STEM CAREER ADVENTURES

Structural Engineer: Corrosion of Bridges

Adventure Description:

In this adventure, students will think like a structural engineer and test the effects of acid rain on steel.

Activity

Step One: Background Information on Structural Engineers, Rust, and Acid Rain (5-10 minutes)

- Explain to students that a structural engineer is someone who uses steel or other metal to design structures, like bridges and tunnels. Structural engineers use steel because it is very strong, holds up against fire, and inexpensive. Steel is also easy to form into different shapes.
- Tell students that even though using steel has many advantages, it also has one major disadvantage.
- Ask students if they have ever seen rust. Rust happens when steel is exposed to water. Rusting is a chemical process that happens when the iron in steel reacts with water to form iron oxide, known as rust. When a steel structure turns to rust, it is no longer strong and needs to be replaced.
- Most steel structures rust very slowly when regular rain hits them. Because of this, structural engineers still use steel in most of their projects. Structural engineers calculate how long these structures will last and plan ahead to replace them before they fall apart. However, in polluted areas, the rain that falls from the sky is acid rain. Acid rain makes steel rust faster than normal rain and causes structures to fail sooner than they should.
- Show Handout: Acid Rain. Explain to students that acid rain is acidic because its pH is lower than normal water. pH is a measure of how "acidic" something is. For example regular water that is not acidic has a pH of 7 and orange juice, which is acidic, has a pH of around 3.
- Explain to students that today they will think like a structural engineer and test to see how different types of rain make steel rust. To do this, students will measure the temperature change of steel that is exposed to different rain samples. When steel rusts, it gives off heat. By measuring the change in temperature of the steel in different types of rain, students can compare how fast the metal is rusting.Have students complete Step 1 on the handout.

Step Two: Testing Steel (30 minutes)

- Explain to students that they will now test steel under different "rain" conditions.
- Provide students with Handout: Testing Steel.

Please contact Allison Bischoff, Director of Teacher Support, at allison@rozzylearningcompany.com or 314-272-2560 with questions.

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- Provide students with the following materials:
  - Fine steel wool
  - Glass thermometer
  - 4 containers with water
  - 3 1/3 teaspoons vinegar
  - pH strips
  - Plastic wrap
  - Wash cloth/towel
  - Paper towel
  - Timer
- While students are working, ask them the following questions:
  - What do you think adding vinegar to the water does? (It makes it more acidic which means it will have a lower pH)
  - Why do you think it is important to have a control test? (So we can see what will happen with plain water, before any acid is added.)
  - Why do you think it is important to wrap the steel wool and end of the thermometer in plastic wrap and a towel? (Without the towel and plastic wrap, the heat might escape into the air)

Step Three: Writing a Youtube Script (20-30 minutes)

- Explain to students that they will now write their script.
- Provide students with Handout: Creating a Youtube Video. Walk through the handout as a class.
- As students are working, ask the following:
  - What does your audience need to understand about how acid rain causes rust?
- Teacher Note: Students can practice their script if they finish before other students.
- Extra Time? Have students record their YouTube videos on a camera or smartphone!

Step Four: Discussion (5-10 minutes)

- Have students discuss their results with each other and share their favorite part of their YouTube script.
- Have a concluding class discussion about how acid rain in polluted areas can cause steel to rust faster than regular rain. Explain that although steel can rust, it is still a valuable metal that is used all over the world in millions of different structures.

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Materials List

Provided online:

- Handout: Acid Rain
- Handout: Testing Steel
- Handout: Creating a Youtube Video

Not provided (each student or group needs):

- Fine steel wool
- Glass thermometer
- 4 containers with water
- 3 1/3 teaspoons vinegar
- pH strips
- Plastic wrap
- Wash cloth/towel
- Paper towel
- Timer

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