Sneaking Up On Sneakers

Making the Connection
Women in Engineering Programs & Advocates Network (WEPAN) Project
Funded by Lucent Technologies Foundation

1. This unit explores why different types of sneakers are used in a variety of common sports. It connects how engineers analyze design needs in sneakers, an everyday item.
2. The two supporting activities can be done with the main activity or separately.
3. This activity has a resource page that provides background information.

Sports

Grades 3 & 4 (suggested)

Objective

The goal is for students to understand the basics of engineering associated with the design of different types of athletic shoes. Sneakers are one of the most commonly worn shoes in our American culture. They provide comfortable support for our feet as we go about our active lives as students, athletes, educators, and engineers. The design of a sneaker, based on how it will be used, is part of bioengineering. This unit focuses on the movements used in a variety of sports and what the resulting requirements are for the sneaker used in that sport.

Skills & Standards

- Analyze a product's components and their functions.
- Recognize a design need or engineering problem.
- Communicate the solution through drawing and speaking.

Activity Outline

Materials required:

4 of the following set-ups:
1. Basketball & hoop
2. Baseball bat
3. Area to jog in
4. Soccer field & net
5. Track & Field events (running, long jump)

Per group:

- Paper, pencils and pens
- Shallow baking pan large enough to step into with one foot.
- Water to put into baking pan.
-Green or red construction paper.
- Paper towels to dry feet.
- Optional materials
  Inexpensive canvas sneaker and other athletic shoes

Timeframe:

Part 1: 10 minutes per sport: 5 minute summary

Part 2: 20 minutes
Part 3: 20 minutes

Overview of Presentation

Briefly explain engineering (See Presenter's Guide for more detail).
Engineering uses scientific information to design and create useful things. In designing and creating, the engineer goes through a problem solving process in which both math and science are important components.

Introduce the activity to the students.
Have a general discussion about sneakers. Encourage students to share what they know about sneakers and when they are used.

Begin the activity.
Before doing the activity, present the '*problem*' and '*who wants to know*'.

Do the activity.
You can work as one group or break up into smaller groups to do the activity which is preferable. Make sure each group has an adult leader. As the students work on the activity present '*how can you help solve the problem*' to help them with the brainstorming and testing.

Reflect on the activity.
After the activity is completed, spend time discussing what was discovered and learned. How are the sports and needs different? How are they the same? Present '*will your suggestion work*' to think about potential re-tests.

Career Connection
Discuss what types of jobs are involved with understanding foot motion and how to produce effective shoes. Asking *'Who can help you solve the problem*' may get students to think about the type of people who would know.

Activity: Use your feet!

This activity has the students participate in a variety of sports, observing and discussing the differences in motions and requirements for the shoes to make them more effective. The activity has been developed based on a traditional engineering design process which pose key questions – all identified in boldface type, that help the students approach the problem as engineers.

PART 1: EXPLORING FOOT MOTION IN SPORTS *(main activity)*

What's the problem? Each sport has its own special motions. Providing the best footwear for each sport improves the athlete's performance.

Who wants to know? The athlete's want to be the best in their sport while having a shoe that is comfortable.

NOTE: *Do the following process for each sport separately. You may want to break the students up into smaller groups and have each group investigating a different sport, rotating through the complete set. Each group should have an adult leader.*

1. Present the sport to the students and have them discuss the most common motions used in that sport.
2. Have 2-3 students do the sport one at a time. They can shoot baskets, swing a baseball bat, jog, dribble a soccer ball, or do a track and field event such as the long jump. As each student participates have the rest of the group observe the actual motions. Make sure to select different students for each sport.

How can you help solve the problem? Think about the sport you are watching. How do their feet move? If your sneaker could have special qualities for that sport what would they be? Watch other people moving as they participate. What suggestions do you have for how their shoes could be changed to match the movements?

3. After all students have tried the sport, have them compare the motions they thought would be most common to the ones they observed actually happening.
4. Lead a discussion focused on what types of properties the sneaker should have to be best for this sport. Should it be flexible or stiff, slippery or sticky, bouncy or firm?
5. Have the students do the sport again, with the rest of the group calling out what would be good for the sneaker to be doing as the sport example plays out in front of them.
6. Move to the next sport and repeat.
7. After all the sports have been done have the students discuss the differences between them. How do the motions differ? What qualities are needed in the sneaker to help these motions?

Will your suggestion(s) work? Select one sport. With the ideal sneaker in mind, choose the person in your group who is wearing sneakers most like the ideal one. Have this student try the activity, discussing how easy or difficult different parts of it are such as starting, stopping, turning, jumping.

Who can help you solve the problem? What type of information or knowledge is needed to understand shoes?

8. Optional: Pass the inexpensive canvas sneaker (and other athletic shoes such as soccer cleats) around. Have students compare the shoe(s) to their own shoes and/or the shoes of the classmate next to them. How is the bottom different? Is it smoother? How does the amount of cushioning and support compare to their shoes? What does the group think is the advantage(s) of each particular shoe?

Engineering Summary: Finish with a discussion about how the students acted as engineers.

PART 2: EXPLORING YOUR OWN FEET (*supporting activity)*

1. Have the students remove their shoe and sock from one foot and step onto a blank piece of red or green construction paper.
2. Trace around the outside of the bare foot with a pen.
3. Each student should bring his or her foot tracing to where the baking pan is located on the floor. The pan should have about 1/2 inch of water in it. Have the students step into the water with their bare feet, and then place the wet foot inside their traced outline. Shaking off the drips will help create a clearer image.
4. Lead a discussion about in what ways the wet footprint looks different and similar to the traced outline. Why might both images be important in sneaker design?

PART 3: CREATE YOUR OWN SNEAKER DESIGN *(supporting activity)*

Have teams of students select any sport (not just the ones done for this activity) and draw a picture of the ideal footwear for that sport. They should include a description of their footwear's qualities and why that is important. The ideas can be shared through a leader lead discussion or large drawing on a board.

Activity Resource Page

Background Information for Activity Leader

The design of today's sneakers is an engineering science that combines physics and biomechanics. The engineering design utilizes materials that provide durability, comfort, cushioning, and stability. Good designs also consider the type of foot (female, male, or child) since each has different characteristics. Another important component in the design is the consideration of which sport the sneaker will be used to play. Each sport has different footwear requirements. Some need high flexibility, others maximum cushioning or high levels of friction. In addition, the structure of the foot is considered as well. Women's feet have a different shape than men's feet and children's feet are shaped differently than adult's feet. The inside layout of a well-designed sneaker takes these physical differences into account.

Sneakers originated in 1908 and were comprised of a rubber sole with a canvas upper. 1917 brought the introduction of Keds™ brand. In 1922 the technology of creating different models for different needs was introduced. The health and fitness movement of the 1970's created a high demand for sneakers by the public, and in 1979 the concept of cushioning air bubbles in the sole was introduced. Since then the advancing capabilities and creation of new materials has resulted in highly specialized (and expensive) sneakers.

Questions to Ask

As you go through this activity with the students you should lead them through the process by asking the questions provided in the design approach of the activity. While they will not be designing and building a physical device or object, they will be developing an understanding of the different needs and therefore the different designs for sneakers.

Additional questions to ask:

Q: What part of a sneaker responds to and is made to create friction?
A: The sole or bottom of the sneaker.

Q: Why isn't it wise to play indoor athletics barefoot or in socks?
A: There is a lack of traction/friction and a lack of cushioning.

Q: Is the cushioning important for all sports?
A: No. Some sports require high flexibility such as dance and tightrope walking.

Q: Why do some sneakers have smoother bottoms than others do?
A: Smoother bottoms provide more contact area with the floor, which is an advantage on smooth courts such as basketball courts.

TIPS

Having an adult volunteer work with each small group is ideal.

Involve a local expert to enhance the activity. Contact the engineering school at a local university, WEPAN at www.wepan.org, or the Society of Women Engineers at www.SWE.org.

Potential Safety Issues

Standard playground safety issues.

Vocabulary Words

Traction – adhesive friction, like tires on a road
Flexibility – easily bent
Friction – resistance of motion between two touching surfaces
Support – to keep from slipping, to hold up
Cushioning – absorbing of shock (sudden force)

Expanding the Activity

1) Make a list of sports that have similar types of foot motions. Do these sports need the same kind of shoes or different ones? Why?
2) Examine the sneakers worn by the students in the class. Make a list of the sports that each student's sneaker would be best suited for.

Additional References

Http://www.saucony.com/science.htm
"Sneakers: From Start to Finish (Made in the USA)" Samuel G. Woods, Gale Zucker (Photographer)

What Makes Up **Your** Sneaker