structure. Since the target age group is kindergarten, the teacher may have the materials at each students place, and walk them through what a pendulum is as well as how to construct it. Students may need help with poking holes in the cup and tying the string. Students could create a curtailed version of a design loop by drawing pictures of their pendulum and how it moved, as well as includes their painting and explain why they think it looks the way it does, and completing the sentence: "One thing I learned about gravity is…"

Student Feedback: Students would be assessed based on their ability to follow directions and listen as well as their completion a shortened, kindergarten version of the design loop. As students painted and worked with their pendulums, the teacher would go around and provide verbal feedback.

Content Outline: the effects of force of gravity on objects, gravity, force of motion, structure, timing, measurement

Larger STEM Challenge: In an activity geared towards kindergarten and first grade students, the teacher constructs a pendulum while students construct different towers. The pendulum could be crafted in many different ways and with many different materials. I have seen it done with PVC pipe, string, and a ball. I have also seen it constructed with a tennis ball, stockings, and hung from the ceiling rafters. Regardless, some form of pendulum is constructed. Students are to build towers out of different sized boxes, card board cylinders, yogurt containers, and other house hold items. After everything is constructed, students will release the pendulum and try to knock down their towers. Not only will they build upon their knowledge of pendulums and gravity, they will also learn about balance, stability, structure, tower position, and force. The activity could include a more detailed design loop where students explain the thinking and construction behind their towers, as well. This activity could be adapted further for older students by having them construct their own pendulum and their own tower. They would have to provide design loops for both structures as well as explain why and how their pendulum worked and why their tower fell or not.

Uber Anyone?

Standard: Identify one of the math or science standards outlined below.

- *CCSS.MATH.CONTENT.K.MD.B.3* Classify objects into given categories; count the numbers of objects in each category and sort the categories by count.

Quick Challenge: Develop a quick challenge that will introduce a concept related to the standard. This may include a simple written design brief for the student, or written instruction that the teacher will present orally.

- **Scenario/Written Instructions**
  - Dora and Boots are going to Blueberry Mountain and are running late. Diego is having his tenth birthday party on the mountain. Out of nowhere Tico shows up in a car. Tico has taken a part time job as an Uber driver and can give Dora and Boots a lift to Blueberry Mountain. Tico doesn't like waiting on people so Dora and Boots need to hurry and get in the car. Tico acquires different payments every trip.
    - Dora and Boots need to get inside Dora's backpack and get whatever payment that Tico desires. You will have two minutes to get inside the backpack and grab the right payment method Tico requires. Or else you will be kicked to the curb and miss the party!

Methodology: Describe the method by which the teacher will implement the quick challenge (materials needed—keep it simple, testing procedure, concepts to reinforce)

- The students will have to grab the right item out of a bag and get however many of said item is needed to keep the car going. The teacher will call out different numbers and items for the kids to collect and organize.

Student Feedback: *Quick challenges* are typically ungraded assignments, but develop some method by which students can be provided with feedback concerning their performance.

-

Content Outline: Outline the major concepts or content that would ideally be delivered following the quick challenge (just an outline, no need for including all content information at this point).

- The student will need to know how to find what item is necessary for payment.
- They will have to organize/categorize the items based on color and shapes.
- They will have to be able to count the number of items that the payment requires.
- They will have to have some idea of time management. (two minutes to find and count out .

Larger STEM Challenge: Identify a larger STEM design challenge that could follow and expand upon this quick challenge (just 1-2 sentences describing the larger STEM challenge that could follow).

- We could use actual money or fake money and have the students count out coins and dollar bills to pay Tico.

A paper copy of all materials (one or two pages maximum). Bring next class period.

- Plastic color Rods
- Two Color Counters
- Colored Pop Cubes
- Color Tiles
- Assortment of Coins

Mag Racer

Standard:

PS.7.1.7 --- Investigate the properties of magnets:

Attraction

Repulsion

Quick Challenge:

With a partner, students will be stationed to a track where one will be the operator of a magnetic "racer" and the other will be the director for the operator. Each group will be given two magnets, one to place at the top of the table and one on the bottom to control the movement of the top magnet. The operator will close their eyes and must move the racer through the track with instructions from the director. The track will be arranged by the teacher prior to the challenge. The track will be constructed out of pencils and will be just placed on the surface of the table. If a pencil is knocked out of place, the group must start over at the beginning of the track after repair of the pencil boundary.

Methodology:

The teacher will just need multiple high strength magnets (enough for there to be two to a group), a rather thin tabletop, and several pencils. The tracks will already be made when the class comes in. Operators will sit under the table, and directors will be above watching the movement of the racer. Reinforcement of the idea that magnets can't be too far apart to operate correctly is important. This must be related to the speed that the operator is moving.

Student Feedback:

The director should keep track of how many times attraction between the magnets was lost during the race. After the activity, students can self assess how well they adjusted their speeds and the quality of their awareness of attraction distance after the challenge is over.

Content Outline:

- Magnetic Poles – the sides of a magnet that cause either repulsion or attraction.
- Magnetic attraction – what causes magnets to be pulled together, and the arrangement of the poles of the magnet required to attract.
- Magnetic repulsion – what causes magnets to be pushed apart, and the arrangement of the poles required to repel.
- Magnetic Field – the area around a magnetic surface that possesses magnetic forces required to repel or attract magnetic materials.

STEM Challenge:

Staying on the topic of “racers”, students would then be presented with a design challenge where they are required to build a gravity powered maglev vehicle.

Marshmallows and Candy Canes
STEM Quick Challenge

Standard:

CCSS.MATH.CONTENT.2.G.A.1

Recognize and draw shapes having specified attributes, such as a given number of angles or a given number of equal faces. Identify quadrilaterals, pentagons, hexagons, and cubes.

Quick Challenge:

Each team will be given ten candy cane sticks and twenty marshmallows. The goal of the quick challenge is to create as many shapes out of the marshmallows and candy cane sticks as possible, with the candy cane sticks suspended off of the table (candy cane sticks cannot touch the table, but marshmallows can). In order for their shape to count, they must either draw a picture of it and identify the shape, or show the teacher and identify the shape by defining the shape. The team that has created the most shapes at the end of the 15 minutes wins the quick challenge.

Methodology

Materials will already be divided out so that teams can quickly pick up a bag and get started. Once a shape is made, the students will be asked to prove how they know that it is a shape (either orally or written).

Student Feedback

Students will be asked to define the attributes of their shape and how they know that is the shape they made. The teacher will be able to see who needs more help, and how many shapes the students know. She will also be able to see commonly mistaken and forgotten shapes that the students struggle with.

Content Outline

Once the teacher gets a feel for what shapes the student's struggle with, he or she can review what needs to be reviewed with the students. The teacher could then begin to show how to make shapes out of the candy cane sticks and marshmallows. The teacher can also show 3D shapes if none of the students were able to come up with one.

Larger Stem Challenge:

This quick challenge could be the precedent for many holiday themed quick challenges. One in particular is a gingerbread house challenge where the students can use their prior knowledge of 2D shapes, and new knowledge of 3D shapes in order to create a gingerbread house within certain parameters.

Standard:

PS.6.K.1: Demonstrate spatial relationships, including but not limited to

- Over
- Under
- Left
- Right

Quick Challenge: Design the tallest structure you can using no more than the provided 4 notecards, 20 toothpicks, and 1 Dixie cup. The Dixie cup must be positioned upright in the structure. Your structure must be one big structure with all parts connected, held together only by tape, and have:

- The Dixie cup over/above/on top of a notecard
- A toothpick under a notecard
- A toothpick to the right of the Dixie cup
- A toothpick to the left of the Dixie cup

Methodology: The teacher will remind students of the spatial relationships the objects in their structure must have (objects must be over/under/left/right of other objects). The teacher will test for if the materials are in the correct spatial relationships with what the assignment qualifications are, as well as how strong their structure is based on how many pennies their structure can hold.

Student Feedback: They will be given feedback from the teacher as to if the objects in their structure follow the correct spatial relationships listed in the criteria of the quick challenge. This will show the student and teacher if the student understands the spatial relationships of over, under, left and right.

Content Outline: Structure, strength

Larger STEM Challenge: Build the structure using the criteria with spatial relationships and then put as many pennies in the Dixie cup in the structure as possible until the structure breaks. The more pennies that are able to be held, the stronger the structure is.

Name: _____

Building Structures Using Spatial Relationships

Directions: Brainstorm solutions to your problem. What do you think would work best when designing your structure? Draw sketches of your structure. Make sure if follows the spatial relationship criteria required!

Ready Set Sit
Materials: a single sheet of paper, tape, and a small stuffed animal

1. You will get in teams of two and will have ten minutes to make a paper chair with only one sheet of paper and tape.

2. It has to be able to support the weight of a small stuffed animal.

3. The last five minutes we will test the chair to see if it can withstand the weight of a small stuffed animal.

Questions:

1. Did you brainstorm before making your chair?

_____
_____
_____

2. Did you chair design work and hold the weight?

_____
_____
_____

3. What would you change about your design?

_____
_____
_____

4. What worked the best about your design?

_____
_____
_____

5. Of all the designs what worked, which worked the best and why?

_____
_____
_____

Standard I choose was the PS.6.4.2

Investigate the relationship between force and mass

Paper Cup Telephones

Standard: PS. 6.3.2 Investigate the relationship between sound and wave motion.

Quick Challenge: Students will pair off. One person in each pair will be handed a sheet that instructs them on different sounds to make. The other person will turn around and guess what sound their partner is making.

Methodology: The teacher will orally give instructions and then hand each pair a sheet with sounds on it.

Student Feedback: Students can discuss which sounds they recognized and which sounds they didn't recognize. They can also discuss why or why not.

Content Outline: Information on how sound waves work would be delivered after this quick challenge.

Larger STEM Challenge: The students could make a paper cup telephone as a larger stem challenge. They could experiment with different lengths of string.

Sounds

Directions: Tell your partner when you are ready to start each time. Check off what your partner got right.

- ☐ Tap on your desk
- ☐ Write with a pencil
- ☐ Turn the pages of a notebook or textbook
- ☐ Crinkle up a paper
- ☐ Clap your hands

Relationship between force and direction

A catapult is a device in which accumulated tension is suddenly released to hurl an object some distance, in particular.

Challenge: You are challenged to build a catapult out of the materials provided. Creativity is key. The idea is to see how far you can catapult an object. Does more or less tension make the object go further? Does the weight of the object have any influence on the distance that the object will fly? After you have the desired tension and weighted object, you will challenge other groups to see whose can go the farthest.

The teacher will introduce this challenge by first, explaining what a catapult is, then by describing how tension (force) and direction are applied to this challenge by using the catapult to launch objects of varying weights and tensions through the air. After the students get their desired weighted objects and find the perfect tension on their device, they will compete with other groups to see whose goes the farthest. The students can also make a data sheet with how far the object is thrown to come up with an average distance, if time does not allow the students to compete with one another.

This quick challenge could lead in to building their own rubber band cars. They will know that they need to put more tension (force) on the rubber band in order to get the car to propel forward faster and for a longer distance. They will also be able to play with the placement of the rubber band to change direction of trajectory.

Supplies and Materials:

Materials	**Launching Materials**
Popsicle Sticks	M&Ms
Rubber Bands	Gummi Life Savers
Plastic Spoon	Gum Drops

Create A Maze

Standard:

PS.6.K.2 Science

Demonstrate various ways that objects can move, including but not limited to

- straight
- zig-zag
- back and forth
- round and round
- fast and slow

Quick Challenge: Create a maze using only the materials provided. Try to create a successful path using the words below. Use these words to design the maze, use as many words as possible in the time allotted.

- Straight
- Zig-zag
- Back and fourth
- Round and round
- Fast and slow

Materials:

- Yarn
- Tape
- Paper

Methodology: Students will construct a maze using a piece of paper, yarn, and tape. Then the student will attempt to create a maze using the descriptive words shown above. They will use the yarn and tape to create an outline of the maze. They then will take their pencil and outline around the yarn to complete the maze. After ten minutes is up have the students switch with a partner and have the partner see how many of the different paths were completed within the maze. This allows for the teacher to see if the maze is completed, and creatively constructed to create a path that demonstrates the ways an object could move.

Student Feedback: Students will be provided feedback through the person who completed their maze. The other student would describe what they saw in the different patterns of motion in the maze. This might be different and they might see a way of motion that the creator of the maze did not see. This is a way for students to interpret other students work, and a way for the student to explain their own work.

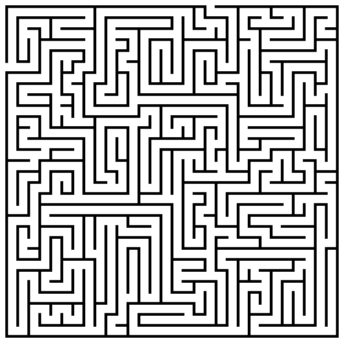
Content Outline:

The major concepts that would be completed after the quick challenge:

- Understand the different methods of how objects can move
- Configure a successful maze
- Be able to explain how to complete the maze using the vocabulary above, such as "straight" and "round and round".

Larger STEM Challenge: A way to expand this quick challenge would be to have the students create a version of the maze in three dimension. Using a type of construction block have the students create a larger scaled track that demonstrates many different types of motion. It would become more of a track rather than a maze.

Quick Challenge



Create a maze, in which the pattern demonstrates the words provided below:

- **Straight**
- **Zig-zag**
- **Back and fourth**
- **Round and round**
- **Fast and slow**

Use the following materials to complete the maze

- **Paper**
- **Yarn**
- **Tape**
- **Pencil/pen**

When finished give your maze, outline the yarn using your pencil and hand it to a partner to complete. When completing the maze you are given describe the types of movement you

are doing when doing through the maze, by using the words from above, and any other type of motion you are presented with.