



Module: Forces and Motion **Lessons: 9, 10, 11, 12 & 14**
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Date(s): January 2007 **Final Challenge Activites (Extension Lesson)**

<p>Content Vocabulary:</p> <p>Force Motion Friction Acceleration Slope Variable(dependent/independent) Mass</p>	<p>Concepts/Skills/Core Content:</p> <p>What should a student know/be able to do as a result of this lesson? The students should be able to design, test and modify vehicles to meet the design requirements. They should be able to exhibit an understanding of the cause and effect relationship between force and motion. The students should be able to utilize the data collected in their challenge to support their conclusion.</p> <p>Which core content bullet(s) is addressed in this lesson? 2.1 SC-04-1.2.1 SC-04-1.2.2</p>
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Materials:
What materials are needed for this lesson?

***See each challenge card for specific material list.(appended and ready for laminating)

Materials not included in the module are chart paper(for the groups to present their challenge),markers, tape, ramps(4), small fan, carpet pieces/towels, wax paper

What materials preparation is necessary for this lesson?

Most materials are provided in the Force and Motion Modules. A few items will need to be gathered by the teacher. How the materials are organized is left up to the individual teacher. Materials may be organized in one central location for the students to choose what is needed for their challenge or each individual challenge may be prepared for each group.

Classroom/Materials Management:
How will students be grouped?

6/7 Small groups of 3-4 students in each groups..

How will materials be distributed/returned?

Handling of materials should be left up to the individual teacher.
Suggestions: Use of one central location for the students to choose materials needed
Have each individual group's materials prepared in tubs

Student Notes/Notebooks:

Where and how will students record important classroom information? How will students know what to record?

Each member of the group will record the set-up, procedure and conclusion for their challenge in their notebook. The individual challenge card explains what is needed to be recorded. Each student will also complete a self assessment in their notebook. The questions are provided on the challenge card. The groups should also prepare a presentation on chart paper to show and explain to their classmates.

How will the students organize their notes/notebooks?

The students will follow the organization that is stated on the challenge card.

How will you provide feedback to your students about their notes/notebooks and their organization?

Each student's notebook should be reviewed to check that each component of the challenge is included. Feedback should be written in the notebooks, making comments or asking questions. Comments and questions should focus on the accuracy of the information recorded in the notebook.

Literacy Connections:

No literature is utilized in this lesson

Thinking Through the Lesson:

Introduction-How will you introduce the lesson and connect it to prior student learning?

There should be a brief review/discussion of the module lessons that have been covered thus far. Each challenge card specifically states the background knowledge that should assist the students in completing the task. Expectations for the notebook entries and group presentations should be explained to the students.

Facilitation-How will you facilitate learning and move all students to higher order thinking?

As the students work through the challenge cards, the teacher needs to make observations of each group, give guidance when needed and ask questions of the students to check for understanding.

Closure-How will you know what each student has learned/is able to do?

Assessing the group presentation-

Look for:

- all students are involved in the presentation
- the goal of the challenge was achieved
- the data or results are presented for others to view
- the group is able to explain their procedure and results
- the group is able to use the data to support their conclusion

Assessing notebooks-

Look for:

- the information recorded is organized
- the set-up, procedure and conclusion is explained in details
- check for the accuracy of the investigation and results
- does the student's data/results support the student's conclusion
- the self assessment is complete and detailed

Homework:

After all groups have presented, each student could be asked to develop his/her own challenge for homework. The challenge should include title, goal, materials and background.

Groups could also develop questions about the content of their presentation for their classmates to answer.

Challenge Card 1

Title: Moving the Load Around

Goal: Develop and perform an experiment to test how varying the position of the load on the vehicle affects the motion of the vehicle.

Materials: Vehicle, Blocks, Stopwatch, Tape Measure, String, Paper Clips, Washers, Ramp, Roll Paper, Stickers

Background: We have learned that increasing the load (mass) of the vehicle decreased the change in motion of the vehicle when pulled with the same amount of force. Now you will investigate how varying the position of a constant load (mass) affects the motion of your vehicle.

Setup:

- List the materials you will use.
- Identify the (independent) variable (what you change)
- What will you measure (dependent variable)?
- What did you keep the same (constants)?
- Write your Experimental Question
- Write your if-then hypothesis

Procedure: Decide how you will record your data. Set up a chart, graph, or observation table- whatever works for your experiment.

- Conduct your experiment and record your results. Remember how to conduct a fair experiment; run several trials, keep everything but your variable the same.

Write a Conclusion: Answer your experimental question, and **support** your answer with your data. Was your hypothesis correct? Why do you think you got the results you did?

Wrap-Up and Report: Prepare a group presentation about your experiment and results. It should include a Title, your Experimental Question, a brief description and demonstration of your experiment, your Results (on chart paper), and your Conclusion.

Self Assessment

- How do you think your group did?
- How would your group members evaluate your participation?
- What parts did you struggle with?
- What ideas did you use from previous investigations?
- Did you use your notebooks or other Resources?
- Did you have fun?

Challenge Card 2

Title: Pizza Delivery

Goal: Design a pizza delivery car. The vehicle must travel at least 2 feet from the store, drop off the pizza, and return backwards to the store, stopping within 6 inches of the store (starting line).

Materials: Vehicle, Large Wheel (pizza), Tape Measure, Ramp, Blocks, Rubber Bands, Extra Parts Bucket (Connectors, Rods), Table of Trials and Results (provided)

Background: You have learned how to use rubber band energy to drive the vehicle forwards or backwards. Design your vehicle to travel with the pizza, stop and deliver the pizza, then travel backwards to the starting line. Once the vehicle starts, you cannot touch it!.

Setup and Procedure:

- List the materials you will use.
- Draw up a plan, and test it.
- Record your results in your data table (given). Record what tasks were completed (What Worked) and which ones were not completed (What Didn't Work).
- Continue until your vehicle is complete

Write a Conclusion: Describe how you achieved your challenge. What forces moved the vehicle forwards? What forces moved it backwards? How did it deliver the pizza?

Wrap-Up and Report: Prepare a group presentation about your challenge and results. It should include a Title, your Challenge, a brief description and demonstration of your design, the Results of your different trials, and your Conclusion.

Self Assessment

- How do you think your group did?
- How would your group members evaluate your participation?
- What parts did you struggle with?
- What ideas did you use from previous investigations?
- Did you use your notebooks or other Resources?
- Did you have fun?

Trial Number	What We Did/ What We Changed	What Worked	What Didn't Work

Challenge Card 3

Title: Mountain Climber

Goal: Design a vehicle that will climb up a ramp and stop at the top. The ramp must be at least 8 inches tall and the vehicle should stop within 4 inches of the top.

Materials: Vehicle, Blocks, Tape Measure, String, Paper Clips, Washers, Ramp, Rubber Bands, Extra Parts Bucket

Background: We have learned many ways to apply a force to get a vehicle to move. We have also learned about forces that stop motion, or cause motion in the other direction. Think about all the forces involved here that might cause motion up or down the ramp.

Setup:

- List the materials you will use.
- Decide how you will get your vehicle to move up the ramp
- Identify the (independent) variable (what you change)
- What will you measure (dependent variable)?
- What did you keep the same (constants)?

Procedure: Decide how you will record your data. Set up a chart, graph, or observation table- whatever works for your challenge.

- Conduct your trials and record your results. Remember how to conduct a fair experiment; run several trials, keep everything but your variable the same.

Write a Conclusion: Describe how you achieved your challenge. How did you get your vehicle to move up the ramp? How did you get it to stop? What forces were involved?

Wrap-Up and Report: Prepare a group presentation about your challenge and results. It should include a Title, your Challenge, a brief description and demonstration of your design, the Results of your trials, and your Conclusion.

Self Assessment

- How do you think your group did?
- How would your group members evaluate your participation?
- What parts did you struggle with?
- What ideas did you use from previous investigations?
- Did you use your notebooks or other Resources?
- Did you have fun?

Challenge Card 4

Title: A Flying Car?

Goal: Design a propeller-driven vehicle. A sample design is included, but feel free to design your own! Then Develop and perform an experiment to test how the number of turns of the propeller affects the motion of the vehicle.

Materials: Vehicle, Tape Measure, Rubber Bands (#64), Extra Parts Bucket, Pre-assembled Propeller, Roll Paper, Stickers, Safety Glasses

Background: We have learned how the stored energy in a stretched rubber band can be used to drive a vehicle. Now that energy will be used to move a propeller that will move the vehicle.

Setup:

- List the materials you will use.
- Design and Build your vehicle.
- Identify the (independent) variable (what you change)
- What will you measure (dependent variable)?
- What did you keep the same (constants)?
- Write your Experimental Question
- Write an if-then hypothesis

Procedure: Decide how you will record your data. Set up a chart, graph, or observation table- whatever works for your experiment.

-Conduct your trials and record your results. Remember how to conduct a fair experiment; run several trials, keep everything but your variable the same.

Write a Conclusion: Answer your experimental question, and **support** your answer with your data. Was your hypothesis correct? Why do you think you got the results you did? How are the forces different with the propeller compared to just the rubber band?

Wrap-Up and Report: Prepare a group presentation about your design, experiment and results. It should include a Title, your Challenge, a brief description and demonstration of your design, your Experimental Question, the Results of your trials, and your Conclusion.

Self Assessment

- How do you think your group did?
- How would your group members evaluate your participation?
- What parts did you struggle with?
- What ideas did you use from previous investigations?
- Did you use your notebooks or other Resources?
- Did you have fun?

Challenge Card 5

Title: Sail Away

Goal: Design a sail-driven vehicle. Your Sail-car should be able to travel at least 6 feet.

Materials: Vehicle, Tape Measure, Extra Parts Bucket, Paper for sail, Tape, Fan

Background: We have learned several ways that force can be applied to change the motion of a vehicle. Think about where the force will come from in your design.

Setup:

- List the materials you will use.
- Design and Build your vehicle.

Procedure: Once your Sail-car is built, experiment with the design to see how far it will travel. Make a table to record your changes and results (What We Changed, What Happened).

Write a Conclusion: Look at your vehicle. Explain how your vehicle moves. What forces moved the vehicle, and what forces slowed the vehicle.

Wrap-Up and Report: Prepare a group presentation about your design and results. It should include a Title, your Challenge, a brief description and demonstration of your design, the Results of your trials, and your Conclusion.

Self Assessment

- How do you think your group did?
- How would your group members evaluate your participation?
- What parts did you struggle with?
- What ideas did you use from previous investigations?
- Did you use your notebooks or other Resources?
- Did you have fun?

Challenge Card 6

Title: Steady As She Goes!

Goal: Design a vehicle that will travel slowly down a ramp. The vehicle must take at least 7 seconds to reach the end of the ramp.

Materials: Vehicle, Stopwatch, Ramp, Blocks, Rubber Bands, Extra Parts Bucket (Connectors, Rods), String, Washers, Towel, Paper Clips, Paper, Tape

Background: You have learned how forces can increase or decrease the motion of a vehicle. Think about finding the right balance of forces to complete your task.

Setup and Procedure:

- List the materials you will use.
- Draw up a plan, and test it.
- Record your results in a data table. The table should include Your Design or What You Changed, and the time you measured.
- Continue until your challenge is complete

Write a Conclusion: Describe how you achieved your challenge. What forces caused the vehicle to move down the ramp? What forces slowed the vehicle down?

Wrap-Up and Report: Prepare a group presentation about your challenge and results. It should include a Title, your Challenge, a brief description and demonstration of your design, the Results of your different trials, and your Conclusion.

Self Assessment

- How do you think your group did?
- How would your group members evaluate your participation?
- What parts did you struggle with?
- What ideas did you use from previous investigations?
- Did you use your notebooks or other Resources?
- Did you have fun?

Challenge Card 7

Title: Rising to the Surface

Goal: Develop and perform an experiment to test how varying the surface that a vehicle travels on affects the motion of the vehicle.

Materials: Vehicle, Blocks, Stopwatch, Tape Measure, String, Paper Clips, Washers, Ramp, Roll Paper, Stickers, Towel, Table, Tile Floor, Carpet Floor, Roll of Wax Paper

Background: Friction, when two surfaces rub together, slows down a vehicle. Investigate how the motion of the vehicle changes when it travels on different surfaces.

Setup:

- List the materials you will use.
- Identify the (independent) variable (what you change)
- What will you measure (dependent variable)?
- What did you keep the same (constants)?
- Write your Experimental Question
- Write your if-then hypothesis

Procedure: Decide how you will record your data. Set up a chart, graph, or observation table- whatever works for your experiment.

- Conduct your experiment and record your results. Remember how to conduct a fair experiment; run several trials, keep everything but your variable the same.

Write a Conclusion: Answer your experimental question and **support** your answer with your data. Was your hypothesis correct? Why do you think you got the results you did? Which surfaces seemed to increase the frictional force?

Wrap-Up and Report: Prepare a group presentation about your experiment and results. It should include a Title, your Experimental Question, a brief description and demonstration of your experiment, your Results (on chart paper), and your Conclusion.

Self Assessment

- How do you think your group did?
- How would your group members evaluate your participation?
- What parts did you struggle with?
- What ideas did you use from previous investigations?
- Did you use your notebooks or other Resources?
- Did you have fun?