Beat the quake.

Did you know?

Earthquakes are more common than you think. On average, magnitude 2 earthquakes occur several hundred times a day across the word.

What is an earthquake?

The earth's surface consists of 20 tectonic plates that constantly move. Normally, the plate motion is smooth, but sometimes the plates become stuck together and slide past each other quickly. This releases energy in the form of seismic waves that move through the ground, causing the earth's crust to shake.

Rocking the earth

During an earthquake, ground shaking can cause buildings, roads and other structures to collapse. To help prevent earthquake damage and keep people safe, engineers design and construct structures that are resistant to seismic activity, ground motion and soil failure. Engineers have developed shock absorbers and structure sliders to reduce the forces that cause side to side shaking and allow buildings to move independently from the ground during an earthquake.

Present the challenge

Imagine you are a structural engineer tasked with designing one of the tallest skyscrapers in Los Angeles, California. Rising 1,100 feet from the ground, the proposed tower will stand in the footprint of one of the world's most active earthquake zones. To lift the tower from the ground into the Los Angeles skyline, the structure will need a seismically resilient foundation. You must design and create a structure that has the strength to withstand Southern California's fiercest earthquakes.

Did you know?

San Francisco is moving toward Los Angeles at the rate of about 2 inches per year — the same pace as the growth of your fingernails.

Let's get to it.

Materials you will need

> **8** boxes Gelatin (Jell-O)
> Eight 8½-inch square pans
> 30 toothpicks
> 30 marshmallows
> Ruler

Preparation

Prepare the gelatin the night before so that it is completely set when students begin the activity.

Building and testing structures

Pour the Jell-O into eight 8½-inch square pans and divide the class into groups of four. Distribute 30 toothpicks and 30 marshmallows to each student. Give students 20 minutes to plan and execute their design. Direct students to create a sturdy structure by connecting the toothpicks to the marshmallows.

Ask students to measure the structure with a ruler to ensure it is at least six inches tall. When time is up ask each group to place the structure on the pans of Jell-O. Quickly move the gelatin pan back and forth for 10 seconds to simulate an earthquake. Ask students to record which structures withstood the simulated earthquake.

Evaluate the outcome of each structure

> Did the structure stay up during the entire earthquake?
> What were some characteristics of different structures that made them successful?
> If you were to make a new structure, what would you do differently?

Power the world.

Did you know?

There are more than 341,000 wind turbines spinning across the world.

What is wind power?

Wind power is the process of using turbines to convert the kinetic energy of wind into mechanical or electrical energy that can be used for power. It is the fastest growing source of renewable energy in the world and a sustainable alternative to fossil fuels. The burning of fossil fuels (coal, oil and gas) to generate electricity causes increased emissions of greenhouse gases in the atmosphere, which leads to global warming. Unlike fossil fuels, wind energy does not release toxic substances or contaminates into the air nor does it generate waste or contaminate water. Wind power reduces carbon emissions and pollution and keeps water resources clean.

Engineering clean energy

To harness the power of wind energy, different types of engineers work together to design and construct productive wind farms. For example, civil engineers design support structures for wind turbine generators, whereas mechanical engineers develop and test the machines that help wind farms operate properly. Regardless of their function, engineers play an important role in helping protect the environment and creating a renewable future.

Present the challenge

Imagine you are a design engineer tasked with designing the largest onshore wind farm in Europe. As a design engineer on this project, you are required to create wind turbine structures that generate the most power. You must design a wind turbine capable of lifting a paper or plastic cup off the floor up to bench height. The winning team will be the one that produces a machine that lifts the most weight.

Did you know?

That just one wind turbine could power up to 500 homes!

Let's get to it.

Materials you will need

> Scrap card
> Sticky tape
> Pencils
> Scissors
> String
> Paper or plastic cup
> Weights (or coins)
> One hairdryer or small fan

Discuss the variables involved in making design decisions

> Shape of the blades
> Size of blades
> Thickness of blades
> Number of blades
> How the shaft is attached to the desk

Discuss how the design could be made as sustainable as possible eg:

> Reusing scrap material rather than new
> Reducing waste to a minimum (card, sellotape, string)
> Do they need to use a hairdryer?

Ask the students to think about how they want to make it a 'fair' test.

> Limiting the amount of materials (card, sellotape, string) that can be used for each group
> Ensuring all the hairdryers are of the same power rating
> Ensuring the hairdryer is a fixed distance away from the blades
> Allowing or not allowing students to touch the machine when it is operating

Discuss the design process

Students should be encouraged to research, design, build, test, evaluate then redesign. Divide the class into groups of about four and give them a time limit of 30 minutes to complete the challenge. When time is up ask each group to demonstrate their machine and briefly describe the process they went through in reaching the final design.

Water you gonna do?

Did you know?

More than two billion people do not have access to clean, safe drinking water.

Clean, safe water

A clean, safe and dependable water supply is vital to our health and our communities. Using an unprotected, contaminated source of water can cause severe illness and the spread of disease. To secure a safe water supply for communities, engineers design and develop innovative water treatment systems and technologies to treat contaminated groundwater sources.

What is water treatment?

Water treatment is a process that improves water quality by removing sediment, bacteria, chemicals and other contaminants that could be harmful to human health. One of the most common methods of water treatment is filtration. A water filter is a device that removes impurities from water by using a physical barrier or biological process.

Present the challenge

Imagine you are an engineer at an environmental engineering firm that specialises in water treatment and supply. You have been tasked with designing a water filtration system for the Buena Vista community in Honduras. The community is currently recovering from the aftermath of a recent Category 5 hurricane. The storm caused catastrophic flooding and landslides, damaging critical water supply systems across the region and leaving the community without safe drinking water. You must design and build a water filter that removes contamination from the water to provide a source of clean and reliable drinking water for the community.

Did you know?

The Great Lakes contains 21% of the world's supply of surface fresh water.

Let's get to it.

Materials you will need

> Approximately four litres of dirty water (containing sand or gravel) per group of students

For each group of four students

> A range of junk modelling equipment including: 2' x 2' litre plastic bottle, large plastic tubs and plastic piping
> Bucket/container (for dirty water)
> Measuring jug
> Materials for filtration layers (marbles, gravel, play sand, fine sand, cotton wool, cloth, filter paper/paper handtowels

Preparation

Make several litres of polluted water for all groups to use. Use sand, gravel, cloths etc. to make the water dirty.
Give students the opportunity to design their own filter using litre bottles, plastic tubs or plastic piping.
To assist younger students, show them how to create a filter by cutting approximately 15cm off the bottom of the 2 litre plastic bottles and positioning the bottom underneath the neck of the bottle to capture the filtered water.

Creating and testing water filters

Divide the class into groups of four students. Inform students that they will have 20 to 30 minutes to make and test two different water filters using different materials before making a final filter for the challenge. Their final water filter needs to be capable of collecting at least 100ml of water in five minutes.

Ask students to record their results after making the filters and answer the following questions:

> **How can you change the flow of filtration?**
> **What type of pollutants can't be removed from your filter?**
> **Can you think of other ways to remove dirt from water?**

Present the outcome

Ask each team to present their results and answer the following questions:

> **How successful was your filter?**
> **What did you discover?**
> **What would you do differently in the future?**