ACTIVITY 4: MODELING THE STEEPNESS OF SKI SLOPES

The purpose of this activity is for students to observe and measure how the angle and steepness of a ski slope affect a skier's speed by modeling a ski slope and skier with an inclined plane and ball.

Materials:

- Inclined plane* (ramp) with an adjustable angle or different inclined planes with varying fixed angles
- Ball (such as a marble or small metal ball)
- Meter stick, tape measurer, or rulers
- Stopwatch or timer
- Protractor (to measure and adjust angles)
- Tape or Velcro strips (to secure the ramp and ball)

Note: this can be made simply from cardboard and blocks to prop the surface at different angles, or using another design.

First, inform students that they will be investigating how the angle of an inclined plane affects the speed of a moving object.

Next, have them form groups of four, gather the materials needed for the lab, and begin setup.

Then, have students determine what each person in their group's role will be and review the procedural steps to determine how they will carry out the experiment. They should determine what angles they will choose (at least 5 different trials) and do some practice runs to test out their procedure for measuring the time, distance, and angle of the ball each time. When ready, allow students time to carry out the experiment and record the data for each of their trials, adjusting the angle each time.

Last, have students calculate the speed (e.g., speed = distance/time) and create graphs from their data to show the relationship between the angle v. time.

Data Collection Procedure:

1. Set up the inclined plane on a flat surface. Ensure it is stable and securely positioned.
2. Use a protractor to measure and set the initial angle of the inclined plane. Start with a gentle slope (e.g., 5-10 degrees) and have options for steeper angles (e.g., 20 degrees, 30 degrees, etc.).
3. Position the ball at the top of the inclined plane. Ensure it starts from a stationary position in the same spot at each set angle.
4. Release the ball from the top of the inclined plane and simultaneously start the stopwatch.
5. Time how long it takes for the ball to roll down the incline and reach the bottom or a predetermined and marked point.
6. Repeat the experiment for each different angle setting of the inclined plane.
7. Make sure to record the time (t) taken for the ball to travel the same distance down the ramp for each angle.
8. Make sure to record the distance traveled from the starting to ending point of the ball's path of motion down the inclined plane.

Post-Lab Discussion:

Have students transfer their graphs to chart paper or large dry erase boards in order to be able to see the results of other groups. Facilitate a whole-group discussion about the results.

Ask students to note what is the same and what is different between each group's results (as shown on their graphs). Focus the conversation to ensure that the group arrives at a consensus about conclusions can be drawn about the relationships between angle and time to travel the fixed distance.

Extend the discussion to make connections between the way the angle affects the motion of the ball, and how the rating (e.g., steepness) of ski hills relates to the skiers' motion.

Teaching Tip: Set this up and test this experiment out ahead of time, possibly even recording a video of your set up steps to use if you teach more than one class in a day.