Hot Wheel 6th Grade Lesson Plan

Designed by Chris Herald, USD 383 STEM Coordinator Time: 90 minutes

LESSON TITLE: Hot Wheel Cars and Velocity

QUESTION: How fast can a Hot Wheel car travel?

LESSON OBJECTIVES: Students will view how engineers built a track for a giant sized Hot Wheel car and then design their own experiment to obtain the highest velocity with their Hot Wheel car. Students will learn how to use new technology (a sensor) to measure velocity (speed).

KCCR STANDARDS MATH: 6NS.3 Fluently add, subtract, multiply and divide multi-digit decimals
Mathematical Practices = Make sense of problems and persevere, Reason abstractly and quantitatively, Attend to precision, Use appropriate tools strategically

KCCR STANDARDS SCIENCE: MS-PS2-2 Plan an investigation to provide evidence that the change in an object's motion depends on the sum of the forces on the object and the mass of the object. **MS- PS3-1**Construct and interpret graphical displays of data to describe the relationships of kinetic energy to the mass of an object and to the speed of an object.
MS E1S1-2, E1S1-3, E1S1-4 Engineering Design
Science & Engineering Practices: Asking questions & defining problems, developing & using models, planning & carrying out investigations, analyzing & interpreting data, constructing explanations & designing solutions and obtaining, evaluating & communicating information
Crosscutting Concepts: Patterns, Cause & Effect, Energy & Matter, Stability & Changes

MATERIALS: hot wheel car, 6 pieces of track, 5 connectors PART 2 EXPLAIN - Lab Quest, photo gate, Hot Wheel clamp, Popsicle sticks, calculator on Lab Quest, different surfaces (cloth, sandpaper, cardboard) tape, washers, rulers *NOTE:* no photo gates available, students can measure the distance the car travels

Learning activities

ENGAGE: Show video clip - http://www.youtube.com/watch?v=7SjX7A_FR6g
Ask students to pay attention to how the engineers designed the ramp and track. What caused the car to move? How could you get a toy car to move faster? How do we measure speed?

EXPLORE: Assign roles to students in groups of three – catcher, launcher & recorder. *PART 1* Allow students 8 minutes to experiment with the only the tracks & cars to investigate how fast they can get the car to move by just observing the car. Ask questions such as- What did you learn? What caused the car to go fast? How did you get it to move faster? How do you measure speed? What units are used? They should observe that the steeper the ramp the faster the car moves.
PART 2 Brainstorm a list of variables that could affect the speed of the car. Allow each group to choose one to investigate (examples: mass of car, height of ramp, length of track, starting point, surface of track) or decide on one as a class. Groups design a data table for at least three trials for each change.

EXPLAIN: Students set the photo gate at the same location along the track. They need to enter the length of the car and select "Gate mode" before collecting data on the Lab Quest. They observe the velocity of the car for at least 3 trials (why 3 trials?) and write in a data table. Next, they change the set up to change the variable two more times. Use this site http://www.online-stopwatch.com/ to display the time for each exploration time. If photo gates are not used, students can measure the distance they car travels. What did they learn? Students look at their data. Can they see any patterns? Did their variable affect the car's speed? Students share their highest reading. Why do you think a group had the highest speed? Lowest speed? Did a second trial result in a faster speed? Why or why not? Introduce potential and kinetic energy if it doesn't come up in the class conversation and how it is affected by the variable tested. Does gravity make a difference?
ELABORATE: What did students learn about speed? Students discuss how they can improve on this experiment and if time allows make those modifications. What careers are needed to design cars and race tracks? Calculate the potential energy PE_{grav} = mass • g • height and kinetic energy $KE = 0.5 \bullet m \bullet v^2$
EVALUATION: graph data at http://nces.ed.gov/nceskids/createagraph/ . Look at different careers at http://careersight.concord.org/careers/index.php OR http://ionfuture.org/ OR create a information board at http://www.discoveryeducation.com/

Vocabulary or topics discussed

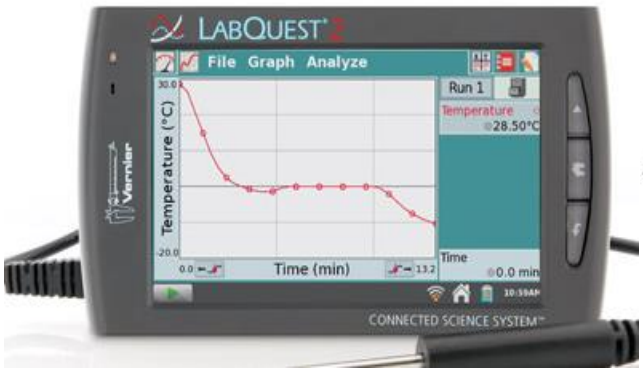
Science = potential energy, kinetic energy, speed, distance, metric system, mass, gravity, momentum

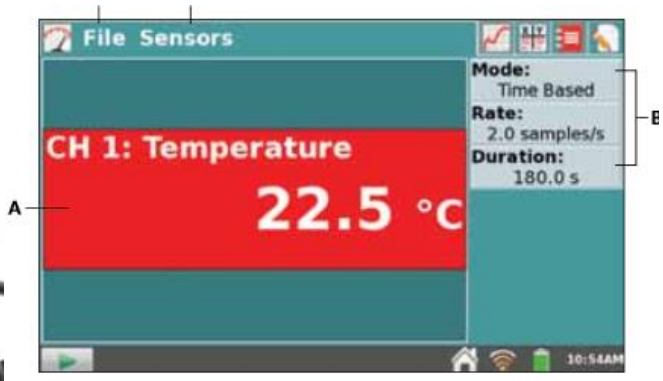
Technology = use of photo gates and meter stick; testing design solutions

Engineering = apply the design process that involves defining a problem, generating ideas, selecting a solution, testing the solutions, making the item, evaluating it, and presenting the results.

Mathematics = slope, measurements, averages, height, decimals, recognizing patterns, computational thinking

Which STEM careers were highlighted? = Roller coaster designers, automotive technicians, machinists, drivers and car racing technician. Mechanical engineers deal with the motion of vehicles. It is important for them to be able to read and understand graphs that show velocity and acceleration to then analyze data from testing sites to learn how to design their products to be efficient and safe.





Use the Meter screen to set up your experiment.

Using the photo gate

1. Turn the Lab Quest on (the photo gate should be connected next to the red power button)
2. Tap "Mode" in the upper right hand of the screen
3. Tap the black triangle  and select "Gate"
4. Measure the length of your car in centimeters.
5. Enter the number in "Length of object" , press "Done"
6. Change the units to cm and press "Done"
7. Press "OK"

   To get back to this screen touch the meter picture at the top left corner

8. To start data collection, press the green arrow at the bottom of the screen
9. Let go of the car. After the red LED blinks, press the red square to stop data collection. 

NOTE: Because the orange track blocks the photo gate, it must be placed on 2 Popsicle sticks.

http://www.online-stopwatch.com/

Part 1 Pick up the supplies and experiment to get the Hot Wheel Car to move as fast as you can but stay on the track. Share with the group your results. What did you learn? What caused the car to go fast? How did you get it to move faster? So how do we know it went fast? How do you measure speed? What units are used?

To create an experiment we need an independent & dependent variables. What might these be?

Independent dependent

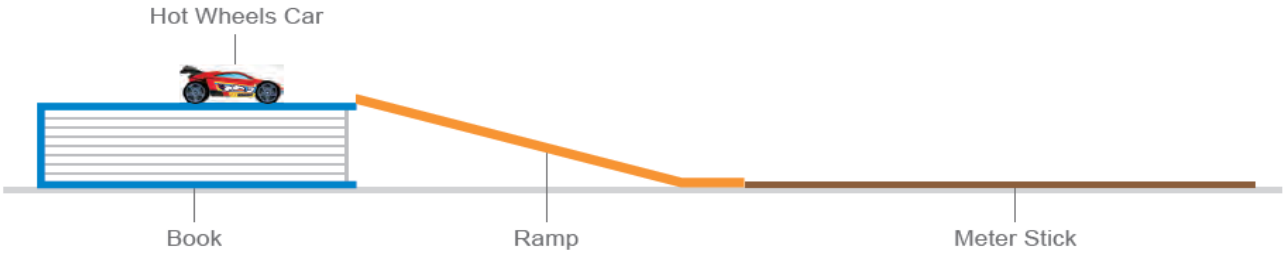
Part 2

Decide on the location of the photo gate as a class. Pick up a Lab Quest with photo gate. Place 2 Popsicle sticks under each leg of the photo gate. Test your car at least three times by pressing the green start button each time. Calculate the average velocity (there is a calculator on the Lab Quest under accessories). Round your answer to two decimal places.

Title? What will you measure? Units?

(Put them in the heading so you don't have to write it each time!)

Independent (units)	Trial 1	Trial 2	Trial 3	Average
Set up # 1 =				
Set up # 2 =				
Set up # 3 =				
Set up # 4 =				



Groups of three

- launcher – releases the car at the same place on the ramp
- catcher – picks up the car & brings it back to launcher
- recorder – measures & writes distance for each trial

Additional Activity

Review data from first lesson- what was the highest velocity? Velocity is a rate d/t like 2m/s

How did you get the car to go faster? Discuss Energy & give examples

1 = Potential energy PE

2 = Kinetic Energy KE

As the height of the ramp _____, the potential energy _____ which caused the car to have a higher velocity.

Today's question "How can you change the design of your set up to change the potential energy?"

Brainstorm ways & then in group of three decide on one variable. Change set up three times. What can you measure? Look at table from last time.