SIEMENS STEM DAY | Science Technology Engineering Math

SIEMENS STEM DAY ACTIVITY

ZIP TO IT

REAL-WORLD SCIENCE TOPICS

- An exploration of how the gravitational force of Earth pulls an object towards the planet's center.
- An exploration to analyze why an event occurred using interactions of forces and motion

ADDRESSES NGSS

LEVEL OF DIFFICULTY

2

GRADE RANGE

3–5

OVERVIEW

Students will build a device that can carry a small ball from the top of a two-meter zip line to the bottom in less than six seconds.

TOPIC

Types of Interactions

OBJECTIVE

After completing this activity, students should be able to use force, friction, motion, and gravity to explain a zip line.

NGSS THREE-DIMENSIONS

Science and Engineering Practices	Disciplinary Core Idea	Crosscutting Concepts
Planning and Carrying Out Investigations Make observations and/or measurements to produce data to serve as the basis for evidence for an explanation of a phenomenon. (4-ESS2-1)	**PS2.B: Types of Interactions** ake observations and/or measurements to produce data to serve as the basis for evidence for an explanation of a phenomenon. (4-ESS2-1)	**Cause and Effect** Cause and effect relationships are routinely identified, tested, and used to explain change. (5-PS2-1)

BACKGROUND INFORMATION

What is force?

A force is a push or pull on an object. An important force you feel every day is gravity. This force keeps you on the ground. A force might be seen or unseen. You can see a person push or pull open a door using force. You can see a flag blowing in the wind but cannot see the force of wind that pushes the flag.

What is friction?

Friction is a force between two objects that rub together. Its acts against motion and slows moving objects.

How do zip lines work?

Zip lines need to be at a slope. Gravity will pull a person's mass down and accelerate until the opposing force of friction slows them down. At the end of the zip line, the line will point slightly uphill to help slow them down. Zip lines can be used to access remote outdoor areas such as jungles and rainforest canopies. Some playgrounds and camps have smaller zip lines to travel down for recreation.

Historically zip lines have been used to transport food, mail, and goods. They have also been used to travel across rivers or travel down mountains to access more populated towns and cities.

KEY VOCABULARY

Force: a push or pull
Friction: force that goes against motion
Motion: when an object is moving
Gravity: a force that exists between any two objects that have mass

MATERIALS NEEDED FOR ACTIVITY

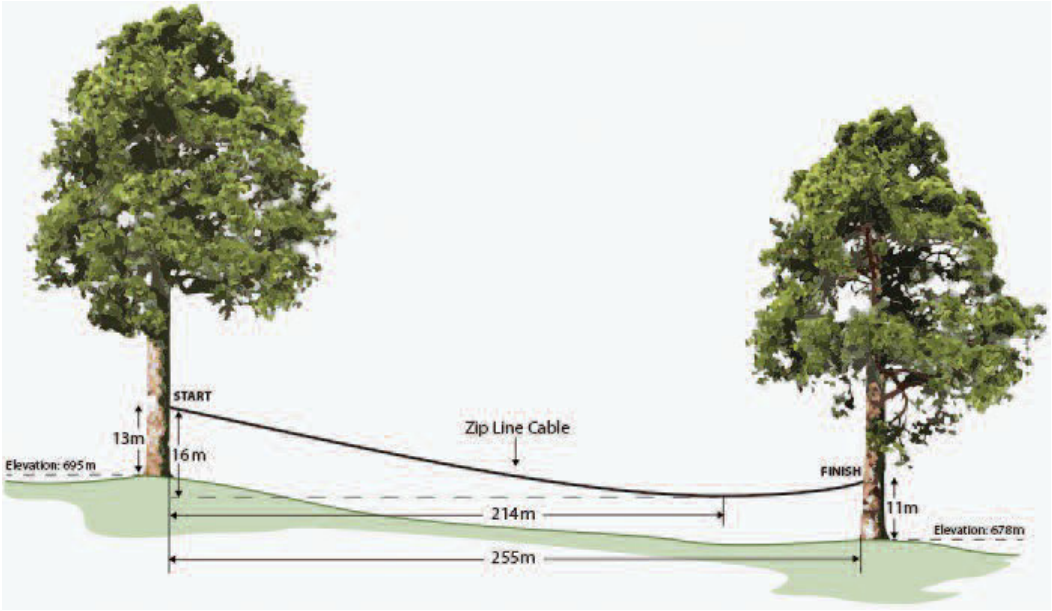
- 1.5 meters fishing line
- thin cardboard (size of standard loose-leaf paper)
- 4 small paper cups (3 ounces)
- Ping-Pong ball
- 4 plastic straws
- scissors
- tape
- single-hole punch
- 4 steel washers (1 inch)
- 4 wooden skewers
- timer

TEACHER PREPARATION

Before students arrive, setup the zip line station. For a class of 32 you might want to include two to four stations for students to test their designs.

Cut out 1.5 meters of fishing line. Using a student chair, tie the top of the fishing line to the back and extend the line down to a table leg.

1. Warm-up Activity: Share with students a video of a zip line in action. https://www.seeker.com/10-amazing-zipline-tours-all-around-the-world-1765432799.html
   Provide students with the zip line image, and project a copy of the same image. Then play the audio clip of a person going down a zip line. https://www.youtube.com/watch?v=L4G4Z021iu4



   As students view the image and listen to the audio, ask them to give you a thumbs-up when they think the person on the zip line starts to speed up. Ask students to give you thumbs down when you hear them slow down. Direct students to mark on their diagram both points they observed.

2. Pass out two index cards to each student. Ask students to make a series of Vocabulary Frames using the words, **force, friction, motion,** and **gravity**

   In the Center: Write the word

   Top Right Corner: Write the word's definition

   Top Left Corner: Write the word's opposite and cross it out

   Lower Left Corner: Write a silly sentence that uses the definition of the word

   Lower Right Corner: Draw a graphic to help you visualize the concept

3. Play the zip line vocabulary video https://www.youtube.com/watch?v=L4G4Z021iu4 Ask students to label the vocabulary on the zip line image. Students at this level should be able to identify Earth's surface pulling the human down the zip line. They might need assistance clarifying the friction caused by the zip line. Students will identify the force of gravity pulling the human.
4. Explain to students that they are going to create a smaller version of a zip line. They will be challenged to use provided materials to build a device that can carry a Ping-Pong down 1.5 meters of fishing line in six seconds. Guide students to review this information in their Engineering Design Capture Sheet.

5. Review the materials that students will have available and ask students to record this information in their Engineering Design Capture Sheet.
6. Students will brainstorm possible solutions to this problem in groups of 2–3. They will sketch a labeled design on their Engineering Design Capture Sheet and ask for teacher approval before building their design.
7. Once student groups have constructed their designs, they can test it using one of the zip line stations. Remind students that the challenge asks them to carry Ping-Pong ball from one end to the other in less than six seconds. They will record times on the data table in their Engineering Design Capture Sheet. Observations might include if the Ping-Pong ball drops or if a part of their design prevents the carrier from moving down the line.
8. **Wrap-up:** Ask student to write about how well their design solved the problem. Share with students that there were multiple solutions to their problem and not all designs met the requirements of the challenge. Engineers are constantly redesigning and testing to find the best solution to a problem. Ask students to consider how they would redesign their solution. Could fewer materials be used to cut costs?

EXTENSION ACTIVITY

Students can be further challenged to add additional Ping-Pong balls or to complete the task in a shorter amount of time.

SOURCES

Videos:

http://news.discovery.com/adventure/outdoor-activities/10-amazing-zipline-tours-all-around-the-world.htm

Websites:

http://zipline.wvu.edu/Introduction/

ZIP LINE IMAGE

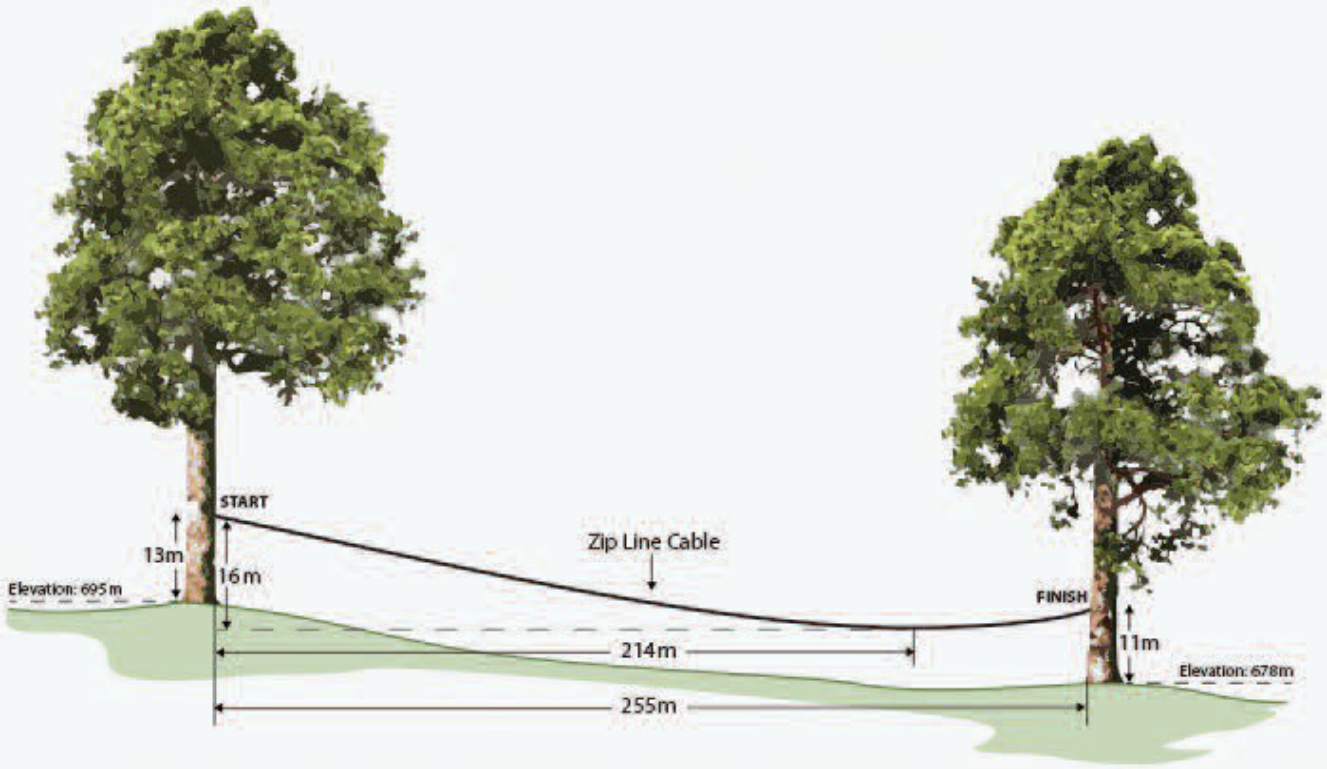


Photo credit: zipline.wvu.edu

ENGINEERING DESIGN CAPTURE SHEET

What is the problem you want to solve?

Use the provided materials to build a device that can carry a Ping Pong ball down 1.5 meters of fishing line in six seconds.

What are the materials you have to use?

Brainstorm and draw a labeled design to solve this problem. Drawing:

Check with your teacher to build your design. Teacher check: _____

Test your design		
Trial	Time (seconds)	Observations

After testing your design, describe any changes you want to make. Draw your new design below.