KNex Car Challenges (1-8)

Subject: Math and Science (5th-9th grades)

Challenge 1: Reading a Schematic –Building Cars with K'Nex **Time:** 30-45 minutes

Guiding Question, Course/Grade Level Expectations, and SPI's are included for 6th, 7th, and 8th grade Math and Science, Physical Science, Biology, Physics, Algebra 1, Algebra 2, and Geometry. (**See the Standards Spreadsheet.**)

View detailed Tennessee Curriculum Standards:
http://www.tennessee.gov/education/curriculum.shtml

Materials: K'Nex Forces, Energy, and Motion Set with schematics.

Preparing the lesson:

1. Divide students into small groups. (4-6 students)

2. Provide K'Nex Set to each group.

Teaching the Lesson:
Assignment: Follow the schematic to build the vehicles on pp.12-17, as shown below in the shortest time. (Make sure each member has separate copy of instructions to facilitate full participation.)

Assessment: Write the names of teams on the board in the order that they finish. Award points as follows: 1st place-30 points;, 2nd place-28 points, 3rd place – 24 points, 4th place - 18 points, 5th place-12 points, and 6th place-6 points. Then, add 30 points to each team that build their cars exactly according to the schematic.

Journal Writing: Have students reflect on their method(s) of problem solving and communicating. How could they have improved their time and accuracy?

CHALLENGE 2: Spring Racer Challenge **Time: 30 min for data collection**

30 min for contest

Materials: K'Nex Forces, Energy, and Motion Set with schematics.

3 - Pre-Built Spring Racers (From KNex Car Building Activity)
Measuring Tape
Masking Tape

Preparing the lesson:

1. Divide students into small groups. (4-5 students)
2. Provide K'Nex Set to each group.
3. Mark off testing area in a hallway, as shown below.
3. Students will use the "3-Spring Racers" they built in the KNex Car Building Activity.

Teaching the Lesson:

1. Present the competition rules, as follows:
    - Use trial and error to determine how far back you need to pull the car

(independent variable) to make it advance a certain distance (dependent variable).

- Make an x-y table of your data.
- Repeat this process for each car.
- Now determine a distance at random for the competition. (For our competition, we used 10 feet.)
- Based on the collected data, each team must choose the car that they feel will be the best to perform the task.
- Each group will have 3 attempts to make their vehicle travel a straight line distance of exactly 10 feet.
- Record the actual distance for each team.

Assessment: Since the target distance is 10 ft, 11 ft would be recorded as a 1 ft amount of error. 9 ft would also be recorded as a 1 ft amount of error. A car that travels 10ft, but veers to the side 2 ft would be recorded as a 2 ft amount of error. Calculate the accuracy for each team and determine the order. Award points for 1st place through last place.

Journal Writing: Have students reflect on their method(s) of problem solving and communicating. How could they have improved their methods, communication, and accuracy?

Extension: Have students plot their data, find the "line of best fit," and develop an equation for each car. Then students can use the equation to predict an outcome beyond their collected data. Use the vehicle to determine the accuracy of the prediction. Discuss the reasons for possible variations.

Challenges 3-8: K'Nex Car Competitions Time: 40 min for each build and testing

20 min for competition

Materials:
K'Nex Forces, Energy, and Motion Set with schematics.

Measuring Tape

Duct Tape

Hula Hoop

AA Batteries

GI Joe Figurine

Kitchen mat or rug with low pile

Door mat or rug with heavy pile or texture

Plastic Coat Hangers (10-12)

Flat novelty erasers

Craft Sticks or cardboard to make a stretcher

2-Bridges built from K'Nex Structural Engineering Kit

Preparing the lesson:

1. Divide students into small groups. (4-5 students)

2. Provide K'Nex Set to each group.

3. Set up Testing Area (You will need a 4-20 ft length, perhaps in a hallway. Use masking tape to mark a starting line and place the hula hoop for the target location.

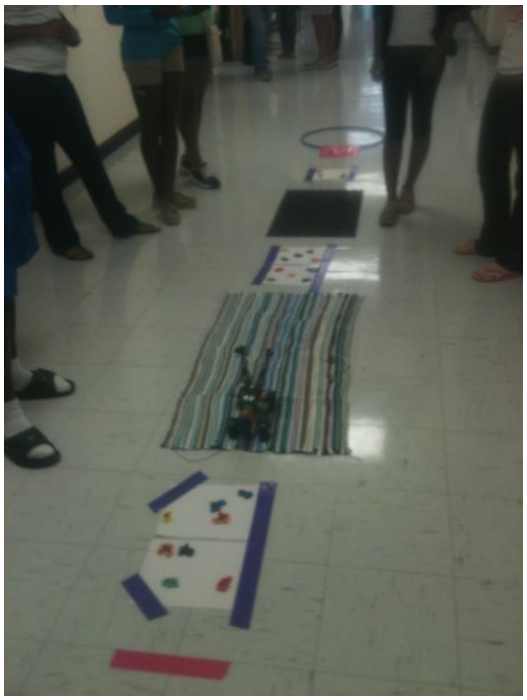
Teaching the Lesson:
1. Scenario: A soldier has been wounded and must be transported to a recovery zone for the helicopter to pick him up. (The helicopter zone is within the hula hoop.)

2. For **Challenge #3**, students must design a vehicle that will successfully travel a distance of 4 ft and enter the hula hoop.
3. For **Challenge #4**, students must modify the vehicle, so that it will also carry the injured soldier into the hula hoop area, which is 4 ft away.

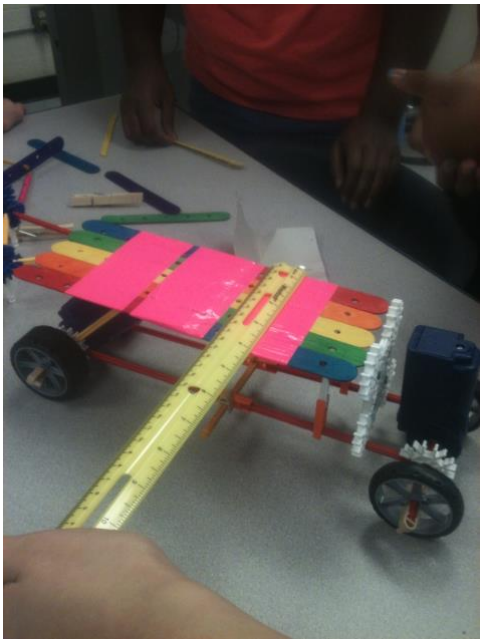
4. For **Challenge #5**, students must modify the vehicle, so that it will carry the injured soldier across rugged terrain. The vehicle must travel 2 ft on smooth surface, then across a low pile mat, 2 more ft on smooth surface, then across the higher pile mat, 2 more ft on smooth surface, then into hula hoop.

5. For **Challenge #6**, students must modify the vehicle to travel over even more obstacles.

In this challenge, bundles of 5-6 plastic coat hangers are placed under the low pile mat and novelty erasers are used to create bumps in the road.



6. For **Challenge #7**, students must modify the vehicle to carry the injured soldier on a stretcher. The track conditions are the same as the previous challenge.



7. For **Challenge #8**, students must modify the vehicle to travel over even more obstacles. In this challenge, 2 KNex bridges have been added to the track and additional “bumps in the road” have been added by under the low pile mat and novelty erasers are used to create bumps in the road.

8. Discuss gears and gear ratios, which combinations will increase power and which combinations will increase speed or torque.

9. For the more advanced challenges, center of gravity is an important concept for students to consider. The weight of GI Joe might cause the car to topple when going over the "bumps in the road," if he is being carried at a level that makes the car top heavy.

8. Present the competition rules, as follows:

- Build a vehicle having your own design. It does not have to be like any of the vehicles in the K'Nex book.
- You may NOT use the plastic bag or rubber bands.
- It must be powered by the battery-operated spring motor(s).
- It must have only parts from the kit you were given.
- The course your vehicle will travel will be a straight-line course of 4 feet in length, into the hula hoop. (Tape may be placed to create a "ramp" to allow easier access to the inner circle.)
- The end of your run will be when your vehicle has entered the target (hula hoop) at the end of the course.
- Since moving the soldier to the recovery area is a "need," not a "want," this challenge is determined simply by success or failure.
- If time permits, experiment with your vehicle and make modifications to achieve success.

Assessment: Award points to successful teams for **Challenges 3-4**.
Scoring for **Challenge 5** is as follows: A successful challenge is worth 250 points, but a 25 point deduction is made for each time the car is touched and 100 point deduction is made if the soldier falls from the vehicle. The lowest score could be zero, as no negative scores will be awarded.
Scoring for **Challenge 6** is as follows: A successful challenge is worth 500 points, but a 50 point deduction is made for each time the car is touched and 200 point deduction is made if the soldier falls from the vehicle. The lowest score could be zero, as no negative scores will be awarded.
Scoring for **Challenge 7** is as follows: Same scoring system as Challenge 6.
Scoring for **Challenge 8** is as follows: A successful challenge is worth 1,000 points, with 700 points possible for completion of the task and 300 points awarded for the time it takes to complete the task. A 50 point deduction will still be made for each time the car is touched and a 200 point deduction will be made, if the soldier falls from the vehicle. The lowest score could be zero, as no negative scores will be awarded.
(Sample Score Sheet)

Journal Writing: Have students reflect on their method(s) of problem solving and communicating. How could they have improved their methods, communication, and

accuracy?

Extension: Have students plan and present a technical presentation. (See Technical Presentation Lesson Plan for criteria and grading rubric.)
