

COPY OF HOT WHEELS LAB

Lesson Overview

This lesson is to give students the opportunity to explore force, mass, acceleration, and their relationship.

Objectives:

Students will be able to explain Newton's Second Law of Motion with a high degree of accuracy by the end of the lab, and when prompted throughout class.

Students will be able to explain how ramp height and vehicle mass affect the distance traveled by the vehicle by the end of the lab with a high degree of accuracy.

Students will be able to explain how ramp height and vehicle mass affect the force applied to the vehicle by the end of lab with high degree of accuracy.

Standards

National Standards

SC Science Standards

HS-PS2.1: Analyze data to support the claim that Newton's second law of motion describes the mathematical relationship among the net force on a macroscopic object, its mass, and its acceleration.

P-2.4: Interpret the resulting motion of objects by applying Newton's three laws of motion: inertia; the relationship among net force, mass, and acceleration (using $F = ma$); and action and reaction forces.

PS-5.7: Explain the motion of objects on the basis of Newton's three laws of motion: inertia; the relationship among force, mass, and acceleration; and action and reaction forces.

Materials

Toy Cars

Tape

Weights

Track for the cars

Straws

Measuring tape

Rulers

Books

Data Tables

Documents

[data table.docx](#) (17KB)

Web Links

[Source 1](#)

[Source2](#)

[Source3](#)

[Source4](#)

Instructional Plans

Engage 1 (5 min)

1. Engage Details

Sub-components:

Prior Knowledge, Misconception

Representative Questions:

(1) What do you know about...? (2) What have you seen like this? (3) What have we studied that might apply here?

Engage Description:

What is force?

When something pushes something else and makes it move.

Examples of force in everyday life?

When you step on gas pedal and the engine moves car forward.

When you're pushing a book across a table.

Can you see, feel, or touch force?

You can feel it.

Can you describe force?

It's when an object acts on another by pushing or pulling the other object, causing it to move.

What forces are acting on books?

Gravity, Friction, Normal forces.

(Demo: Drop books)

Which book will hit the floor first and why?

The heavier book will hit first, or they will both hit at the same time.

(Lead into activity)

Set up experiments.

Do you think objects rolling down a ramp will behave in the same way?

Yes. No. Maybe, the objects will roll faster from higher up and if they have more mass.

2. Formative Assessments

Warm-Up

Students will be asked questions during the demonstration. The answers to the questions will provide evidence of their prior knowledge and any misconceptions.

Take notes while answering questions if needed.

Explore 1 (10 min)

1. Explore Details

Sub-components:

Predict, Test, Collect

Representative Questions:

(1) What if...? (2) What would you expect to happen? Why? (3) What do you need to collect? (4) How will you organize your information? (5) How much data/information do you need to collect?

Explore Description:

Students send a car down ramps of different heights.

Start with one or no book. Increase height 3 more times.

Students send trucks of different masses down a ramp of a constant height.

Start with no weight added to trucks. Increase weight 3 more times throughout activity.

*Will rotate stations to improve time management.

*For both lessons, it is optional to reduce to only using 2 trials if class runs out of time.

*If there is extra time, then students may observe the affects of changing mass of vehicle and simultaneously changing height of ramp on the vehicle's force.

2. Formative Assessments

Observation, Record/Data Collection, Science Notebooks

Students will write down a hypothesis for each experiment. They will also record data. They will also write any observations on the back of the sheet. The data sheets will be collected and then kept in science notebooks.

Students will also be observed during the activity to make sure that they remain on task. If they are struggling with the lab, they will be asked guided questions.

Explore 2 (5 min)

1. Explore Details

Sub-components:

Predict, Test, Collect

Representative Questions:

(1) What if...? (2) What would you expect to happen? Why? (3) What do you need to collect? (4) How will you organize your information? (5) How much data/information do you need to collect?

Explore Description:

Students push car from different marks to see the distance traveled.

*Will rotate stations to improve time management

2. Formative Assessments

Observation, Record/Data Collection, Science Notebooks

Students will write down a hypothesis for each experiment. They will also record data. They will also write any observations on the back of the sheet. The data sheets will be collected and then kept in their science notebooks.

Students will also be observed during the activity to make sure that they remain on task. If they are struggling with the lab, they will be asked guided questions.

Explain 1 (5 min)

1. Explain Details

Sub-components:

Interpret, Evidence/Justify/Verify, Communicate, Alt.explanations, Analyze

Representative Questions:

(1) What took place? (2) Explain what happened? (3) What pattern(s) did you notice? (4) What surprised/puzzled you? What is still confusing? (5) What evidence do you have for your statement? (6) How would you explain...? (7) What trend does the data show? (8) What do you mean when you say, ...? (9) How is your idea different from...? (10) What do you think will happen if? (11) How does this apply to what we learned before? (12) What has been learned? (13) Do you agree with...? Why/Why not? (14) Where have you encountered a similar phenomenon?

Explain Description:

This will be a discussion of the lab. The teacher will clarify any misunderstandings.
Small Group Discussion Questions Immediately After Lab

Did the height of the ramp increase the distance the car rolled? Why? Why not? The height increased the distance traveled by the car. This occurs because the ramp is higher.

Do you think the same thing would happen if you used a different surface for your ramp (example: carpet, sandpaper, tile)? If used sand paper, the highest ramp would still go the farthest but it would not go as far as it would with a smoother ramp. It would also travel slower.

How does increasing mass (adding more weights) affect the force of objects in motion (the distance the vehicle rolls)? Explain your answer using data from the chart. The bigger the mass of the object then the bigger the force of that object. The bigger object rolls faster and further.

What force is acting on the cars/trucks? Gravity and friction and normal force.

Key Points:

Force and Acceleration are Proportional.

Both go up or down.

Mass and Acceleration are Inversely Proportional.

One up and other down.

$F = m \cdot a$

$a = F/m$

$m = F/a$

2. Formative Assessments

Whole Class Discussion, Small Group Discussion, Teacher Presentation, Exit Ticket

Discussion: Students will write down the group answers to each question

Create a hypothetical real world scenario where Newton's Second Law is occurring and students' have to explain each component.

Exit Ticket: Will be used to have a written record of students' understanding after this activity and clarify any misunderstandings or misconceptions in the next class.

Contributed by:

Brittany Bolin, Clemson, SC

Rick Freemantle, Clemson University, SC

Gail Platenberg, Clemson University, SC

Revised by:

Sandy Ledwell, Alabama Department of Education, AL