

# Highway Engineer: Improving Highways

NGSS Standard: 5-PS1-1



## Adventure Description:

In this adventure, you will think like a highway engineer and design a liquid material to use for melting ice on a highway.



## Activity

Teacher Notes:

- This activity can be done across two days. Step 1 and 2 on one day and Step 3 and 4 on a different day.
- Prepare juice cups for each student group. Each student group should receive 3 cups of juice. Each cup should contain 1/2 cup of juice. See [Teacher Handout: What Juices are Needed](#).

### Step 1: Background On Highway Materials to Melt Ice (10-15 minutes)

- Show [Video: Improving Highways](#).
- Explain to students that highway engineers make sure highways are safe for vehicles to drive on. Some highway engineers design roads for winter weather.
- Show [Handout: Highways in Winter Weather](#). Have students look at pictures. As a class, discuss what problems exist on highways when there is winter weather. Discuss what a highway engineer might do to solve that problem.
- Explain to students that when roads are slippery or icy, salt is poured on them. The salt makes the roads easier to walk and drive on. The problem is that salt eventually leaves the road and enters nearby soil and water.
- Show [Handout: How Salting Roads Harms the Environment](#). Discuss how salt can harm plants, animals, and water!

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- Explain that some highway engineers are trying to find a new, safer material to put on slippery and icy roads. This material should not harm the environment as salt does. For example, engineers have discovered that sugar particles in beets cause ice to melt! How crazy to think that vegetables can be used to melt ice?
- Explain how both the road salt and beet sugar are made up of really tiny particles we cannot see. Even though we cannot see them, it makes a really big difference what they are made of. Discuss how the salt particles are harmful to the environment and the beet sugar particles are not.
- Show [Handout: Made of Particles](#). Explain to students they cannot see the sugar particles. Tell them, in fact, all things are made up of tiny particles they cannot see.

## Step 2: Creating a Highway (10-15 minutes)

- Explain to students that they will be creating their own ice highway and then creating a liquid to put on the highway that can melt the ice. Show [Handout: Melting Ice off of a Highway](#).
- Tell students that they will first complete the first step, creating a highway.
- Provide students with water-proof materials (tin foil, plastic wrap, cardboard pieces, etc)
- Tip: students can wrap cardboard in tin foil to make it water proof.

## Step 3: Creating a Liquid to Melt Ice (20 minutes)

- Explain to students they will now design a liquid to melt ice that will be on the highway. To do this, each group will get 3 small cups of juice.
- Explain to students they will then decide which juices they want to mix together. Tell them they do not need to use all three types, but they can if they want to. They can only use 1 cup total of juice.
- Explain they will pour each juice type into the measuring cups and record how much they are using on the handout.
- Then, they will pour the juice from the measuring cup into the larger cup (or bowl).
- Divide the class into small groups of 2-3 students.

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- Provide each group with the following materials:
  - 1/2 cup of orange juice
  - 1/2 cup of apple juice
  - 1/2 cup of cranberry juice
  - Large cup or bowl
  - Measuring cups (1/4 and 1/2 only)

## **Step 4: Testing the Liquid (10 minutes)**

- Explain to students that each group will now test their liquid to see if it can melt ice on their highway.
- Have students follow Step 3 on their handout. They will place their highway in a large plastic tub, place an ice cube on their highway and pour their liquid on top of the ice cube. They will then time how long it takes the liquid to melt the ice cube.
- Provide each group with an ice cube.
- Explain to students that each group will time how long it takes to melt their ice cube. Have groups start the timer when they put their ice cube in their cup of liquid.

## **Step 5: Reflection (5+ minutes)**

- Explain to students that they will now discuss how long it took for groups' ice to melt.
- Have a class discussion about which liquids are best to melt ice the fastest. Explain to students that some groups mixed juices that resulted in more sugar. When there is more sugar in the liquid, the ice cube will melt faster!
- As a class, discuss other liquids that students could test in the future that have sugar in them (soda, lemonade etc).

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## Materials List

### Provided online:

- Video: Improving Highways
- Handout: What Juices are Needed
- Handout: Highways in Winter Weather
- Handout: How Salting Roads Harms the Environment
- Handout: How Things are Made of Particles
- Handout: Melting Ice off of a Highway

### Not provided (each pair of students needs):

- Cardboard pieces
- Water-proof material (aluminum foil or plastic wrap)
- 3 types of juices (1/2 cup for each type of juice)
- Large cup or bowl
- Measuring cups (1/4 and 1/2)
- Large plastic tub or plastic tray
- Ice cubes (3 small or medium sized ice cubes per group)
- Clock or timer (can use cell phone timers)

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