ACTIVITY 3: MAPPING THE MOTION OF DRY ICE

The purpose of this activity is for students to measure the acceleration of a block of dry ice on a flat, smooth surface so that they better understand how lower friction aids skiers.

Materials:

- Block of dry ice*
- Flat, smooth surface (such as a lab bench or a large glass/plastic sheet)
- Stopwatch or timer
- Measuring tape, meter stick, or rulers
- Gloves (for handling dry ice safely)
- Tongs or a cloth (for handling dry ice)
- Markers and strips of paper, or stickers
- Chart paper or large dry erase boards

**Notes on dry ice: always handle dry ice with gloves. The pieces of dry ice should be about 2" in diameter. They need to have a flat side. In order to flatten them, let the piece rest on a flat surface and it will vibrate until is flattens itself out and can glide with a push.*

First, inform students that they will investigate and graph the motion of a block of ice to examine its motion over time as it moves in a straight line path. Have students form groups of 4 and make a prediction about the motion of the dry ice block: will it speed up, slow down, or travel at a constant speed once pushed?

Then, have them get their materials and set up their experiment. They can design their own procedure, you can give them a pre-made procedure, or as a class you can discuss what steps are needed to measure the motion of the block of dry ice as it travels across the surface.

Teaching Tip: If your students are less experienced with graphing, you can review the steps of graphing first.

Possible Procedure:

1. Ensure the surface is flat, smooth, and free from any debris or rough spots.
2. Use tape or markers to mark distances along the surface (e.g., every 0.5 meters).
3. Use gloves and tongs to place the dry ice at the starting point on the surface.
4. Have someone ready with the stopwatch ready to start it when the block releases.
5. Release the block by gently pushing it and letting it go so it can glide slowly across the surface in a straight line path.
6. Use the stopwatch to either: a) measure the time it takes for the dry ice block to travel between each marked distance, or b) announce when a certain time interval has passed (e.g., 1sec, 2sec, or 5sec) so the distance can be marked at each time
7. Be sure to do 3 similar trials to compare your data on subsequent runs of the dry ice.
8. Repeat the experiment multiple times to ensure accuracy and consistency of the measurements. You can consider doing a set of distance based trials (e.g., measure the distance at different time intervals) and then do a separate set of trials that are time based, (e.g., record the times taken to travel from 0 to 0.5 meters, 0.5 to 1 meter, etc.).

Next, give students time to collect data and run their trials with the motion of the dry ice. Have them create a graph of position v. time for their trials on chart paper or large dry erase boards. Depending on ability, they can find the y=mx+b form of the equation of their graphs, with units. Be sure to monitor their data collection, calculations, and graphing to ensure you're providing support where needed based on their level of experience and math abilities.

Last, facilitate a class discussion that allows each group to see the other groups' graphs. Based on the data, have the class talk about their results and experimental procedures to arrive at a consensus about the motion of the dry ice in a straight line path. Make sure they each calculate and report the speed of their block (speed = distance / time). Help them to see that the speed is constant because the forces are balanced once the block is released.