C5ISR CENTER STEM@Home

Welcome to STEM@Home!

As we maneuver the challenges of the COVID-19 epidemic, we strive to continue to make STEM accessible to all.

The STEM@Home Newsletter is intended to be a resource to provide engaging and educational activities that can be done with minimal materials and a whole lot of imagination.

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Math Challenge

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7	3		2					
5					4	9	3	1
2		1		5	3	7		4
		7						
	5	4		7		3	1	
	7	3	6					9
						1		
		8		3	4			2

Directions:

To complete the puzzle, the numbers 1,2,3,4,5,6,7,8,9 once (and only once) in each ROW, COLUMN, and CUBE

(solution is on page 4)

SHARE YOUR STEM…

Visit the C5ISR Center on Facebook to post a photo or video of your child completing one of the STEM@Home Activities.

https://www.facebook.com/CCDC.C5ISR/

#C5ISRCenterSTEM

Push & Pull Challenge (Grades K-2)

Forces—pushes and pulls that can change an object's position and put it into motion—power everything on Earth. A push is the force that moves an object away from something, like when you push a chair away from you. A pull is the force that brings an object closer, like when you pull a chair closer to you. When moving heavy items, it is easier to use the forces of push and pull to move items instead of carrying them. Over the years, engineers have designed devices such as wagons, carts, wheelbarrows, wheelchairs, and sleds that make it easy to move people or heavy objects from one place to another.

Vocabulary

Motion: the act or process of changing place or position.

Materials for device:

- Empty tissue box
- Pieces of poster board
- Cardboard
- Craft sticks
- Straws
- Pipe cleaners
- String
- Tape
- Scissors
- Toilet paper tubes

Materials to use for test:

- Rocks (3 different sizes, all small enough to be placed in the device)
- Coins
- Bottle caps
- Paper clips

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Mission: Happy the Dancing Clown needs a new device to push and pull her balloon animals and prizes around at the carnival. Wonderopolis Attractions has hired you as an engineer to design a new and improved wagon that will allow Happy to push and pull her materials.

Requirements:

Your device must be able to push and pull as well as hold materials. Test your device by placing objects of different sizes in it to push and pull.

Design Process:

ASK: What is the problem you need to solve?

-Design a prototype of a push-and-pull device that will carry heavy materials across a carnival.

IMAGINE: Brainstorm and decide on an idea. What will your push-and-pull device look like?

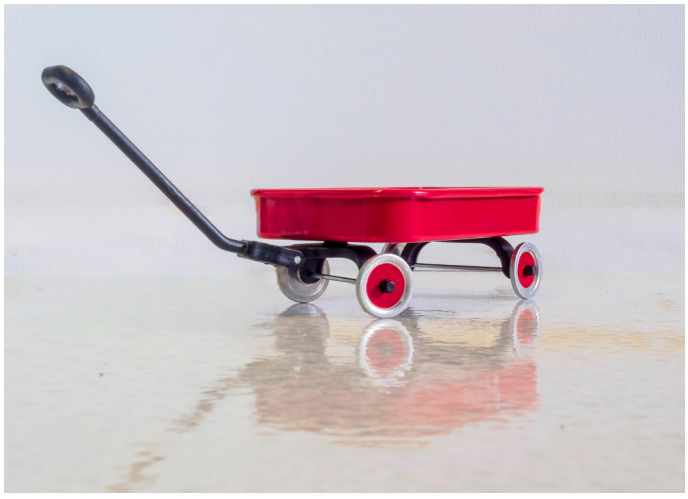
PLAN: Draw a picture of your push-and-pull device.

CREATE: Use the materials to build a prototype of your push-and-pull device.

IMPROVE: Think of ways you could improve your push-and-pull device. Test your device by placing different objects in it.

Questions to think about:

- What was successful about your design?
- How would you change your design to make it better?
- Did you notice that some objects were easier to push and pull than others?



Wrecking Ball Game Challenge (Grades 3-5)

VOCABULARY:

Gravity: an invisible force that pulls objects towards each other.

Inertia: the principle that states an object at rest will stay at rest and an object in motion will stay at motion.

Acceleration: the process of an object moving faster or something happening more quickly.

Force: a push or pull that acts upon an object as a result of that object's interactions with its surroundings.

Materials for pendulum wrecking ball:

- Cardboard
- String
- Tape
- Rubber bands
- Masking tape
- Cardboard tubes
- Ball
- Plastic soda or water bottle

Materials for target:

- Toy action figures
- Empty cans
- Empty water bottles

Pendulums are used in many everyday items, including clocks, earthquake sensors, amusement park rides, and even games. A pendulum is a mass or weight that hangs from a string that swings freely under the force of gravity. A moving object only changes direction when a force acts upon it. In a pendulum, gravity is the force that pulls mass down, while inertia is the property that keeps the mass in motion. When the mass is drawn upwards and let go, the force of gravity accelerates and sends it back to the original position and inertia keeps the mass moving through the rest of its arch. By knowing the science behind pendulums, engineers can design rides and games for amusement parks, such as a swing ride or a pirate ship ride that swings back and forth or others.

Mission: Wonderopolis Attractions has hired you as an engineer to design a new game for carnivals called the Wrecking Ball that uses the concept of a pendulum and requires the player to swing a wrecking ball at targets to knock them down.

Requirements:

You must test your game to see if it works. (You can use a chair to attach your device for your game or hold it up over the target. Be careful where and how you set your game up. Check with an adult to make sure your game is safe.)

Design Process:

ASK: What is the problem you need to solve?

Design a prototype of a carnival game using a pendulum-style wrecking ball to knock over targets.

IMAGINE: Brainstorm and decide on an idea. What will your game look like and how will it work?

PLAN: Draw a picture of your wrecking ball game. Label your picture with the materials you intend to use for each purpose.

CREATE: Use the materials to build a prototype of your wrecking ball game.

IMPROVE: Think of ways you could improve your wrecking ball game.

Questions to think about:

- What was successful about your design?
- What was the most beneficial building material in your design and why?
- How would you change your design to make it better?

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Catapult Ball Game Challenge (Grades 6-8)

Vocabulary:

Newton's Second Law of Motion: the greater the mass of an object, the greater the force needed to change the object's motion.

Potential energy: the stored energy of an object due to its position.

Kinetic energy: a form of energy that results from an object's motion.

Materials for catapult:

- Ping pong ball, bouncy ball, or cotton ball
- Popsicle sticks
- Rubber bands
- Cardboard
- Tape
- Clothespins
- Glue
- Plastic bottle cap

Materials for target or basket:

- Paper plate
- Paper bowl
- Cup
- Paper with a target drawn on it

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Have you ever been to a carnival or fair and played the "shoot the basketball into the basket" game? Think about how much more fun the game would be if you used a simple machine such as a catapult to do the throwing? A catapult is a compound machine that consists of a lever, wheel, and axle. A catapult uses the forces of tension and gravity to convert potential energy into kinetic energy when it is launched. Catapults use the concept of Newton's Second Law of Motion because the more force you apply to a catapult, the more force is applied to object being launched.

Mission: You have been contacted by Wonderopolis Attractions to design a new game called the Catapult Ball Challenge. Your game should launch a ball at a target or into a basket by using a catapult.

Requirements:

-Your ball must be able to land in a basket or hit a target.

Design Process:

ASK: What is the problem you need to solve?

-Design a prototype of a carnival game that uses a catapult to launch a ball at a basket or target.

IMAGINE: Brainstorm and decide on an idea. What will your game look like and how will it work?

PLAN: Draw a picture of your catapult ball game. Label your picture with the materials you intend to use for each purpose.

CREATE: Use the materials to build a prototype of your catapult ball game.

IMPROVE: Think of ways you could improve your catapult ball game.

Questions to think about:

- What was successful about your design?
- What was the most beneficial building material in your design and why?
- How would you change your design to make it better?

SOLUTION FROM PAGE 1

1	4	**6**	**3**	**9**	5	**2**	8	7
7	**3**	9	**2**	1	8	4	6	5
5	8	2	7	6	**4**	**9**	**3**	**1**
2	6	**1**	8	**5**	**3**	**7**	9	**4**
3	9	**7**	1	4	6	5	2	8
8	**5**	**4**	9	**7**	2	**3**	**1**	6
4	**7**	**3**	**6**	2	1	8	5	**9**
6	2	5	9	8	7	**1**	4	3
9	1	**8**	5	**3**	**4**	6	7	**2**

Bumper Car Challenge (Grades 9-12)

Materials for car:

- Craft sticks
- Straws
- Cardboard pieces
- Cardboard tubes
- Tape
- Wooden skewers
- Newspaper
- Foam
- Bubble wrap
- Rubber bands
- String or yarn
- Pipe cleaners
- Paper clips
- Foam or pool noodle
- Egg

Materials for ramp:

- Long piece of cardboard, lid to storage bin, or foam board

Questions to think about:

- What was successful about your design?
- What was the most beneficial building material in your design and why?
- How would you change your design to make it better?

If you like caravel rides, you have probably experienced the crashing, bouncing, and rattling around in bumper cars. Did you know that Newton's laws are the driving force behind bumper cars. The first law is demonstrated when a person in a bumper car collides with another bumper car, feeling a jolt. The second law is seen when people who weigh less get bumped around more than people who weigh more. This is because it takes a great force to move the cars with more mass than the cars with less mass. Lastly, the third law is demonstrated when two bumpers cars that are traveling at the same speed and carry the same weight run into each other. Those cars will bounce off each other and move an equal distance away from each other. With all the bouncing around, it is important that bumper cars have multiple safety devices.

Mission: Wonder Park Attractions, has contracted you as an engineer to design a new and improved bumper car for its customers. You will need to build a prototype of the bumper car and test it for safety by using an egg to make sure it is secure.

Requirements:

- Your bumper car must have a device that will hold an egg and protect it from damage.
- The egg must be contained in the device but be easily removed.
- You must test your bumper car. You will need to place your ramp towards a wall. Make sure to line the wall with foam, a pool noodle, or a pillow to represent the rubber that would be on another bumper car.

Design Process:

ASK: What is the problem you need to solve?
IMAGINE: Brainstorm and decide on an idea. What will your bumper car look like and how will it secure an egg?
PLAN: Draw a picture of your bumper car. Label your picture with the materials you intend to use for each purpose.
CREATE: Use the materials listed above to build a prototype of your bumper car.
IMPROVE: Think of ways you could improve your bumper car.

Vocabulary:

Newton's First Law of Motion: every object in motion continues in motion and every object at rest stays at rest unless an outside force acts upon it.

Newton's Second Law of Motion: the greater the mass of an object, the greater the force needed to change the object's motion.

Newton's Third Law of Motion: For every action, there is an equal and opposite action.

Standards: C5ISR Center STEM Outreach Activities Align with the Next Generation Science Standards

ACTIVITY ONE: K-PS2-1 Motion and Stability: Forces and Interactions: Plan and conduct an investigation to compare the effects of different strengths or different directions of pushes and pulls on the motion of an object. K-PS2-2: Analyze data to determine if a design solution works as intended to change the speed or direction of an object with a push or pull.
ACTIVITY TWO: 3-PS2-2 Motion and Stability: Forces and Interactions: Make observations or measurements of an object's motion to provide evidence that a pattern can be used to predict future motion. 3-5-ETS1-3 Engineering Design: Plan and carry out fair tests in which variables are controlled and failure points are considered to identify aspects of a model or prototype that can be improved.
ACTIVITY THREE: MS-PS2-1 Motion and Stability: Forces and Interactions: Plan an investigation to provide evidence that the change in an object's motion depends on the sum of the forces on the object and the mass of the object (grades 6 - 8).
ACTIVITY FOUR: HS-PS2-3 Motion and Stability: Forces and Interactions: Apply scientific and engineering ideas to design, evaluate, and refine a device that minimizes the force on a macroscopic object during a collision.