THE SCIENCE OF SOCCER

ENGINEERED BY THE FRANKLIN INSTITUTE

Activity 4

FOOT FRICTION

Activity 4: **Foot Friction**

Audience: Children ages 6-10

Time Frame: 30-45 minutes

Summary: In this activity, learners will take on the role of sports engineers to test how traction works on the sole of a soccer cleat. Learners will design, build, and test their own prototype soccer cleat. They'll explore how friction and traction affect movement and performance on different surfaces.

Guiding Questions:

- How can we design a soccer shoe that helps players from slipping?
- What role does traction play in running and changing direction?
- How does changing the sole design affect performance?

Science & Engineering Concepts:

Prototype: A first version of something that engineers make to test their ideas.

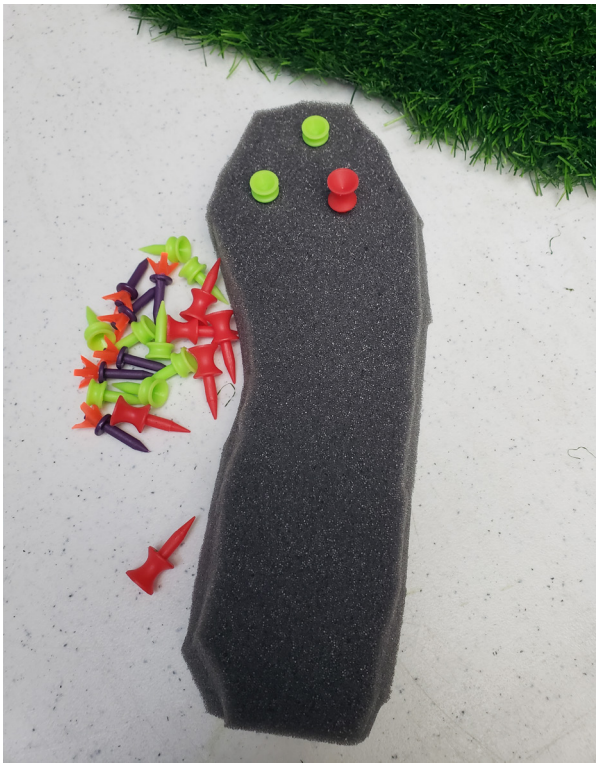
Friction: The force that resists sliding between two surfaces.

Traction: How well something grips or sticks to a surface.

For more information about these concepts, see the Background section at the end of this guide.

MATERIALS

- Large plastic tray (1 per group)
- Foam sheet (1 per group of 3-4 learners)
- 1-inch tees, flat (6-8 per group)
- 1-inch tees, tall (6-8 per group)
- 1-inch tees, pronged (6-8 per group)
- Turf pad (1 per group)
- Felt (1 per group)
- Sandpaper (1 per group)
- Pencils, pens, or markers
- Shoe blueprint printout (1 per learner)
- *Foot Friction* photo printouts
- Scissors (for educator use)
- Optional: Internet access, computer, and screen for showing video clips



SET-UP

1. Print copies of photos and shoe blueprints, if necessary.
2. As needed, trim sheets of turf, felt, and sandpaper to fit the size of the tray bottom.
3. Cut the foam sheets into shoe-shaped pieces, using the shoe blueprint or your own shoe as a guide. Make 1-2 pieces per group of 3-4 learners. Once cut, they can be used more than once, but if you plan to repeat the activity with many groups, you may want to cut extras to account for wear-and-tear. Optionally, older learners can cut the foam pieces themselves during the activity.
4. Where possible, set up video equipment and cue up one or more of the video clips listed in the Video Resources section at the end of this guide.

ENGAGE (10 MIN)

1. Gather the group and show images or short clips (*if possible*) of soccer players in action. Ask:
   - What sport do you think this is?
   - What comes to mind when you think about soccer?
   - Who has played or watched soccer before?
2. Ask learners what they notice about what soccer players are wearing in the photos, specifically the types of shoes.
   - What do you notice about the shoes in the photos?
   - How are they different from regular shoes and sneakers? (Guide learners to look at each other's shoes)
   - Why do you think soccer shoes have spikes or studs at the bottom?
3. Explain that the spikes on the bottom of soccer shoes are called **studs** or **cleats** (and because of that, the whole shoe is often called a cleat, too!) They are specially designed to help players run faster, change direction quickly, and control the ball. Different cleat designs work better in different conditions - like wet grass, dry turf, or sandy fields.
4. Explain that today learners will be sports engineers, and their goal is to design and build a **prototype** soccer shoe that helps a player move well and control the ball.
   - A prototype is a first version of something that engineers design to test their ideas.

You may want to mention that in 2026, the US, Mexico, and Canada are hosting the Men's World Cup, where men's soccer teams from countries across the world come to compete for the title of World Cup Champion. The next Women's World Cup will take place in Brazil in 2027.

EXPLORE (30 MIN)

1. Divide the group into teams of 3-4 and provide each team with:
   - 6-8 golf tees of each type (flat, tall, pronged)
   - A foam foot model
2. Describe that they will be using golf tees as a model of a cleat. Ask teams to make observations of the different types of golf tees:
   - What is similar and different about the tees?
   - Which tee looks like it would grip sand best? Grass? Turf?
   - How do these tees compare to the cleats in the images?
   - What shapes might help with turning quickly or stopping fast?
3. Guide them to experiment with adding the golf tees to the bottom of the foam piece.
   - Where should the tees go—heel, toe, or spread across the sole?
   - Will they be in rows, clusters, or another pattern?
   - How might spacing affect traction?
   - How many tees is enough? Could too many be a problem?
   - What kind of field or surface did you have in mind as you designed? Wet grass? Uneven ground? Rough pavement?
4. Encourage learners to test the traction of their prototype cleat on the different surfaces (turf, sandpaper, tray). **Demonstrate how to do this: press it against the surface (to model the player's weight) and try to slide or turn it.** Ask guiding questions:
   - What happens if you press harder or less hard?
   - When does your prototype slip and when does it stick? Does that match what the player might need?
   - How does your prototype grip differently on different surfaces?
5. Encourage learners to make changes to their design based on the tests.
6. Hand out shoe blueprints and writing utensils, and invite learners to sketch a blueprint of their best design:
   - What kind of surface is your prototype designed for?
   - Which shape of cleat worked best for that surface?
   - How did you decide how many to use, and where to put them?

REFLECT (5 MIN):

1. Gather the group and ask:
   - Which feature of your shoe worked best?
   - If you could change one thing, what would it be?
   - Why do you think professional players need different shoes for different fields?
   - What other parts of the shoe do you think could be designed to help the player play better?
2. Discuss how students felt like scientists. Ask:
   - How did you feel like a scientist?
   - How did experimenting help you learn something new about soccer?
   - If you were designing a new soccer shoe, what else would you do to test how well it works?

BACKGROUND:

Sports engineers design shoes to help athletes perform their best while staying safe. Soccer cleats must balance traction, comfort, and ball control. The placement, size, and shape of studs on the sole can change how a player moves, and the flexibility of the shoe affects speed, agility, and control. Different cleat designs work better on different surfaces—wet grass, dry turf, or sandy fields—so engineers test prototypes under real-world conditions before finalizing the design.

In this activity, learners will be sports engineers exploring how shoe features affect performance. They will: **Build a prototype** of a shoe sole with simple materials.

- **Test** how different cleat types and placement affect traction.
- **Reflect and iterate** by adjusting their design based on test results to improve performance.
- **Draw a blueprint** of their best design to communicate it to others.

Through this process, learners see how science, engineering, and design work together. They make observations, test ideas, and make improvements—just like real engineers—while connecting concepts like friction, force, motion, and material properties to everyday sports experiences.

VIDEO RESOURCES:

Men's Soccer Highlights:

https://www.youtube.com/watch?v=aTTOQtSOX3I

Women's Soccer Highlights:

https://www.youtube.com/watch?v=m5IXs5ASt3c