

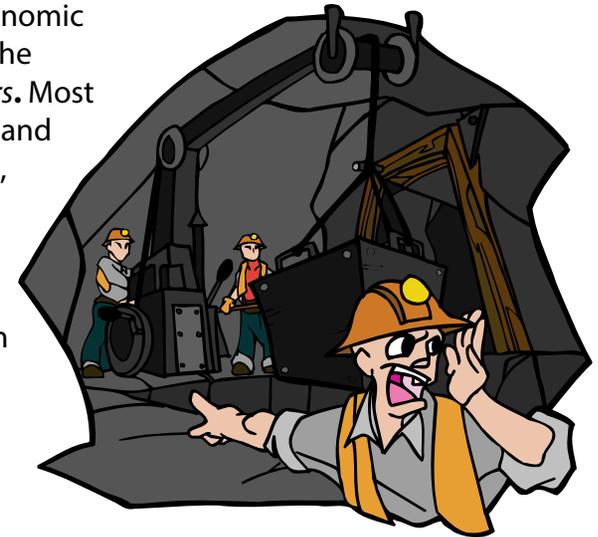
Coal Train

Background: We have learned that increased transportation of goods played a big part in the economic development of Virginia after the Civil War. We have also learned that the Appalachian Plateau is the Virginia region where coal is mined. Coal is transported from a *coal mine* in train cars called *hoppers*. Most coal hoppers are open on the top and have slanted sides, both of which make them easier to load and unload. Several kinds of open coal hoppers have been used over the years, including gondola cars, ore jennies, and rotary car dumpers. The hoppers carry the coal to a *coal pier*, where it is taken to many parts of the world by ship. Virginia's biggest coal piers are some of the biggest in the world and are located in Hampton Roads.

Design Challenge: Design and create coal hoppers that can carry a load of 43 grams, and show on a map how they travel from a mine in the Appalachian Plateau to a coal pier in Hampton Roads.

Criteria:

- Each member of your group must create a coal hopper labeled with your group's company name in large letters.
- Each coal hopper must be built on a wooden frame, and the wheels must fit between rails separated by three inches on an imaginary or modeled track.
- Your group's coal hoppers must couple and uncouple.
- Your group presentation must include
 - a speaking part for each member
 - a demonstration of how the coal is loaded and unloaded into and out of each hopper
 - a demonstration of the coupling and uncoupling of the hoppers
 - a demonstration of the fact that the baggie contains exactly 43 grams of "coal" (raisins)
 - the train's path through the regions of Virginia and at least three cities, using the map
 - pictures of a coal mine and a coal pier placed on the map of Virginia in appropriate locations.



Materials: Select from the list below.	Tools: Select from the list below.
<ul style="list-style-type: none"> • balsa sticks (1 cm x 1 cm x any length) • bottle caps or small circles cut from cardboard or wood • card stock • construction paper • dowel rods • glue • map of Virginia with regions marked • paper clips and small clamps • raisins in a baggie • straws • string or yarn 	<ul style="list-style-type: none"> • balance • computer (for access to Internet) • hole punch • markers or colored pencils • ruler in metric or U.S. Customary Units • printer • scissors <p>The following should be used only under adult supervision:</p> <ul style="list-style-type: none"> • safety glasses • corner jig • drill • saw

Targeted Standard of Learning: History and Social Science VS.10c
 Supporting SOL: History and Social Science VS.1i, VS.8c
 English 4.1, 4.2, 4.4, 4.6, 4.9; Science 4.1, 4.2, 4.9

Targeted Standard for Technological Literacy: 18
 Supporting STL: 9, 10, 11, 12, 16

Recommended Web sites for research components:

- <http://www.sdrm.org/roster/freight/hopp7801/index.html>
- http://www.coalwoodwestvirginia.com/coal_mining.htm
- http://www.jaha.org/edu/discovery_center/work/img/mining/
- <http://www.coal-miners-in-kentucky.com/>
- <http://www.nscorp.com/nscportal/nscorp/Customers/Coal/>
- <http://www.flickr.com/photos/norfolksouthern/4293372400/>
- http://imagebase.lib.vt.edu/browse.php?folio_ID=/trans/nss/bus/ship

Tips for Teachers

Targeted Standards of Learning:

History and Social Science VS.10 The student will demonstrate knowledge of government, geography, and economics by
 c) explaining how advances in transportation, communications, and technology have contributed to Virginia’s prosperity and role in the global economy.

Supporting SOL: History and Social Science VS.10b, VS.8c English 4.1, 4.2, 4.4, 4.6, 4.9; Science 4.1, 4.2, 4.9

Targeted Standards for Technological Literacy:

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

Supporting STL: 9, 10, 11, 12, 16

Prior Knowledge & Skill	Materials & Preparation	Safety Issues	Class Management	Materials Provided	Design Process
<ul style="list-style-type: none"> Geographic regions of Virginia Locating Web sites by URL Printing a picture from a Web site Using saws and balances Elements of an effective presentation 	<ul style="list-style-type: none"> Create centers for research, sawing, and weighing. Prepare a baggie of raisins for each group. The baggie should weigh more or less than 43g so that students must adjust the weight at the weighing center. 	<ul style="list-style-type: none"> Use of saw and/or drill (optional) requires the wearing of safety glasses and should be closely supervised. 	<ul style="list-style-type: none"> Groups of three or four Allow students early access to the rubric so that groups may plan accordingly for their presentation. Recycled materials can be substituted for wooden frame. For those groups who finish early, assign extensions. 	<ul style="list-style-type: none"> Virginia map with regions delineated but not labeled Design Brief Guided Portfolio (adapt as appropriate/ optional) Rubric Assessments 	<ul style="list-style-type: none"> Follow the Design Process: Restate the problem. Brainstorm solutions. Create the best solution. Test the solution. Evaluate the solution.

Tips for Teachers, continued

Extension Ideas:

- Have students design and create a working method for unloading raisins from the hoppers.
- Have students write a paragraph about or draw pictures of hopper design, using Internet resources.
- Have students design and create a track to guide the wheels.
- Have students evaluate each region of Virginia for its potential for providing the most energy for the train and include this information in their presentation.
- Have students make a list of other Virginia resources that might be transported by train to market.
- Have students research and report on the history of train coupling.

Differentiation Option: For students with more advanced reading skills, the following page is provided as an alternative to page 1.

Coal Train

Background: We have learned that increased transportation of goods played a big part in the economic development of Virginia after the Civil War. We have also learned that the Appalachian Plateau is the Virginia region where coal is mined. Coal is transported from a *coal mine* in train cars called *hoppers*. Most coal hoppers are open on the top and have slanted sides, both of which make them easier to load and unload. Several kinds of open coal hoppers have been used over the years, including gondola cars, ore jennies, and rotary car dumpers. The hoppers carry the coal to a *coal pier*, where it is taken to many parts of the world by ship. Virginia's biggest coal piers are some of the biggest in the world and are located in Hampton Roads.

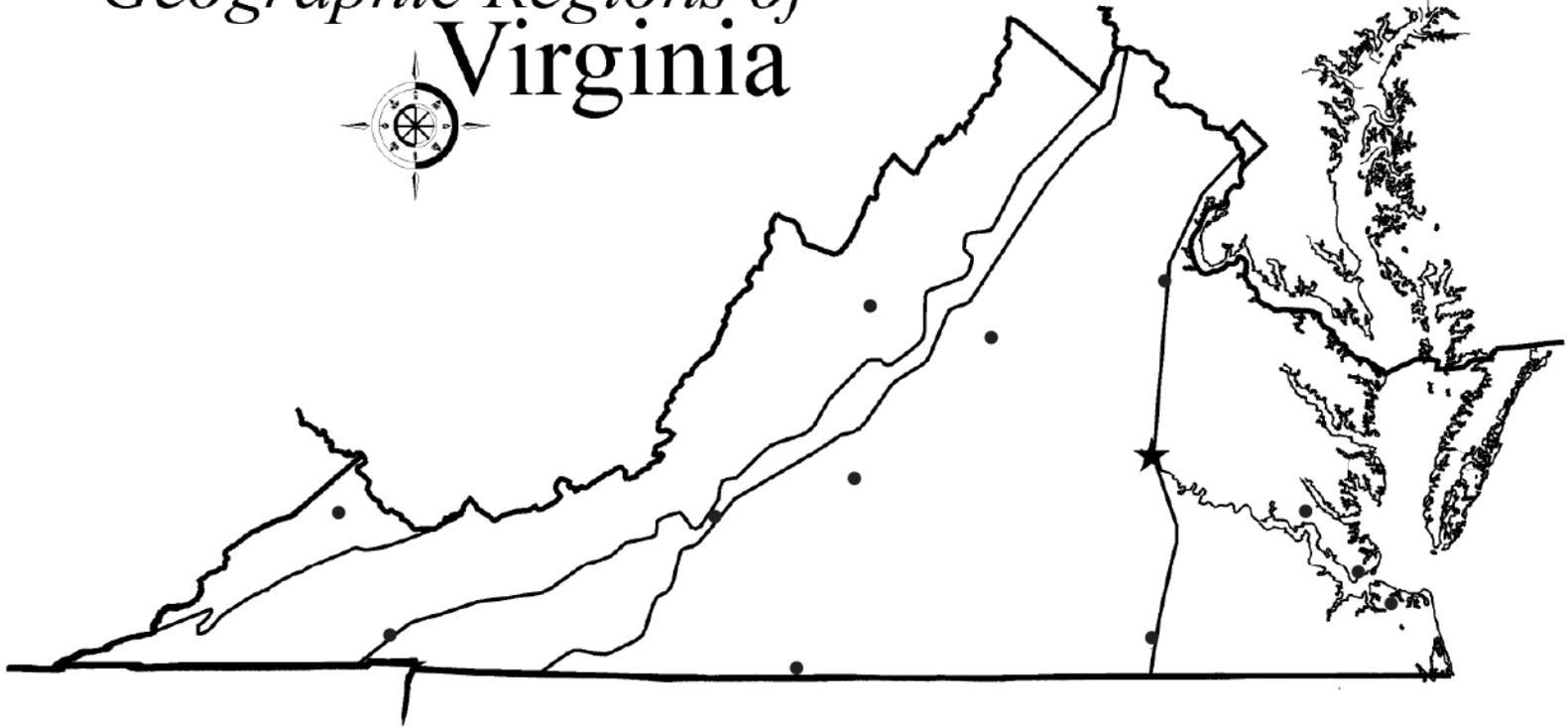
Design Challenge: Design and create coal hoppers that can carry a load of 43 grams, and show on a map how they travel from a mine in the Appalachian Plateau to a coal pier in Hampton Roads. Each member of your group must create a coal hopper labeled with your group's company name in large letters. Each coal hopper must be built on a wooden frame, and the wheels must fit between rails separated by three inches on an imaginary or modeled track. Your group's coal hoppers must couple and uncouple.

During your group presentation, each group member must have a speaking part. The presentation should include a demonstration of how the coal is loaded and unloaded into and out of each hopper. Coal is represented by the raisins, and you must demonstrate that there are exactly 43 grams of "coal" in each baggie. Your group must also demonstrate the coupling and uncoupling of the hoppers.

The presentation should include a diagram on the map handout of the coal train's path through the regions of Virginia and at least three cities, and it should be accompanied by pictures of a coal mine and a coal pier placed on the map of Virginia in appropriate locations.



Geographic Regions of **Virginia**



VIRGINIA DEPARTMENT OF EDUCATION

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 coal hopper display your group’s company name in large letters?	YES	NO
Is your coal hopper built on a wooden frame?	YES	NO
Does your coal hopper have wheels that are no more than three inches apart?	YES	NO
Does your group’s baggie hold exactly 43 grams of “coal” (raisins)?	YES	NO
Does your hopper couple and uncouple with all the other hoppers made by your group?	YES	NO
Does your presentation include		
• a speaking part for each member of your group	YES	NO
• a demonstration of how the coal is loaded and unloaded	YES	NO
• a demonstration of the coupling of the hoppers	YES	NO
• the train’s path through three cities and five regions of Virginia	YES	NO
• pictures of a coal mine and a coal pier placed on the map in the right places?	YES	NO

Guided Portfolio, p5

Name _____

5. Evaluate your solution.

Was it the best solution? Would one of your other ideas have been better? Why, or why not?

What would you have done differently?

Could you add to it to make it better? What would you add to it?

Rubric for Coal Train

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 kept notes and/or made sketches while creating a solution, to include problems and how they were solved.					
The student tested to make sure					
• the hopper displays the group’s company name					
• the hopper is built on a wooden frame					
• the hopper’s wheels fit on a three-inch track					
• the baggie holds 43 grams of “coal” (raisins)					
• the hopper couples and uncouples					
• each team member has a speaking part in the presentation					
• the loading and unloading of coal is demonstrated					
• the coal train’s path includes five Virginia regions and at least three cities					
• the path is illustrated with pictures of a coal mine and a coal pier.					
The student evaluated how he/she could make it better next time.					

Rubric for Coal Train

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

Communication: Speaking, Listening, Media Literacy Rubric	0	1	2	3	4
4.1 The student will use effective communication skills in a variety of settings. <ul style="list-style-type: none"> a) Present accurate directions to individuals and small groups. b) Contribute to group discussions across content areas. c) Seek ideas and opinions of others. d) Use evidence to support opinions. e) Use grammatically correct language and specific vocabulary to communicate ideas. f) Communicate new ideas to others. g) Demonstrate the ability to collaborate with diverse teams. h) Demonstrate the ability to work independently. 					
4.2 The student will make and listen to oral presentations and reports. <ul style="list-style-type: none"> a) Use subject-related information and vocabulary. b) Listen to and record information. c) Organize information for clarity. d) Use language and style appropriate to the audience, topic, and purpose. 					

Standards of Learning

English (2010)

Communication: Speaking, Listening, Media Literacy

- 4.1 The student will use effective oral communication skills in a variety of settings.
- a) Present accurate directions to individuals and small groups.
 - b) Contribute to group discussions across content areas.
 - c) Seek ideas and opinions of others.
 - d) Use evidence to support opinions.
 - e) Use grammatically correct language and specific vocabulary to communicate ideas.
 - f) Communicate new ideas to others.
 - g) Demonstrate the ability to collaborate with diverse teams.
 - h) Demonstrate the ability to work independently.
- 4.2 The student will make and listen to oral presentations and reports.
- a) Use subject-related information and vocabulary.
 - b) Listen to and record information.
 - c) Organize information for clarity.
 - d) Use language and style appropriate to the audience, topic, and purpose.

Reading

- 4.4 The student will expand vocabulary when reading.
- a) Use context to clarify meanings of unfamiliar words.
 - b) Use knowledge of roots, affixes, synonyms, antonyms, and homophones.
 - c) Use word-reference materials, including the glossary, dictionary, and thesaurus.
 - d) Develop vocabulary by listening to and reading a variety of texts.
 - e) Use vocabulary from other content areas.
- 4.6 The student will read and demonstrate comprehension of nonfiction texts.
- a) Use text structures, such as type, headings, and graphics, to predict and categorize information in both print and digital texts.
 - b) Formulate questions that might be answered in the selection.
 - c) Explain the author's purpose.
 - d) Identify the main idea.
 - e) Summarize supporting details.
 - f) Draw conclusions and make simple inferences using textual information as support.

- g) Distinguish between cause and effect.
- h) Distinguish between fact and opinion.
- i) Use prior knowledge and build additional background knowledge as context for new learning.
- j) Identify new information gained from reading.
- k) Use reading strategies throughout the reading process to monitor comprehension.
- l) Read with fluency and accuracy.

Research

- 4.9 The student will demonstrate comprehension of information resources to research a topic.
- a) Construct questions about a topic.
 - b) Collect information from multiple resources including online, print, and media.
 - c) Use technology as a tool to organize, evaluate, and communicate information.
 - d) Give credit to sources used in research.
 - e) Understand the difference between plagiarism and using own words.

History and Social Science (2008)

Virginia Studies

- VS.1 The student will demonstrate skills for historical and geographical analysis and responsible citizenship, including the ability to
- a) identify and interpret artifacts and primary and secondary source documents to understand events in history;
 - b) determine cause-and-effect relationships;
 - c) compare and contrast historical events;
 - d) draw conclusions and make generalizations;
 - e) make connections between past and present;
 - f) sequence events in Virginia history;
 - g) interpret ideas and events from different historical perspectives;
 - h) evaluate and discuss issues orally and in writing;
 - i) analyze and interpret maps to explain relationships among landforms, water features, climatic characteristics, and historical events.

Civil War and Postwar Eras

- VS.8 The student will demonstrate knowledge of the reconstruction of Virginia following the Civil War by
- a) identifying the effects of Reconstruction on life in Virginia;
 - b) identifying the effects of segregation and “Jim Crow” on life in Virginia for whites, African Americans, and American Indians;
 - c) describing the importance of railroads, new industries, and the growth of cities to Virginia’s economic development.

Virginia, 1900 to the Present

- VS.9 The student will demonstrate knowledge of twentieth- and twenty-first-century Virginia by
- describing the economic and social transition from a rural, agricultural society to a more urban, industrialized society, including the reasons people came to Virginia from other states and countries;
 - identifying the impact of Virginians, such as Woodrow Wilson and George C. Marshall, on international events;
 - identifying the social and political events in Virginia linked to desegregation and Massive Resistance and their relationship to national history;
 - identifying the political, social, and/or economic contributions made by Maggie L. Walker; Harry F. Byrd, Sr.; Oliver W. Hill; Arthur R. Ashe, Jr.; A. Linwood Holton, Jr.; and L. Douglas Wilder.
- VS.10 The student will demonstrate knowledge of government, geography, and economics by
- identifying the three branches of Virginia government and the function of each;
 - describing the major products and industries of Virginia's five geographic regions;
 - explaining how advances in transportation, communications, and technology have contributed to Virginia's prosperity and role in the global economy.

Science (2010)

Scientific Investigation, Reasoning, and Logic

- 4.1 The student will demonstrate an understanding of scientific reasoning, logic, and the nature of science by planning and conducting investigations in which
- distinctions are made among observations, conclusions, inferences, and predictions;
 - objects or events are classified and arranged according to characteristics or properties;
 - appropriate instruments are selected and used to measure length, mass, volume, and temperature in metric units;
 - appropriate instruments are selected and used to measure elapsed time;
 - predictions and inferences are made, and conclusions are drawn based on data from a variety of sources;
 - independent and dependent variables are identified;
 - constants in an experimental situation are identified;
 - hypotheses are developed as cause-and-effect relationships;
 - data are collected, recorded, analyzed, and displayed using bar and basic line graphs;
 - numerical data that are contradictory or unusual in experimental results are recognized;
 - data are communicated with simple graphs, pictures, written statements, and numbers;
 - models are constructed to clarify explanations, demonstrate relationships, and solve needs; and
 - current applications are used to reinforce science concepts.

Force, Motion, and Energy

- 4.2 The student will investigate and understand characteristics and interactions of moving objects. Key concepts include
- a) motion is described by an object's direction and speed;
 - b) changes in motion are related to force and mass;
 - c) friction is a force that opposes motion; and
 - d) moving objects have kinetic energy.

Earth Resources

- 4.9 The student will investigate and understand important Virginia natural resources. Key concepts include
- a) watershed and water resources;
 - b) animals and plants;
 - c) minerals, rocks, ores, and energy sources; and
 - d) forests, soil, and land.

Standards for Technological Literacy

- 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 12: Students will develop the abilities to use and maintain technological products and systems.
- Standard 16: Students will develop an understanding of and be able to select and use energy and power technologies.
- Standard 18: Students will develop an understanding of and be able to select and use transportation technologies.

Please give us some feedback.

Complete the form below to let us know how this design brief worked for you and your students. Please be specific so that we might use your suggestions to improve the activity. *You can fill this out on your computer, or you can print it, fill it out manually, and scan it.*

Teacher: _____

School: _____

School division: _____

Design brief title: _____

Background	<i>Put an X in the appropriate column:</i>	Needs to be rewritten	Needs minor adjustment	Is ready for classroom use
Does it set the context for the activity?				
Is it age-appropriate in language, length, and complexity?				
Does it reference prior learning and/or research that the students did that will facilitate designing a solution to a problem?				
Is it detailed enough that an adult will understand the purpose for the design brief?				
COMMENTS. <i>If any of the questions above are marked other than "ready for classroom use," please provide suggestions here.</i>				

Design Challenge	Needs to be rewritten	Needs minor adjustment	Is ready for classroom use
Does the challenge support your curriculum?			
Is it age-appropriate in language, length, and complexity?			
Is it detailed enough that an adult will understand the purpose for the design brief?			
COMMENTS. <i>If any of the questions above are marked other than "ready for classroom use," please provide suggestions here.</i>			

Criteria Criteria are part of the challenge. They set the limitations for the design. They are not directions.	Needs to be rewritten	Needs minor adjustment	Is ready for classroom use	N/A
Are the limitations age-appropriate?				
Do the limitations encourage critical thinking?				
Is the application of mathematic knowledge/skills integrated into the criteria? If not, should the skill area be addressed?				
Is the application of science knowledge/skills integrated into the criteria? If not, should the skill area be addressed?				
Is the application of social studies knowledge/skills integrated into the criteria? If not, should the skill area be addressed?				
Are language skills integrated into the criteria? If not, should the skill area be addressed?				
COMMENTS. <i>If any of the questions above are marked other than "ready for classroom use," please provide suggestions here.</i>				

Materials Materials help set the limitations for the design. The list should include materials that might work.	Needs to be rewritten	Needs minor adjustment	Is ready for classroom use	N/A
Does the materials list encourage a variety of design solutions?				
Does the materials list include a variety of choices for joining items?				
Does the materials list include materials that force students to make decisions?				
COMMENTS. <i>If any of the questions above are marked other than "ready for classroom use," please provide suggestions here.</i>				

Tools Tools can be used in the construction of the designed product. They are used to manipulate materials. They cannot become part of the product.	Needs to be rewritten	Needs minor adjustment	Is ready for classroom use
Are the tools listed age appropriate?			
Are all tools needed for the activity included?			
COMMENTS. <i>If any of the questions above are marked other than "ready for classroom use," please provide suggestions here.</i>			

Standards of Learning	Yes	No
Does the design brief reinforce the targeted Standard of Learning(s)?		
Are the supporting Standards of Learning appropriate?		
What Standards of Learning would you add or remove?		

Standards for Technological Literacy	Yes	No
Does the design brief reinforce the targeted Standard(s) for Technological Literacy?		
Are the supporting Standards for Technological Literacy appropriate?		
What Standards for Technological Literacy would you add or remove?		

Tips for Teachers	Yes	No
Are the tips listed in the chart helpful for a first-time teacher?		
What tips would you add?		

Guided Portfolio	Needs to be rewritten	Needs minor adjustment	Is ready for classroom use
Are the instructions and questions age appropriate and clear?			
In the "Test your solution" section, do the questions force students to thoroughly test their solutions?			
In the "Evaluate your solution" section, do the questions force students to honestly evaluate their solutions			
COMMENTS. <i>If any of the questions above are marked other than "ready for classroom use," please provide suggestions here.</i>			

<p>Additional Comments Please use this area to provide general suggestions for improving this design brief.</p>