

Lesson Three: Finalizing Friction

Grade level: 6-8

Expected length of Lesson: 45 minutes

Overview:

Students will be given the Finalizing Friction Quiz to assess their understanding of the concepts that are used in the previous lessons. After the quiz students engage in either an open or guided discussion of the simulation activity and/or discuss the concepts themselves, clearing up any misconceptions that still persist. There may also be opportunity for further journaling.

Standards and Benchmarks:

NGSS:

Performance Expectations:

- The motion of an object is determined by the sum of the forces acting on it; if the total force on the object is not zero, its motion will change. The greater the mass of the object, the greater the force needed to achieve the same change in motion. For any given object, a larger force causes a larger change in motion. (MS-PS2-2)
- For any pair of interacting objects, the force exerted by the first object on the second object is equal in strength to the force that the second object exerts on the first, but in the opposite direction (Newton's third law). (MS-PS2-1)

Cross-Cutting Concepts:

- Cause and effect relationships may be used to predict phenomena in natural or designed systems. (MS-PS2-3),(MS-PS2-5)
- Models can be used to represent systems and their interactions such as inputs processes and outputs and energy and matter flows within systems. (MS-PS2-1),(MS-PS2-4)
- Explanations of stability and change in natural or designed systems can be constructed by examining the changes over time and forces at different scales. (MS-PS2-2)

Science and Engineering Practices:

- Construct and present oral and written arguments supported by empirical evidence and scientific reasoning to support or refute an explanation or a model for a phenomenon or a solution to a problem. (MS-PS2-4)
- Science knowledge is based upon logical and conceptual connections between evidence and explanations. (MS-PS2-2),(MS-PS2-4)

Iowa Core:

Science:

- S.6–8.PS.3: Essential Concept and/or Skill: *Understand and apply knowledge of motions and forces.* The motion of an object can be described by its position, direction of motion, and speed. That motion can be measured and represented on a graph.

Comprehension and Collaboration:

- SL.8.1: Engage effectively in a range of collaborative discussions (one-on-one, in groups, and teacher-led) with diverse partners on *grade 8 topics, texts, and issues*, building on others' ideas and expressing their own clearly.

- SL.8.2: Analyze the purpose of information presented in diverse media and formats (e.g., visually, quantitatively, orally) and evaluate the motives (e.g., social, commercial, political) behind its presentation.
- SL.8.3: Delineate a speaker’s argument and specific claims, evaluating the soundness of the reasoning and relevance and sufficiency of the evidence and identifying when irrelevant evidence is introduced.

Presentation of Knowledge and Ideas:

- SL.8.4: Present claims and findings, emphasizing salient points in a focused, coherent manner with relevant evidence, sound valid reasoning, and well–chosen details; use appropriate eye contact, adequate volume, and clear pronunciation.

Learning Goals:

- Students will have an understanding of motion in how it relates to friction and mass.
- Students will engage in discussion using their newfound understandings of motion and friction expanding and challenging those ideas when prompted.

Learning Performances:

- Students will be given a quiz, discussion prompts, and journaling prompts to show their understanding of the material.

Materials:

- Finalizing Friction Quiz
- Discussion prompts (Main Lesson)
- Journaling prompts (Main Lesson)

Students’ Ideas:

By engaging in the Friction and Simulation lessons students have a more complete understanding of how friction and mass affect the motions, and ultimately stopping distance, of a vehicle. Students use what they know about friction and apply it to other real world examples. There may be some misconceptions of what friction is because it can be more abstract than tires on pavement. The purpose of this lesson is to draw out what misconceptions may be lingering and to correct them.

Critical Thinking Questions:

- What could you do next time to improve your results?
- How has your understanding of friction changed after the simulation?
- What are some other real world examples that apply the ideas of friction and motion?

Main Lesson:

1. The quiz can be given at the beginning or the end of the lesson, be sure to allow a minimum of 10 minutes for the students to finish the quiz. The quiz is provided with this document.
2. The journaling portion of this lesson is optional, but encouraged. There should be at least three distinct prompts written on the board for the students to choose from. Encourage them to write as much as possible about one before writing about another. The students

should be given 15 minutes to write. If they do not have a separate journal for the entire class this could be turned in for a completion grade, or used just as a prompt for the discussion. Here are some suggested journal prompts, but feel free to come up with unique ones to suit the classroom.

- a. Journal Prompts:
 1. What would the world be like if there was no friction?
 2. What are some reasons people try to increase (or decrease) friction as much as possible?
 3. What are some unique ways that car makers could make stopping distance even shorter?
 4. How would you teach a class about friction?
3. There are two ways to do the discussion portion of this lesson, teacher led or student led. It is encouraged to have this discussion at the end so any extra time from the other activities can be utilized here.
 - a. Discussion Prompts/Suggestions
 1. The teacher led discussion has the teacher asking specific question and asking students to engage with their own unique experiences or insight. The overall goal is to get the students to challenge their understanding of friction and motion. They realize that even though it is the end of the lesson that these concepts are much larger than they think. This hopefully sparks intrigue into the subject matter and promotes further independent learning. Here are some suggested discussion prompts.
 - a. If there is any disagreement over the quiz questions now is a good time to go over any of those.
 - b. The journal prompts can serve as good discussion topics since the students have already formed thoughts about those topics.
 - c. Ask for any comments or opinions about the unit.
 - d. Find a short video that uses friction in interesting or counterintuitive ways. Then have the students talk out what they think is happening.
 2. The student led discussion is only encouraged for classrooms that are very task oriented and maybe towards the higher end of the suggested age range. The goal of this discussion method for the teacher is to create civil disagreement among the students. In this debate style atmosphere students are forced to refine and articulate their beliefs to their peers. Many times this leads to realizations about the topic and further help solidify their understanding of the topic. Here are some ideas that will help to promote this type of discussion, remember to allow the last 5 minutes to clear up any misconceptions that presented during the discussion.
 - a. If there are any major disagreements over the quiz questions a good way to start off is to have the students take a side and discuss/defend their way of thinking.
 - b. Other more thought provoking questions can also be instituted here. Such as, "Is a magnet holding a piece of paper on a refrigerator utilizing friction?" The best way to go about this method of discussion is to prompt the class, see where there is any

disagreement, and then let the two sides discuss. Playing the devil's advocate may be necessary for this.

Differentiation:

Special Needs Students:

- Students may need extended time for the quiz or take the quiz orally with the teacher or an aid. If they are uncomfortable speaking in a group setting, they could extend the journaling or have a more private discussion session.

ELS Students:

- English language learners could benefit from a word bank or more illustrations to help them understand the tasks. If there is another student in the class that is fluent in both languages, have them work together.

Advanced Learners:

- Advanced learners could benefit from incorporating more calculations (options will be provided on the quiz) or more advanced concepts, such as energy conservation. The student led discussion is also a good option for more advanced students to engage and challenge one another.

Assessment:

This entire day will serve as an assessment for the previous lessons. The quiz will provide quantitative assessment while the journaling and discussion will help to show comprehensive understand of friction and motion concepts.