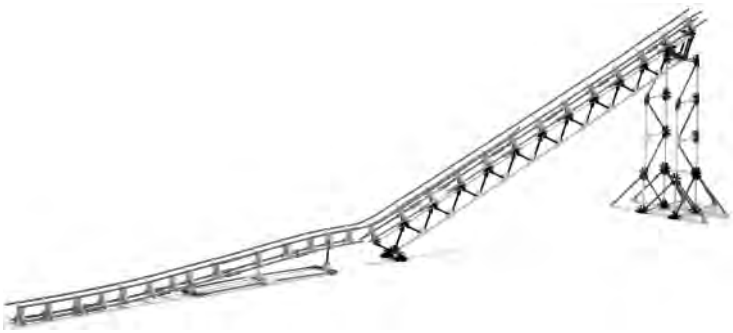

Lesson 2:
How Mass Affects the Speed of a Coaster Car

Time

- *45 minutes (after construction of the model)*

Objectives

Students will:

- Experiment and determine the speed of the coaster car, with different masses. The ramp will be set at its highest position (greatest incline).
- Experiment and determine the speed of the coaster car, with different masses. The ramp will be set at two alternative positions (lesser inclines).
- Draw conclusions as to the effect of different masses and different inclines on the speed of the car.

Materials

Each group will need:

- Materials from 1 K'NEX Amusement Park Experience set
- Building Instructions from CD-ROM: File – Inclined Plane I (for a coaster car)
- 1 coaster car (provided with the construction set)
- 2 AA batteries or other masses
- Tape
- Flexible (sewing) tape measure
- Stopwatch
- Water-based marker

Each student will need:

- Science notebook/journal
- Graph paper

Overview for the Teacher

In a previous activity, students investigated how different release heights impacted the speed of balls on ramps with different inclines. In this activity, students use another object on the track, the coaster car. This allows students to explore how mass impacts the speed of the car when it is released. They may be surprised at the impact that mass has on the speed of an object. Students will also examine what happens to the speed of the car when the angle of elevation is reduced and mass is added.

REVIEW

Students will be more successful with this activity if they have an understanding of the following concepts and vocabulary:

- How to calculate speed (velocity).
- That acceleration results in an increase in speed and deceleration results in a decrease in speed.
- That mass is the "amount of stuff" that an object has and is affected by the force of gravity.

Introduction

The teacher may choose to introduce this lesson by inviting students to share any experiences of inline skating or skateboarding, or by having a general discussion comparing riding a bicycle on a flat surface versus on a hill.

Teacher's Notes
Students should work in small groups of 3-4 as they participate in these investigations and activities. They should be encouraged to record their predictions and observations in their notebooks/journals.

ACTIVITY 1: SPEEDING DOWN THE RAMP

PROCESS

In Groups

1. Distribute K'NEX Education materials and allow the students to build the ramp with the coaster car, using the directions found on the CD-ROM.

2. Once built, students should predict which of the following coasters cars will travel down the ramp fastest:
   - An empty coaster car.
   - A coaster car with one AA battery placed in the front seat.
   - A coaster car with one AA battery placed in the back seat.
   - A coaster car with one AA battery placed in the back seat and one AA battery placed in the front seat.

3. Students should explain how they arrived at their predictions.

4. Ask the students to:
   a. Select a common point at the top of the ramp from which to release the coaster car and mark this start point using a water-based marker.
   b. Measure the length of the track from the start point to the end of the ramp and record the measurement in their notebook.
   c. Have a stopwatch ready for use, place the empty coaster car at the top of the ramp and release it. Time the coaster car as it travels from the top of the ramp to the end of the ramp. Students should run three trials to determine an average time.

5. Students should repeat step 4c for each of the **other variations** of the car, as listed above.

6. Once they have collected their data they can determine the speed (velocity) of the car for each variation using the following information:

   v = d/t

given: t = average time determined through experimentation

   d = length of the ramp from release point to the end of the ramp

> ***Teacher's Notes***
> *The teacher may want to review the appropriate units for speed, distance, and time at this point.*

7. Students should make a bar graph of their data.
   - x-axis – Description of each car variation tested
   - y-axis – Speed of the cars

8. Ask the students to respond to the following questions in their science journals:
   a. Do they notice any trends in their data?
   b. Were their predictions correct? Explain.
   c. Does any of their data provide insight into whether the position of the masses affected the speed of the car? Explain.

Whole Class

9. As a group, students should discuss their initial predictions, reasons for their results, and, if necessary, suggest reasons why their predictions and results differed.

ACTIVITY 2: CHANGING THE ANGLE OF THE RAMP

PROCESS

In Groups

1. Ask each group to repeat Activity # 1 (all steps) for each of the other two angle settings for the ramp. These are indicated in the Building Instructions with #2 and #3 designations.

2. In their journals, students should compare their results for:
   a. Each of the differently loaded cars.
   b. Each of the different release angles.

Whole Class

3. Invite the students to discuss their findings about the effect on the coaster car of lowering the ramp into the different positions.

REVIEW

- How does the angle of the ramp affect the speed of the various cars? Students can relate this back to their earlier comments about skating or riding a bike.

ASSESSMENT

- Using the student notebooks/journals and graphs, the teacher can determine if the students:
  1. Understand graphing concepts associated with the activity.
  2. Can use their data to present reasonable explanations of the effect of car mass on the speed of the car.
  3. Can use their data to present reasonable explanations of the effect of ramp incline (angle) on the speed of the car.