

- 1. Afar Movement Assessment (20 minutes)**
- 2. Introduction to Force Variables Labs (Groups of 2-3 students)**

Navigate



Turn and Talk

- What were the main differences we observed in the motion of the plates?
- What forces do we think are acting on plates that could explain the motion we observed?

→ Be ready to share your ideas with the class!

Consider Plate Interactions



With your class

What is interacting with the plates to push or pull on them?

Model Forces Acting on Plates



With your group

Draw an initial model that shows your ideas about how these forces act on the plates to cause their motion. What would happen to a plate's motion if multiple forces were acting on it at the same time?

When you are ready...

Round Robin (1 minute each)

Share your ideas, using the Plate Interactions Consensus Model poster to illustrate your points.

Considering Variables



With your group

- What physical properties of the plates could cause differences in the forces acting on them?
- What are some ways that we can change a variable to investigate its effect?

→ Be ready to share your ideas with the class!

Considering Variables



With your group

- How would the forces acting on a plate change if 1 of the plate properties were changed (increased/decreased)?
- Develop 2 versions of the model: 1 where this property is larger, and 1 where this property is smaller.

→ Be ready to share these in a gallery walk!

Forces on Plates Gallery Walk



With your group

- Move from model to model with your group.
- Identify similarities and differences between models.

Make Sense of Our Models



With your class

- What do our models have in common?
- What are the differences between our models?

Considering Sliding Forces



With your class

How could we use our hands to represent how the mantle can cause the crust to move?

Quantifying Friction



Turn and Talk

How could we use a spring scale to measure the force of friction acting on an object?

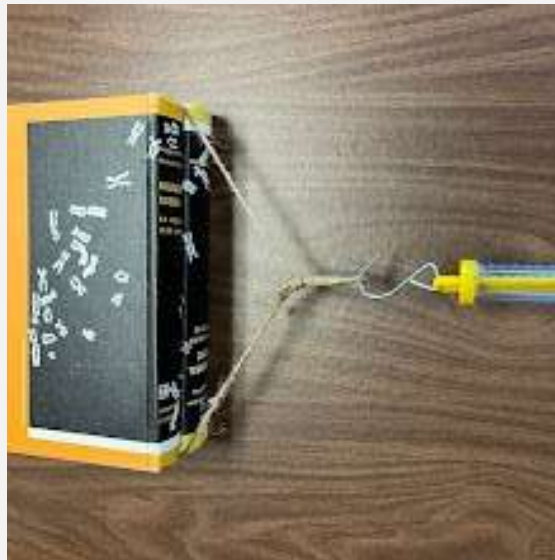
→ Be ready to share your ideas with the class!

Quantifying Friction



With your class

How could we model the forces on a book being dragged by a spring scale?



Quantifying Friction



Turn and Talk

- What forces are acting on the piece of foam?
- How would we model them?

→ Be ready to share your ideas with the class!



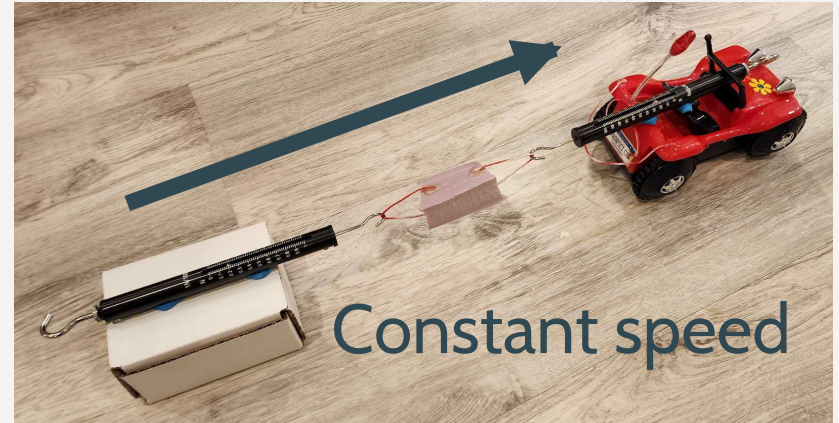
Constant speed

Quantifying Friction



With your class

- What do our data tell us about the friction between the box and the ground?
- What about the book and the surface?

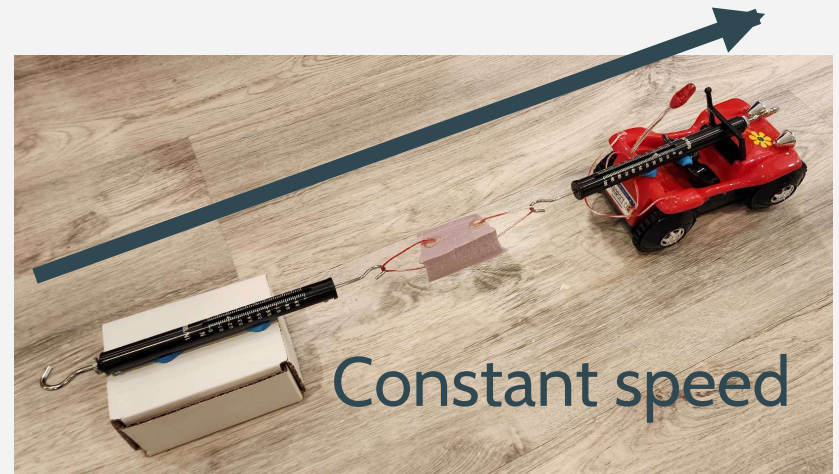
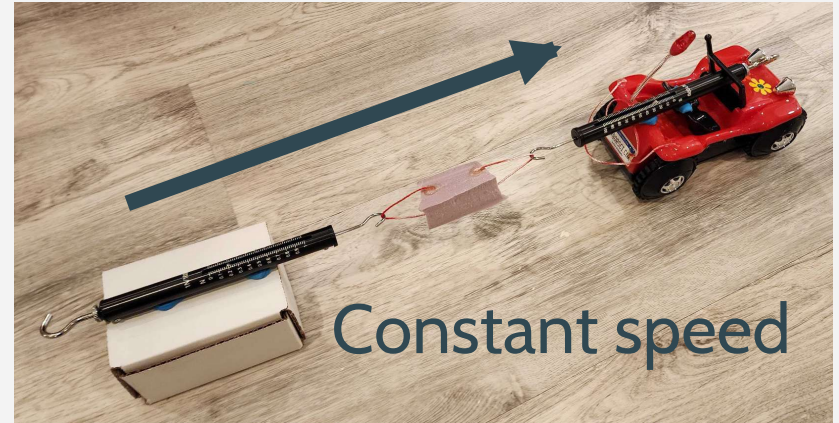


Quantifying Friction



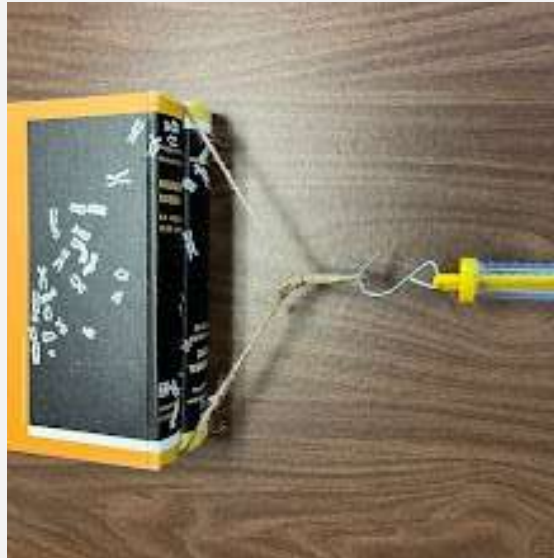
With your class

Does speed affect friction between an object and the surface it is sliding over?



Quantifying Friction

Constant speed



Consider Friction on Different Objects



With your class

- What characteristics of an object might increase or decrease the force of friction acting on it?
- Do we think these characteristics could also affect the force of friction acting on the plates? Why or why not?

Brainstorm Ideas for an Investigation



With your group

Which of the plate properties we have identified might affect friction forces specifically?

→ Be ready to share your ideas with the class!

Navigate: Develop a Hypothesis



With your group

Your group will conduct an investigation to test 1 variable that could affect friction acting on a material.

Complete this sentence in your science notebook to frame a **hypothesis** for the investigation.

*If _____, then when we _____,
we will observe _____
because _____.*

Navigate: Revisit the Hypothesis



With your group

Review your **hypothesis** for the variable you will investigate.

If _____, then when we _____, we will observe _____ because _____.

Design the Investigation of Friction



With your group

How could we use these materials to investigate how plate characteristics might affect friction?

When you are ready...

Round Robin (1 minute each)

Be ready to share (1) how you will manipulate, control, and measure your variables and (2) how data will be recorded.

Carry Out the Investigation of Friction



With your group

- Use your plans to carry out the investigation.
- Record your data and how you collected it.
- Complete this sentence on a new piece of paper to frame your **conclusion** for the investigation:

When we _____, we observed _____. This evidence supports the conclusion that _____.

Make Sense of Our Results



Scientists Circle

Share your results with the class.

- Describe your data.
- What relationship do your data support?
- What was your **conclusion** about how your variable affects friction? Was this the same as your **hypothesis**?
- Does this agree or disagree with the data other groups have presented?

Make Sense of Our Results



With your class

Would a high force of friction acting on a plate make it speed up or slow down?

Connecting Friction and Plate Motion



With your class

- Where do we think plates are experiencing friction?
- How could we use our results from our *Friction Investigation* to help explain the plate motion that we have observed?

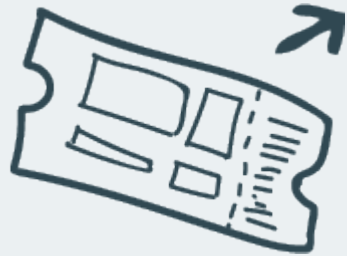
Modeling Friction and Plate Motion



With your group

Use your initial predictive models and your findings from the *Friction Investigation* to model the relationship between friction and mass, surface area, or texture.

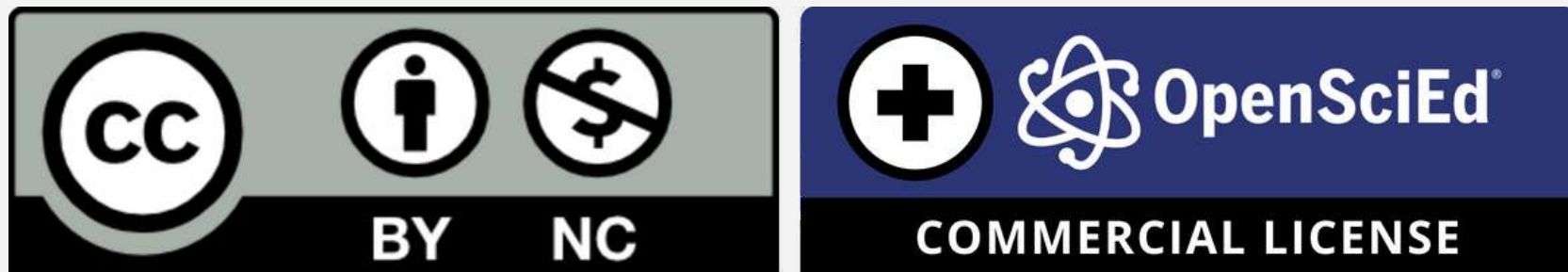
Navigate



Exit Ticket

Which other force(s) should we investigate that could help us explain why some plates change motion differently than others?

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