ORLANDO SCIENCE CENTER

Rising Stars
Independent Engineering
Engineering Design Challenges

What I need

General Supplies

- Paper and Pencil
- Tape
- Timer
- Ruler
- Scissors

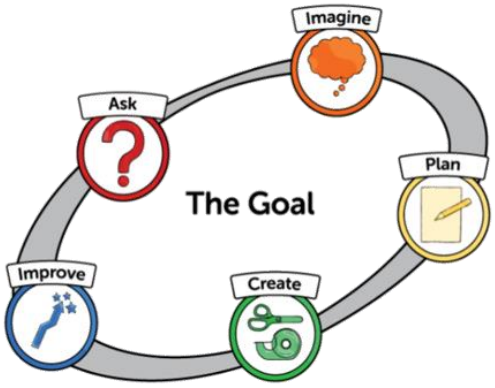


Image source: Museum of Science, Boston

Things to know

Engineers are people who use their knowledge of math and science, as well as their own creativity, as they create and improve technology to solve problems. They focus on making things work more efficiently and effectively. The Engineering Design Process is a tool engineers use when developing new technology or improving existing technology.

What I do

ASK questions that will help you achieve your goal.

- What are the criteria my design needs to meet?
- What are the constraints which limit me?
- What science and math content will I need to consider as I design my technology?

IMAGINE at least two possibilities for design.

- What could be some solutions?
- Brainstorm ideas.

PLAN the design before building.

- Collaborate with my team to make a plan for our design.
- Make a list of the materials needed.

CREATE at least one design solution.

- Follow the plan and create it.
- Test design and evaluate results.

IMPROVE the design based on evidence around the original design criteria.

- Make the design better.
- Re-test and evaluate results.

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Pendulum Engineering Design Challenge

What I need

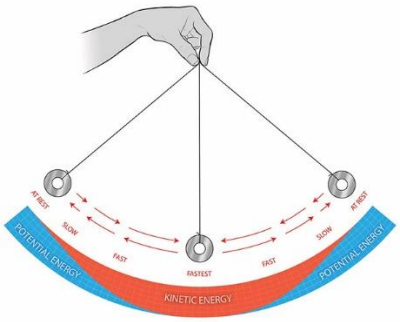


Image source: https://serpmedia.org/scigen/e1.3.html

Supplies

- String
- Tape
- Timer
- Small objects of different weights

Things to know

A simple pendulum is a weight that hangs from the end of a wire or a string. One end of the wire is attached to a fixed point. The weight, called the bob, hangs at the other end. If a person pulls the bob back and let go, the pendulum will swing freely back and forth through an arc. The swing is produced because of the force of gravity. As the ball continues to swing, the length of the arc through which it travels becomes shorter. Finally, it comes to a complete stop, mainly because of air friction. The period of the swing is the time that it takes the ball to travel through its arc and back again to the starting point. As the arc becomes smaller, the speed also decreases but the period remains constant. The period depends only upon the acceleration of gravity and the length of the wire.

What I do

1. Goal: Use the Engineering Design Process to create a pendulum that will swing exactly 50 times per minute.
2. **IMAGINE and PLAN** the structure you will use for your pendulum. For example, you could attach the string to a ruler and balance the ruler between two tables or chairs, or you could use found objects to make a small structure for your pendulum.
3. **CREATE** your pendulum and test as you build. Focus on a smaller time, such as 6 seconds. If your pendulum needs to swing 50 times in one minute (60 seconds), how many times should it swing in 6 seconds? (Answer: 5)
4. **IMPROVE:** What are the variables, or parts of your design that you can change to reach the goal? (Hint: think about the string of your pendulum)

I want to learn more!

Time your pendulum for 2 minutes. Does it swing 100 times? Do you need to make any changes in order to make this happen?

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Mangrove Root Design

What I need

Supplies

- Brown paper bags
- Rubber bands
- Scissors

Things to know

A mangrove is a coastal shrub or small tree. They can grow in saline or brackish water because they are a salt-tolerant tree. Their intricate root system allows them to stay rooted in place when waves crash into the area. The interwoven roots protect coastal areas from erosion. Engineers have designed artificial barriers inspired by mangroves. There are many mangrove forests throughout the state of Florida.



Image source: https://www.bworldonline.com/economy/2021/10/27/406756/value-of-phl-mangroves-declines-sharply-over-two-decades-world-bank-says/



Image source: https://www.britannica.com/story/amazing-mangroves#/media/1/2268061/250123

What I do

1. Using the images above, or a safe image search, **IMAGINE** the unique structure of mangrove roots. They look like sturdy interwoven arms reaching deep into the soil to help the plant survive. Your goal is to make 3-4 mangroves with interwoven roots that can stand on their own.
2. **CREATE** your mangrove root system using the brown paper bags. Cut the bags open and twist them into root shapes.
3. Use the rubber bands as joints in the roots, this is where the root system branches into different arms.
4. Include 4-6 main roots per tree. **PLAN** how will you interweave the roots to create the larger mangrove system?
5. Once you're finished, does the system stand on its own? How can you **IMPROVE** the system? Are there other materials you can add to reinforce your artificial mangrove?

I want to learn more!

- Look up the leaves of a mangrove tree. Make a complete model of a mangrove tree with extra craft materials.
- Visit a mangrove forest! Use this map to help navigate you: https://floridahikes.com/mangroves

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Construct a Crane

What I need

Supplies

- Paper cups
- Pencils
- Straws
- Paper clips
- String
- Ruler
- Tape
- Marbles
- Cardboard
- Rubber bands
- Popsicle sticks



Image source: Wikipedia/Jörg Blobelt

Things to know

Cranes combine simple machines to lift extremely heavy objects. In balance-style cranes, the crane's beam is balanced at a point, called the fulcrum. This allows it to lift heavy objects with a relatively small force. In this way, the crane's beam acts as a simple lever. Cranes also make use of the pulley, another simple machine. Tower cranes often have more than one pulley. This helps it multiply its force to lift heavy objects.

Using the scientific principles behind simple machines, such as the lever and the pulley, cranes can multiply smaller forces to lift heavy loads to great heights. How heavy? It's not uncommon for large cranes to lift loads of nearly 40,000 pounds!

What I do

1. Watch the video here to get inspired for this challenge.
2. **IMAGINE** how you can use the materials you have gathered to construct the tallest crane.
3. **PLAN** to include at least one simple machine in your design.
4. **CREATE** your crane and remember, to be successful, your crane must not tip over when lifting your object.
5. Use marbles or the object you will be lifting. Begin with at least two marbles.
6. If you are satisfied with your design, challenge your crane to lift the heaviest object it can. How can you **IMPROVE** your crane to make it sturdier?
7. Later, share the height of your crane and how many objects it was able to lift.

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Independent Engineering
Mudslide Mayhem

What I need

Supplies

- Plastic waterproof container
- Cup for water
- Paper
- Tape
- Scissors
- Dirt
- Small recycled objects (bottle caps, popsicle sticks, pieces of plastic or cardboard, etc.)
- Ruler



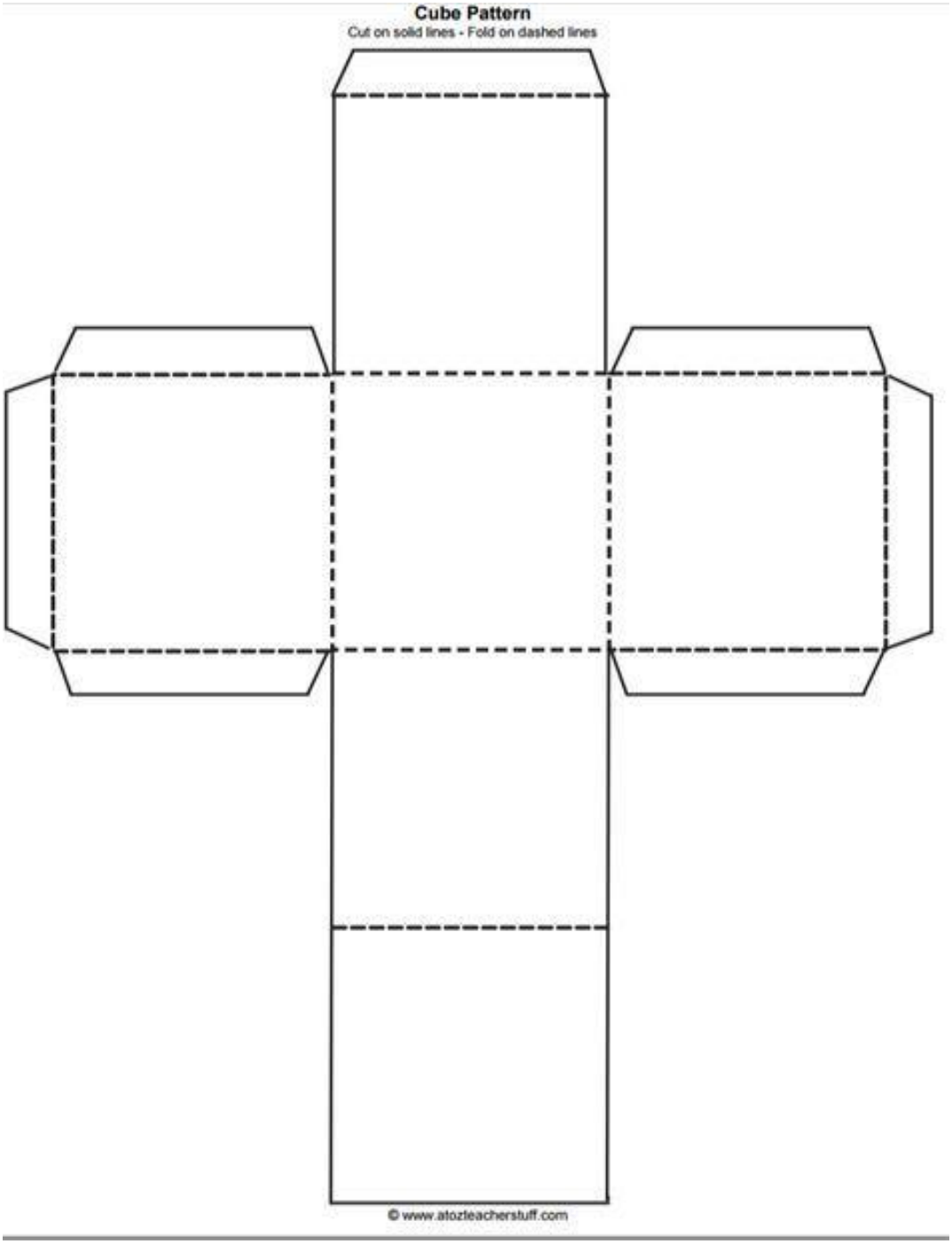
Image source: https://mediaassets.thedenverchannel.com/photo/2014/05/27/wark%20mudslide%20_OP_8_CP_-_1401208902020_5285728_ver1.0_640_480.jpg

Things to know

A mudslide occurs when a large amount of earthly material, such as mud, falls down a slope or hillside. These natural disasters can be very dangerous for neighboring cities. The best way to prepare for a mudslide is to evacuate! There are, however, other precautions that can be taken to prepare for a mudslide.

What I do

1. Draw, cut out, fold, and tape together at least one cube using paper and the template provided. This cube will represent a house.
2. Place the house at one side of your plastic waterproof container.
3. Make a mound of dirt at the other side of your plastic waterproof container. This will represent a neighboring hillside.
4. Pour water onto the hillside and watch how a mudslide might affect a neighboring town!
5. Try the experiment again, but this time find a way to place the house on an elevated space. **ASK:** Did this help protect the house?
6. **IMAGINE** how would building a barrier between the house and the hillside help prevent damage from the mudslide?
7. **PLAN** a design for a barrier made of recycled objects collected to protect your house. Test again!


Cube Pattern
Cut on solid lines - Fold on dashed lines
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