STEM On The Go!

Zip Line Challenge

Objective:

Build a device that can transport a ping-pong ball from the top of a zip line to the bottom in 4 seconds or less.

CPS Target Grade:	3rd	**Age Range: 8-12**
Time Allotment:	60-90 minutes	
# of Students:	*Groups of 4*	
Topic(s) of Study:	Forces and Motion	
Author and Date:	Sheila Sloup Summer 2019	
Industry Connection:	Machines in factories, assembly lines, transportation	
Agricultural or Environmental Connection:	Farmers move grain, hay, animals and water from place to place.	
Technology Used:		
Optional Online Material and Resources:		
Sources and Credits:	MacGillivray Freeman's DREAM BIG This "Zip Line" activity was adapted from the Design Squad Activity Guide, pbskids.org/designsquad/parentseducators/guides/index.html. Used with permission from WGBH Educational Foundation.	
Lesson Evaluation Form:	https://goo.gl/forms/9PwfHUr2RZaDzrV63	

NEBRASKA STANDARDS

Nebraska CCR Science Topic				Disciplinary Core Idea (DCI)	
PHYSICAL SCIENCE			**X**	**PS1**	Matter and Its Interactions
X	**1**	Forces and Interactions	**X**	**PS2**	Motion and Stability: Forces and Interactions
	2	Waves and Electromagnetic Radiation	**X**	**PS3**	Energy
	3	Structure and Properties of Matter		**PS4**	Waves and their applications in technologies for information transfer
X	**4**	Energy		**LS1**	From molecules to organisms: Structures and Processes
	5	Chemical Reactions		**LS2**	Ecosystems: Interactions, Energy, and Dynamics
LIFE SCIENCE				**LS3**	Heredity: Inheritance of Traits
	6	Structure and Function		**LS4**	Biological Evolution: Unity and Diversity
	7	Interdependent Relationships in Ecosystems		**ESS1**	Earth's Place in the Universe
	8	Matter and Energy in Organisms and Ecosystems		**ESS2**	Earth's Systems
	9	Heredity: Inheritance and Variation of Traits		**ESS3**	Earth and Human Activity
	10	Biological Evolution		**ETS1**	Engineering Design
EARTH AND SPACE SCIENCE					
	11	Space Systems			
	12	Weather and Climate			
	13	Earth's Systems			
	14	History of Earth			
	15	Sustainability			

Science & Engineering Practices (SEP)			Crosscutting Concepts (CCC)	
	Asking Questions and Defining Problems			Patterns
X	Developing and Using Models		X	Cause and Effect
X	Planning and Carrying Out Investigations			Scale, Proportion, and Quantity
	Analyzing and Interpreting Data		X	Systems and System Models
	Using Mathematics and Computational Thinking		X	Energy and Matter
X	Constructing Explanations and Designing Solutions		X	Structure and Function
	Engaging In Argument from Evidence		X	Stability and Change
X	Obtaining, Evaluating, and Communicating Information			

Standards	Description
SC.3.1.1.A	Plan and conduct an investigation to provide evidence of the effects of balanced and unbalanced forces on the motion of an object.
SC.3.1.1.B	Make observations and/or measurements of an object's motion to provide evidence that a pattern can be used to predict future motion.

Materials List -

Container(s) Name(s): Zip Line Challenge

Number of Containers: 1

Container Location: STEM On The Go! Trailer

Quantity	Part Description
	Consumables Items
	Small Dixie cups
	Reams of String or yarn
	Fishing line
	Rolls of Masking Tape
	Paper Clips
	Pipe Cleaners
	Straws
	Index Cards
	Wooden skewers or pencils
	Non-Consumable Items
4	Hole Punches
12	Rulers
20	Clothes hangers
15	Ping Pong Balls
40+	Flat, 1” steel washers
	To be provided by Instructor
	Glue
	Scissors (scissors available in the tote labeled “Classroom Supplies” if needed)

Phenomenon

How can you build a model zipline that will help people get from one location to another?

Instructions

1. **Intro:** Ask participants to describe a zip line. Ask questions to get them thinking:
    a. What forces are involved in an object moving down a zip line? (Friction, gravity, etc.)
    b. How are zip lines used today? (Tourism, biological surveys.)
    c. What else could they be used for?
2. **Real World Challenge:** Children in the small village of Los Pinos, Colombia, don't have a school of their own. Instead, they ride a zip line half a mile across a canyon to attend school in a neighboring town. When designing zip lines, engineers must consider speed, the difference in height between starting and ending points, and the safety needs of a rider. Making zip-lining safe is of critical importance.
3. **Getting Ready:** Cut about 4 feet of fishing line to make a zip line. Attach one end of the line to a wall or chair and the other end to an object about 2 feet lower. Make as many zip lines as you want or have space for.
4. **Instructions:** Build a device that will transport a ping-pong ball down a zip line from start to finish in 4 seconds or less.
5. **Provide the following guidance:**
    a. Design, build, and test the device.
    b. Make adjustments to the weight, center of mass, and friction of the device as needed. Participants may need help assessing what needs to be changed. Ask questions like "What can you do to make your zip line faster?" or "Which materials can help your zip line slide quickly?"
    c. Try different prototypes until the conditions of the design challenge are met.
6. **Evaluate the success of each design.**
    a. Did the designed device carry the ball to the end of the line?
    b. Did the ball reach the end of the zipline in 4 seconds or less?
7. **Troubleshooting:**
    a. If the zip line is too slow, try reducing the friction between the carrier and the line. Also, make sure there is enough of a vertical drop.
    b. If the ball falls out of the designed carrier, consider building a larger contraption.
    c. Moving the center of mass by placing metal washers at different locations can impact the zip line.

Use the metal washers to add weight to your zip line. That will keep it balanced and provide extra mass.
Credit: Bill Shribman for WGBH Educational Foundation

Extension of Learning (Optional)

1. Raise the stakes by transporting eggs instead of ping-pong balls.
2. Design a way to slow the egg so that it doesn't crack at the end of the ride.
3. Make several identical long zip lines and have a race.
4. Design a zip line that can drop the ball onto a target at the end of the ride.
5. Try a zip line that is two or three times as long, but keep the 4-second time limit.

Return Instructions

1. Properly dispose of damaged consumable materials.
2. Return all non-consumable and leftover consumable items from the Materials List to the same container they came from.
3. Return containers to the trailer.
4. Email Danita Wickens - wickensd@discoverers.org - if you had any issues with the lesson.
5. Fill out the Lesson Evaluation Form: https://goo.gl/forms/9PwfHUr2RZaDzrV63

Additional Material