

From Here to There

Background: Ancient civilizations used many forms of structures to transport people and goods.

Design Challenge: Design and build a vehicle that carries weight as it rolls down a ramp. Test your vehicle and record its performance in a data table.

Criteria:

Your vehicle must

- roll by itself down a test ramp five times
- carry a load of at least 100 grams
- have a base with an area between 120 and 150 square centimeters
- carry the load inside as it rolls down the test ramp.

You must keep a record of your vehicle’s performance in a data table. Your data table must

- include how far the vehicle rolled at least five trials
- include a title
- be clearly labeled as to each trial and its outcome.



Materials: Select from the list below.		Tools: Select from the list below.	
<ul style="list-style-type: none"> • centimeter graph paper • flattened cardboard • glue • paper lollipop sticks • pipe cleaners • recycled plastic tops 	<ul style="list-style-type: none"> • spools • straws • tag board • tape (limit 12 inches) • wooden dowels 	<ul style="list-style-type: none"> • hole punch • pencil • pushpin paper drill • ruler • scale • scissors • tape measure 	<ul style="list-style-type: none"> • test ramp (provided by teacher) • weights or large paperclips (use for weights) • safety glasses • junior hack saw (optional) – ONLY under adult supervision

Targeted Standards of Learning: Mathematics 3.9, 3.10
 Supporting SOL: English 3.1, 3.2; Mathematics 3.17; Science 3.1;
 History and Social Science 3.4

Targeted Standard for Technological Literacy: 11, 18
 Supporting STL: 8, 9, 10

Tips for Teachers

Targeted Standards of Learning:

Mathematics 3.9 The student will estimate and use U.S. Customary and metric units to measure

- a) length to the nearest 1/2-inch, inch, foot, yard, centimeter, and meter;
- b) liquid volume in cups, pints, quarts, gallons, and liters;
- c) weight/mass in ounces, pounds, grams, and kilograms; and
- d) area and perimeter.

Mathematics 3.10 The student will

- a) measure the distance around a polygon in order to determine perimeter; and
- b) count the number of square units needed to cover a given surface in order to determine area.

Supporting SOL: English 3.1, 3.2; Mathematics 3.17; Science 3.1; History 3.4

Targeted Standards for Technological Literacy:

11 Students will develop the abilities to apply the design process.

18 Students will develop an understanding of and be able to select and use transportation technologies.

Supporting STL: 8, 9, 10

Tips for Teachers, continued

Prior Knowledge & Skill	Materials & Preparation	Safety Issues	Class Management	Materials Provided	Design Process
<ul style="list-style-type: none"> • Exposure to concepts and vocabulary related to measurement, including area, distance, and weight • Experience using measurement tools • Exposure to collection of data and creation of graphs • Exposure to simple machines (e.g., wheel and axle) 	<ul style="list-style-type: none"> • Check Design Brief for recommended materials. Teacher may substitute materials. • Set up ramp, using a thick, long piece of cardboard or a long piece of plywood. • Require students to research the weight of paper clips before they use them as measuring tools. • Consider using the Design Brief as a reading-comprehension lesson. 	<ul style="list-style-type: none"> • Discuss proper use of tools. • Junior hack saw (optional) should be used ONLY under adult supervision. • ALWAYS wear safety glasses when using a saw. • Use only clean, recycled tops. • Be aware of food allergies when using recycled containers. 	<ul style="list-style-type: none"> • Groups of three or four • Cooperative learning is recommended. 	<ul style="list-style-type: none"> • Design Brief • Guided Portfolio (adapt as appropriate/optional) • Rubric Assessments 	<p>Follow the Design Process:</p> <ul style="list-style-type: none"> • Restate the problem. • Brainstorm solutions. • Create the best solution. • Test the solution. • Evaluate the solution.

Guided Portfolio, p2

Name _____

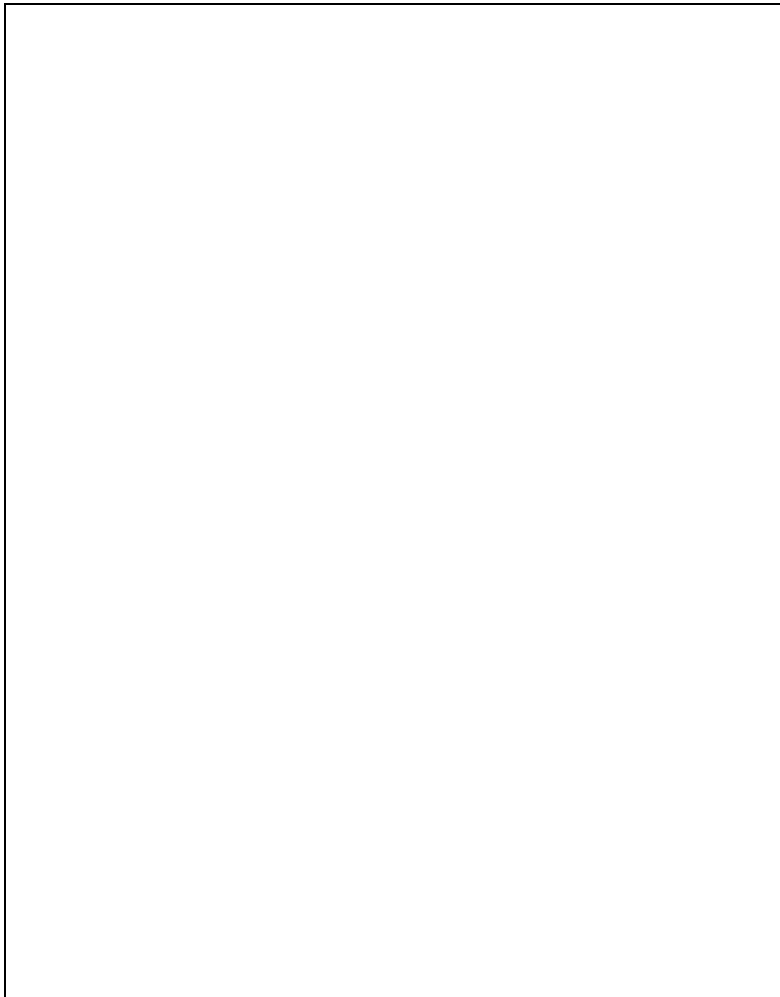


2. Brainstorm solutions. Sketch and/or describe some possible solutions.

Name _____

3. Create the solution you think is best.

Keep notes about your problems and how you solve them. Make sketches if they help.



Name _____

4. Test your solution.

Does your vehicle roll downhill by itself during each of the five tests? YES NO

- Did your vehicle stay on the ramp for each test? YES NO

Did your vehicle hold a load of at least 100 grams? YES NO

- Did the load stay inside your vehicle during each test? YES NO
- What was the heaviest load you tested in your vehicle? _____

Was the base of your vehicle between 120 and 150 square centimeters? YES NO

- What is the area of your vehicle's base? _____ square centimeters

Use your data table to answer the following questions.

- What was the farthest distance your loaded vehicle rolled? _____
- What was the shortest distance your loaded vehicle rolled? _____
- Explain the conclusions you made based on your data table. _____

Guided Portfolio, p5

Name _____

5. Evaluate your solution.

Was it the best solution? Why or why not?

Look back at your brainstorming page. Would one of your other ideas have worked better? Why, or why not?

What did you learn by designing, building, and testing a vehicle that carries weight?

Rubric for From Here to There

Name _____ Date _____

0—no evidence; 1—limited understanding; 2—some understanding with room for improvement; 3—good understanding with room for improvement; 4—substantial understanding

Design Brief Rubric	0	1	2	3	4
The student restated the problem in his/her own words.					
The student brainstormed more than one idea.					
The student shared problems that occurred and their solutions through written notes or oral communication per teacher's instructions.					
The student tested the vehicle to make sure during each of five tests					
<ul style="list-style-type: none"> • it rolled by itself 					
<ul style="list-style-type: none"> • it stayed on the ramp 					
<ul style="list-style-type: none"> • it held at least 100 grams as it rolled down the ramp 					
<ul style="list-style-type: none"> • the weights stayed inside the vehicle as it rolled down the ramp 					
<ul style="list-style-type: none"> • the base of the vehicle measures between 120 and 150 square centimeters. 					
The student recorded the results of the tests in a data table.					
The student evaluated how he/she could make it better next time.					

Rubric for From Here to There

Name _____ Date _____

0—no evidence; 1—limited understanding; 2—some understanding with room for improvement; 3—good understanding with room for improvement; 4—substantial understanding

Oral Communication Rubric	0	1	2	3	4
3.1 The student will use effective communication skills in group activities. <ul style="list-style-type: none"> a) Listen attentively by making eye contact, facing the speaker, asking questions, and summarizing what is said. b) Ask and respond to questions from teachers and other group members. c) Explain what has been learned. d) Use language appropriate for context. e) Increase listening and speaking vocabularies. 					
3.2 The student will present brief oral reports using visual media. <ul style="list-style-type: none"> a) Speak clearly. b) Use appropriate volume and pitch. c) Speak at an understandable rate. d) Organize ideas sequentially or around major points of information. e) Use contextually appropriate language and specific vocabulary to communicate ideas. 					

Standards of Learning

English (2010)

Oral Language

- 3.1 The student will use effective communication skills in group activities.
- Listen attentively by making eye contact, facing the speaker, asking questions, and summarizing what is said.
 - Ask and respond to questions from teachers and other group members.
 - Explain what has been learned.
 - Use language appropriate for context.
 - Increase listening and speaking vocabularies.
- 3.2 The student will present brief oral reports using visual media.
- Speak clearly.
 - Use appropriate volume and pitch.
 - Speak at an understandable rate.
 - Organize ideas sequentially or around major points of information.
 - Use contextually appropriate language and specific vocabulary to communicate ideas.

History and Social Science (2008)

Geography

- 3.4 The student will develop map skills by
- locating Greece, Rome, and West Africa;
 - describing the physical and human characteristics of Greece, Rome, and West Africa;
 - explaining how the people of Greece, Rome, and West Africa adapted to and/or changed their environment to meet their needs.

Mathematics (2009)

Measurement

- 3.9 The student will estimate and use U.S. Customary and metric units to measure
- length to the nearest 1/2-inch, inch, foot, yard, centimeter, and meter;
 - liquid volume in cups, pints, quarts, gallons, and liters;
 - weight/mass in ounces, pounds, grams, and kilograms; and
 - area and perimeter.

- 3.10 The student will
- a) measure the distance around a polygon in order to determine perimeter; and
 - b) count the number of square units needed to cover a given surface in order to determine area.

Probability and Statistics

- 3.17 The student will
- a) collect and organize data, using observations, measurements, surveys, or experiments;
 - b) construct a line plot, a picture graph, or a bar graph to represent the data; and
 - c) read and interpret the data represented in line plots, bar graphs, and picture graphs and write a sentence analyzing the data.

Science (2010)

Scientific Investigation, Reasoning, and Logic

- 3.1 The student will demonstrate an understanding of scientific reasoning, logic, and the nature of science by planning and conducting investigations in which
- a) observations are made and are repeated to ensure accuracy;
 - b) predictions are formulated using a variety of sources of information;
 - c) objects with similar characteristics or properties are classified into at least two sets and two subsets;
 - d) natural events are sequenced chronologically;
 - e) length, volume, mass, and temperature are estimated and measured in metric and standard English units, using proper tools and techniques;
 - f) time is measured to the nearest minute using proper tools and techniques;
 - g) questions are developed to formulate hypotheses;
 - h) data are gathered, charted, graphed, and analyzed;
 - i) unexpected or unusual quantitative data are recognized;
 - j) inferences are made and conclusions are drawn;
 - k) data are communicated;
 - l) models are designed and built; and
 - m) current applications are used to reinforce science concepts.

Standards for Technological Literacy

Standard 8: Students will develop an understanding of the attributes of design.

Standard 9: Students will develop an understanding of engineering design.

Standard 10: Students will develop an understanding of the role of troubleshooting, research and development, invention and innovation, and experimentation in problem solving.

Standard 11: Students will develop the abilities to apply the design process.

Standard 18: Students will develop an understanding of and be able to select and use transportation technologies.