Harnessing Solar Power with K'nex Cars

Overview

In this lesson students will build K'nex rally cars and power them with solar panels. The students will design and build a K'nex car that can hold a solar panel and small motor. They will test their car and make improvements on their design. This lesson incorporates problem solving while teaching students about alternative forms of energy. This activity is appropriate for grades 6th-10th.

Objectives

After this activity, students should be able to:

- Build a K'nex car that runs on solar power
- Understand the mechanics of a fixed axle

Oregon State Science Standards 2009

Engineering Design

8.4D.2 Design, construct, and test a proposed solution and collect relevant data. Evaluate a proposed solution in terms of design and performance criteria, constraints, priorities, and trade-offs. Identify possible design improvements.

Students Pre-requisite Knowledge

Before the activity students should spend some time learning how the pieces connect with each other. The most difficult part of this lesson for most students is fixing a drive axle. The instructor should demonstrate how to fix the axle as shown in the YouTube video link below. A fixed axle is an axle that is connected to the wheels: when the axle spins, the wheels also spin. This is usually done by fixing a pulley wheel to the axle. The axle is connected to the spinning motor shaft by a rubber band.

Materials

- Assorted K'nex pieces
- Small bag within K'nex pieces bag includes
  - Rubber band, Two releasable zip ties, two alligator clip leads, and a motor
- Extra Rubber bands
- Extra Releasable Zip ties (DO NOT CUT ZIPTIES!)
- Extra motor

- 1.5-3 volt Batteries (used to test motors if issues arise)
- Solar Panel
- Light source preferable the sun

Teacher Preparation

Review the K'nex car handout. It is also good to make your own model car to have a better understanding of the fixed axel and motor assembly. It will also give you an idea of the issues students may run into. A You Tube video of different K'nex pieces can be found here: http://www.youtube.com/watch?v=IfojVBNQNAM and a video of how to construct the car can be found here: http://www.youtube.com/watch?v=KFvbuWar4IE

Procedure

1. **Anticipatory activity -** It is nice to show the students an example car, with or without the solar panel attached. You can roll across a table by giving it a push, demonstrating that it rolls easily and freely. Each group is going to build one of these today.

2. **Activity -** Give a 10-15 minute lecture/demonstration about building the car.
   a. Make sure to suggest that they begin by building a frame for the car. This is a good opportunity to let them open up the bags, and try putting a few pieces together. Make sure that everyone is able to snap the pieces together and remove them without forcing them. The pieces can break.
   b. On that frame there should be a fixed axle.
   c. Make sure there is a platform for the solar panel on the car.
   d. Attach the motor onto any part of the car, making sure that the rubber band can stretch between the motor pin and the pulley for the axel (the wheel without a tire).
   e. Finish the car by adding anything else, and reducing as much of the friction possible.
   f. The car should roll freely down a slight incline, if it does not roll freely the students will need to trouble shoot their source of friction.
   g. Instruct them that once their car is ready, they can test it by attaching the motor to a battery source and see how well the motor spins the axle, and thus pulls/pushes the car along. This is the step that usually takes the most time. The zip ties are releasable and the motor often has to be repositioned, or the rubber-band changed.

3. Allow the rest of the period (45 minutes) for them to build and do the initial tests with their car. You will need to peruse the groups and help occasionally. Some students will need more support than others. Not everyone will be at the same place in their cars by the end of the period. If students finish early they may help others. You can offer after-class or lunch time to finish their cars and do initial test by simply rolling the car or using a battery to power the motor. The initial test is to see if there are any trouble places that can be easily remedied. Remind students that they will have time to make minor adjustments to their car next period.

4. During the next class period, give students 15 minutes to attach the solar panels and motor and make any minor adjustments that are needed. After all students have attached the motors and solar panels, as a group go outside to the specified course and allow students to test their solar cars. Give students 5-10 minutes to make any final adjustments before the race. For the last 15 minutes of class time, have each group go up individually to test their solar car. Time the car from the time it is released by the student to the end of the track. Have every group come up one at a time to submit their final time. For the last 10-15 minutes of class, have the class go back inside and lead a short discussion about what factors helped increase the speed of the car. Have students disassemble the cars and clean up their areas.
5. **Closure -** Close the lesson by discussing what variables made the car more/less efficient. Talk about things like car weight, friction on the wheels, and angle of the solar panel.

EXTENSIONS

This could be turned into an experimental design lesson by having the students pick a single variable to change and testing if the car is faster or slower than the previous design.