SCIENCE FRIXION STEM LESSON PLANS

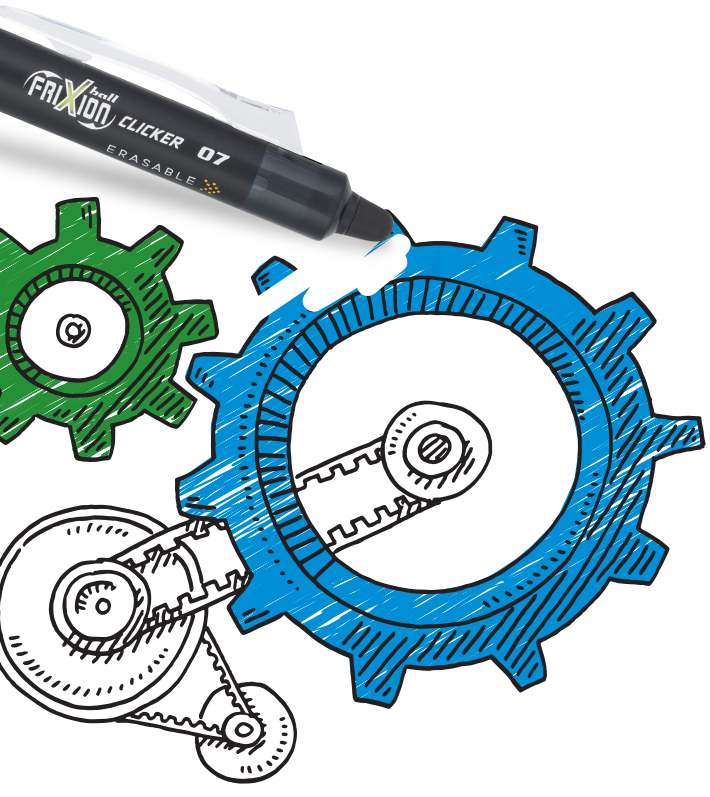
FriXionSTEM.com

Bringing science to life with the incredible, ERASABLE FriXion pens, markers and highlighters.

Grades 6–8

SCIENCE OF FRICTION: HOW FAR & WHY?

To learn how friction affects motion, students explore how different textures provide varying amounts of friction to objects moving across them. They will use the thermo-sensitive ink in FriXion pens as an indicator for the amount of friction created between a note card and various surfaces by measuring the distance that a rubber band stretches. They experiment with a range of materials to determine which provides the least/most friction.



LEARNING OBJECTIVES

After this activity, students should be able to:

- Understand that friction is stronger between some surfaces than others
- Be able to suggest methods of affecting the friction between surfaces
- Understand why friction is an important consideration in many areas of engineering design
- Explain how FriXion ink can be used as an indicator of the amount of friction created during the experiment

Developed by

STEM.ORG FRIXION BY PILOT

MATERIALS

Each group needs:

- FriXion Pens
- Note card
- Paper clip
- Rubber band
- Bottle of glue (8 oz., serving as a weight)
- Gram weights
- String
- Wax paper
- Sandpaper
- Ruler
- Scissors
- Pen
- Tape

INTRODUCTION/MOTIVATION

Friction is a force that arises when things rub against each other. For example, if you rub your hands together very quickly, they get warmer. This is a result of the friction between your moving hands. Different items have different levels of friction when they rub together. In fact, every object has unique characteristics in terms of friction. Engineers are very interested in friction because it affects how smoothly things work. When surfaces grind against each other with lots of friction, they tend to wear out. For example, if the grinding surfaces are gears in a machine, the machine would wear out faster, and need to be replaced sooner, than if there was minimal friction in the machine.

Fortunately, we can measure the amount of friction between surfaces. In this activity, we create an instrument to explore the amount of friction between a note card and various other surfaces. As you measure the friction, observe the properties of the surfaces. Which properties might affect the amount of friction? FriXion pens are a great tool for measuring friction.

By design, FriXion erasable pens, markers and highlighters incorporate science, technology, and engineering. The unique, thermo-sensitive ink formula utilizes covalent bonding and PH to allow the ink to:

- **Write smoothly** and vividly in a variety of colors
- **Be 'erased' completely** by becoming invisible with erasing friction or when heated to temperatures higher than 140°F (65°C)
- **Be made to reappear** when cooled to extremely low temperatures of less than 14°F (–20°C)

The thermochromic chemistry in FriXion uses three types of chemical compounds that rely on acid-base interactions, temperature sensitivity, and covalent bonding. When you rub the ink with the hard rubber eraser, heat from the resulting friction causes the temperature-sensing compound to activate the acid compound, thus neutralizing the dye.

The 3 compounds are:

A. The Color Pigment (which is stable at room temperature but changes color upon reaction with acids).

B. A Color-Activating/Developer that acts as an acid to produce the color change that bonds.

C. A Transparency/Color Change Regulator that controls the temperature at which the color transition takes place.

When A & B covalently bond you can see the ink color, when that bond is broken with heat, B & C bond and the ink becomes invisible. If the bond between A & B is reformed with cooling, the ink color will reappear.

PROCEDURE

Before the Activity

- Gather materials

With the Students

1. Discuss with students the concepts of friction. Ask what happens when you slide across a wood floor versus carpet. Which is easier? (Answer: Wood.) Why? (Answer: There is less friction between your feet and a wood floor vs. your feet and carpeting.)
2. Pass out materials to students.
3. Have the students fold the note card in half “hot dog” style, then cut a 1/2” slit in the center on the fold line.
4. Draw/color a 2x2 square on the face side of the notecard with the FriXion pen. (This will be used to help measure the friction.)
5. Put the paper clip in the slit and slide the rubber band onto the paper clip.
6. Cut a piece of string 25 cm (10 in.) long and loop it through the rubber band.
7. Place the glue bottle at the end of the note card.
8. Gently pull the string just enough to straighten out the rubber band. Mark the point at the end of the straight rubber band “Start.”
9. Pull on the string until the card moves along the table. Measure and discuss how much, if any, of the FriXion ink is erased. What conclusions can we draw from this? Then have students record the distance that the rubber band stretches in their science notebooks.

10. Tape a piece of wax paper and a piece of sandpaper to the table.
11. Move the card along these materials by pulling on the string, once again recording how far the rubber band stretches as well as the amount of FriXion ink that is erased. Remind students to keep the glue bottle or addition gram weight on the card.
12. Explain that friction is something engineers often try to avoid or minimize. Ask them why? (Possible answers: Wastes energy, wears on parts, etc.) When would engineers not want to avoid friction? (Possible answers: To slow things down, such as with brake pads, or to prevent slipping by choosing a material with high friction.)
13. While all the students are finishing, have them pair up with another group, who has finished, and compare answers.

DISCUSSION QUESTIONS

- Do you think that different materials would have a different effect on FriXion pens? For example, if you wrote on canvas would you still be able to erase the same way?
- What materials created the most friction? Why do you think so?
- Are FriXion pens a good tool for measuring friction on a surface? Why?