YOUR CHALLENGE
Build Earth-friendly sneakers.

DEFINE THE NEED
Athletic shoes, trainers, tennis shoes, running shoes, sneakers—they are called different names in different countries. But almost all sneakers are designed the same way. They have a thick layer of foam under your feet, called a midsole, that softens the impact when you run or jump.

Sneaker midsoles are made out of plastic. The plastic is made from oil or natural gas. When sneakers lose their bounce, they get thrown away. Plastic foam takes about 1,000 years to break apart naturally, it cannot be recycled, and it pollutes the oceans and land.

BRAINSTORM & DESIGN

- **Make a prototype for a sneaker midsole.** A prototype is a model to test how a design works.
- **Look over all the materials you have to work with.** Think about how the materials can work in your design.
- **Sketch your design on a piece of paper** and label what materials you would use to make a more environmentally friendly sneaker.
- **Think about the force on your foot when designing.** When you run and jump, your foot hits the ground with a force, a push or pull. The ground pushes back on your foot with the same force. (Ouch!) A sneaker’s midsole softens these forces on your feet.

**PARTS OF A SNEAKER**

- Upper
- Outsole
- Midsole

**MATERIALS**
- duct tape
- scrap of cardboard 12 inches by 12 inches (30 centimeters by 30 centimeters) or larger
- scissors
- pencil/pen and scrap paper
- Various materials that you can recycle or repurpose. The items could be natural materials, such as bamboo, straw, grass, and tree bark. The items could be materials created by people, such as bubble wrap, rubber bands, tennis or rubber balls, sponges, rope, styrofoam, food packaging, plastic tubing, balloons, plastic shopping bags, old clothing, and binder clips (to be used as springs).

**Some ideas for materials:**
- Old tennis balls
- Rubber bands
- Bubble wrap
- Plastic bags

45 minutes / Ages 10 – 13
BUILD

- **Trace your foot on a scrap of cardboard.** Cut along the outline of your foot to start your sneaker design.
- **Attach materials you think would be good for a bouncy and comfortable midsole.**
- You may not have time to build the upper or outsole of the shoe. How can you **build something that will allow you to test** the midsole? One way would be to tape the midsole to your sock during the test. Another way would be to attach it to your shoe with a strap made from tape.
- Think about what happens to your sneakers when they get thrown away. Which materials in your design are environmentally friendly? Can you replace the materials that are not good for the earth with ones that are natural or can be recycled?

TEST, EVALUATE, & REDESIGN

- **Test your prototype.** Wear the midsole on one foot and a real sneaker on the other. Walk, run and jump around with both.
- **Which tests does your sneaker pass?** Is your prototype comfortable? Does it feel bouncy compared with the other foot? Are the materials you used environmentally sustainable?
- **Redesign:** Adjust your materials to make your shoe more bouncy and comfortable.

**Problem-Solving Tips**

- **Not bouncy enough?** Add more material that will give your shoe better cushion.
- **Too unstable to walk?** Remove materials that make the midsole too thick.
- **Or, too uncomfortable to wear?** Try laying harder materials towards the outsole and add softer materials under your foot!

**ENGINEERING AND INVENTION IN ACTION**

Want to make sneakers more Earth-friendly? Try making the uppers from pineapple leather. (No, not fruit leather you eat as a snack!) Dr. Carmen Hijosa invented a way to turn pineapple leaves into a strong material that looks and feels like leather. Her company strips out the fiber from pineapple leaves (shown below), then cuts, mashes, and layers it into thin sheets. So far, shoe companies such as Puma and Hugo Boss have release pineapple-based sneaks. If only Dr. Hijosa could make them taste good too . . .
THE CHALLENGE
Design sneakers that do not harm the environment when created or thrown away.

In this activity, kids will think about:
- the need for sustainable materials and the damage to the planet created by pollution from plastic foam
- the physics of the forces on a person’s feet while running and playing
- the construction of a prototype to test new ideas
- the importance of testing to see how design can improve comfort and performance

I. PREPARE AHEAD OF TIME
- Read these leader notes and the challenge sheet.
- Try the activity yourself so you will know what to expect and where kids may need help.
- Set up the demonstration and the testing stage.

For the demonstration:
Prepare a demonstration of an athletic shoe (like the one described below). Kids love to see how shoes are designed by looking inside. You can easily cut a shoe in half if you work slowly and with caution.
- Turn the athletic shoe over so that the sole is facing you.
- Hold the shoe steady with one hand. Protect this hand with the thick cloth, towel, or glove.

FOR SMALL GROUPS OR A LARGE EVENT
MATERIALS
(50 participants)
Per person or team:
- duct tape
- scrap of cardboard 12 inches by 12 inches (30 centimeters by 30 centimeters) or larger
- scissors
- pencil/pen and scrap paper
- various materials that you can recycle or repurpose. The items could be natural materials, such as bamboo, straw, grass, and tree bark. The items could be materials created by people, such as bubble wrap, rubber bands, tennis or rubber balls, sponges, rope, styrofoam, food packaging, plastic tubing, balloons, plastic shopping bags, old clothing, and binder clips (to be used as springs). It is best to have between 4–8 different materials for kids to choose from.

For the demonstration:
- one plastic bottle (any size, soda or water bottle)
- (optional) old athletic shoe (that you are willing to destroy)
- (optional) razor, utility knife, or other sharp knife. For educator use only.
- (optional) thick cloth or towel, or thick glove
• Make many small cuts down the length of the sole with the razor or knife. Press down lightly many times to lower the risk of the knife slipping and causing an injury.

• Gently and carefully cut through the upper part of the shoe. Pull the shoe halves apart.

### 2. INTRODUCE THE CHALLENGE

**Pass out the challenge sheets.** Tell participants: *The goal is to invent a new kind of sneaker. Like most sneakers, it should feel bouncy when you walk. But, unlike most sneakers, it will be made from materials that do not harm the environment.*

**Show the demonstration sneaker if you made one.** Ask kids: *What are the different parts of a sneaker? What do the parts do?*

- The **upper** protects your foot from scrapes caused by rocks, sticks, and other objects.
- The **outsole** grips the floor or ground so you can stop or turn quickly.
- The **midsole** makes your foot feel better when it hits the ground hard.

**Tell the group:**

- When you run and jump, your foot hits the ground with a force, a push or pull.
- The ground pushes back on your foot with the same force. (Ouch!)
- The pressure your foot feels is the force of the ground on your foot.
- A sneaker’s midsole softens forces on our feet.
• **Hold the plastic bottle.** Ask kids: *Sneakers do a good job of protecting our feet, but what are the midsoles usually made from?* Listen to kids’ answers and add:
  - Both sneaker midsoles and this bottle are made from plastic, which can be hard on the earth.
  - Plastic takes over 1,000 years to break apart naturally.
  - It creates pollution on land and in the ocean.

3. **BRAINSTORM AND DESIGN**

• **Show kids the materials**, including the recycled and scrap materials.

• **Ask them to brainstorm** how to make sneakers less harmful. Discuss the problems and benefits of various materials. Ask:
  - What materials could you use to make a bouncy midsole that is better for the environment than plastic foam?
  - What are ways that you could recycle materials in your design?
  - Why might you use materials that are biodegradable in your design? (Biodegradable materials break into small pieces that don’t harm the environment after they are thrown away.)

• Tell and ask participants:
  - **Draw a sketch of your design on scrap paper.**
  - **Label the materials using arrows to show where you would use plastic, natural materials.**
  - Where does the material come from?
  - Can the material be recycled?
  - Is the material biodegradable?

4. **BUILD**

• **Decide if you would like to have kids work in teams or individually.**

• Ask the kids to **use a scrap of cardboard to make an outline** of their foot:
  - Trace your team member’s foot on a piece of cardboard.
  - Cut it out with scissors.
  - Use this cardboard outline to start your shoe design.

• While kids build, remind them what a **prototype** is:
  - A prototype is a simple model that lets engineers see if their designs work.
  - Prototypes are often made with substitute materials that create the look and feel of a final product.

• **Ask:** Does your design use a special material that we do not have, like metal or leather? How could you use the materials here to make something similar?

• Tell kids:
  - Many designs are possible, and there are no right or wrong ways to build a sneaker. Engineers and inventors are still trying to figure out the best way to design great, environmentally friendly shoes.
  - Focus on designing the midsole part of the shoe. You may not have time to work on the upper or outsole.
5. TEST

• Explain that testing is one of the most important parts of engineering—testing is the way to find out what part of a design needs improvement.

• Ask kids to test their sneakers by attaching the prototype to their sock or shoe with tape. Ask participants to walk, run, and jump in the event space to compare the prototype with a sneaker or sock on the other foot.

6. EVALUATE & REDESIGN

• Ask kids to score their prototypes using the chart below.

• Ask them to remove the parts of their sneakers that did not work and add or adjust the materials to make the shoe more bouncy and comfortable. Ask: Is your sneaker bouncy? How could you change the design to add more cushioning? (Also, see Questions to Promote Reflection in the box on the right.)

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**Questions to Promote Reflection**

- What problems did you have? How did you solve these problems?
- What would customers like about your shoe design? How could you make your design more comfortable?
- Where would the factory get the materials to make your shoes?
- What would happen to your midsoles when the sneakers are thrown away?

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**Testing (Score 1-10)**

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**CHECK OUT THE FULL DESIGN SQUAD GLOBAL INVENTING GREEN CLUB GUIDE**

Looking for activities for the classroom or afterschool programming? This Sneakers activity is one of 6 new activities in the Inventing Green Club Guide, found here: [bit.ly/green_activities](http://bit.ly/green_activities)