Activity 2: Sneaker Challenge!

Introduction

Do you like to have a collection of sneakers? According to the U.S. Department of the Interior, Americans throw away over 300 million pairs of shoes each year. These shoes end up in landfills and they can take 30 to 40 years to decompose.

To reduce this, you can either donate gently used sneakers before they get worn out or partner with an organization to find ways to recycle. But how about we do something creative? Imagine you have the power to design and create your own sneaker that not only is comfortable for your feet, but also completely recyclable? Design an earth-friendly sneaker. The "Move it!" category focuses on technology-based inventions that involve transportation or mobility.

In this activity, you'll experience one such invention project by creating and designing a sneaker that cushions feet with household materials that one can recycle or repurpose. This activity should engage you for at least 45 minutes or more. Have fun learning!

Activity Guide

Materials

- Duct tape
- Scrap of cardboard 12 inches by 6 inches (30 centimeters by 15 centimeters) or larger
- Scissors
- Pencil/pen and scrap paper
- Household or classroom items that you can recycle or repurpose. These could be natural materials, such as bamboo, straw, grass, and tree bark. They could also 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, or binder clips (to be used as springs).

Design Instructions *(This is adapted from PBS Kids' Design Squad activity "The Sneaker Challenge")*

1. **What are the different parts of a sneaker?** Mainly, there are three parts. The upper protects your foot from scrapes caused by rocks, sticks, and other objects. The midsole makes your foot feel better when it hits the ground hard. The outsole grips the floor or ground so you can stop or turn quickly.

2. **What are sneakers made of**? What materials can you see and feel in your sneakers? Record your observation. If you are unable to identify all of the materials, here are some common ones: rubber for soles, synthetic fiber for the upper part of the shoe, leather toe tips (in some cases these add shape to the sneakers), resin, padding materials, and laces.
3. **What do you need to consider when designing sneakers?** Did you know that athletic footwear dates to ancient times, but it gained traction around the 20th century when treaded rubber soles were introduced? These rubber-soled shoes were lightweight and comfortable and landed on the ground quietly; hence, they got the name “sneakers.” From then on, there have been constant design improvements that have increased the appeal of these shoes.

   Force is a key to speed. Top runners hit the ground harder when they run, and this technique makes them go faster, enabling them to maintain their forward momentum. This helps the runners spend more time in the air, and as they lean forward while running, they run faster.
4. **How to do design improvements?** Before a product is built, one must go through the Engineering Design process: It is a step-by-step process that you follow to design your product:

   Step 1: Identify the challenge. Think about the activity that you have been asked to do. Building something is actually the end of the process. It is not the beginning.

   Step 2: Brainstorm. This is an important part of the process because once you start designing your shoes, you will come up with more ideas. During brainstorming, you may get many ideas for how you can design your shoes. Once you have written all your ideas, you will go through each idea and think of its benefits, and then choose one idea that you would like to go after. Remember, sometimes your first solution is not the best solution!

   Step 3: Design a solution. Using the information from the first two steps and resources you have, now you can start to design and sketch your solution.

   Step 4: Test your Idea. You will create a model of your idea and try it out to learn if you are able to walk in your newly designed sneaker. You will test and see if it is safe and comfortable, and whether it is all recyclable. You can also see if you are able to do short walks, runs, etc.

   Step 5: Evaluate. Once you are done with testing, evaluate the results. See if your newly designed shoe worked for all scenarios. If not, try to see where the problem is and rework it.

Step 6: Build it. When steps 1–5 are successfully done, then you can proceed to building a real product. You must continue to test your product throughout the process.

5. **Watch Chi-An Wang's Easy-Fit Design**, a 5 minute video about how Chi-An Wang, an MIT undergraduate, solved a real-world problem. She found that in a triathlon, when athletes make the transition from biking to running, they want a running shoe that is easy to put on and will not wear out easily. She came up with a design and worked with New Balance, a major athletic shoe manufacturer, in the design and testing of a new running shoe for triathletes.
6. **How can we design an earth-friendly sneaker?** Next, let's examine the materials to help us plan what we can do. It's important that inventors know their materials!! Look through the materials you have and consider these questions:

    1. What materials will you use for each part?
    2. Consider what materials are environmentally friendly.
    3. What would feel bouncy on your feet?
    4. Which materials in your shoe could be recycled?

7. **Draw ideas of your shoe.** How would you like to design it?
8. **Now let's design and create.** Click on this link and follow steps 6 through 10. If some parts of your prototype are not working, make sure you remove those parts that did not work. You can add other materials to make your shoe bouncier and more comfortable. If you have used materials that are not earth-friendly, replace them with ones that are natural and recyclable.
9. **Test and extend your thinking:**

    - Walk, run, jump around, and see how they feel!
    - Wear your prototype on one foot and your regular shoe on the other. Walk, run and jump around and note the difference.
    - Think about the force on your foot. When you run and jump, your foot hits the ground with a force. The ground pushes back on your foot with the same force.
    - When you run, your foot-strike-pattern can be observed. While running, do you land on your heels or on your forefoot? Based on that, you can give more cushion in that part of your shoes. Feel free to re-design if you need to.
    - Also, the speed at which you run matters a lot. If you run faster, then you are putting more energy on the ground and you may need more cushion under your foot to absorb that push from the ground. If you run slowly, then you may need a different type of support for your feet. What type of a runner are you?

- Does your sneaker soften these forces on your foot?
- Are the materials you used environmentally sustainable? Why or why not?
- What do you think would happen to your midsoles after the sneakers are thrown away?
- Would you like your shoes to be more earth-friendly? Try making the uppers from pineapple leaves. So far, shoe companies Puma and Hugo Boss have released pineapple-based sneakers.

10. **Did you know?**

- Inventors often test their shoes by placing them on a robot foot. Then the robot steps down thousands of times. If the sneakers survive this pounding, they are approved for sale.
- To make a single pair of sneakers, factories use the same amount of energy as running a microwave oven for two days straight!
- The special type of plastic used in shoe midsoles is the same used to make hot glue sticks.