Measure Up!

Background: We are studying about measurement and learning to measure the volume of liquids. We've practiced measuring using cups, pints, quarts, and gallons.

Design Challenge: Design and create a model that shows the relationship between gallons, quarts, pints, and cups.

Criteria: Your model must

- ☐ show how many quarts are in a gallon
- ☐ show how many pints are in a quart
- ☐ show how many cups are in a pint
- ☐ have at least one moving part.

Materials: Select from the list below.			**Tools:** Select from the list below.
• clothes pins • construction paper • craft sticks • flattened cardboard containers • glue	• hanger (limit 1) • paper plates • paper fasteners (limit 2) • plastic containers • pipe cleaners (limit 5) • scrap paper	• spools • tape (limit 12 inches) • toothpicks • yarn	• hole punch • pencil for writing • pushpin paper drill • ruler • scissors

Targeted Standard of Learning: Mathematics 2.11
Supporting SOL: English 2.1, 2.2, 2.3; Science 2.1

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

Tips for Teachers

Targeted Standard of Learning:

Mathematics 2.11 The student will estimate and measure

a) length to the nearest centimeter and inch;
b) weight/mass of objects in pounds/ounces and kilograms/grams, using a scale; and
c) liquid volume in cups, pints, quarts, gallons, and liters.

Supporting SOL: English 2.1, 2.2, 2.3; Science 2.1

Targeted Standard for Technological Literacy:

11 Students will develop abilities for a technological world and be able to apply the design process.

Supporting STL: 8, 9, 10

Prior Knowledge & Skill	Materials & Preparation	Safety Issues	Class Management	Materials Provided	Design Process
• Concepts and vocabulary for standard liquid measurement • If using for assessment, present after concepts and vocabulary has been taught.	• Check Design Brief for recommended materials. Teacher may substitute materials.	• Discuss proper use of tools. • Clean all recycled plastics. • Be aware of food allergies when using recycled containers.	• Work in small groups.	• Design Brief • Guided Portfolio (adapt as appropriate/ optional) • Rubric Assessments	Follow the Design Process: • Restate the problem. • Brainstorm solutions. • Create the best solution. • Test the solution. • Evaluate the solution.

Guided Portfolio

Name _____

Group Members_____

1. **What is the problem?** State the problem in your own words.

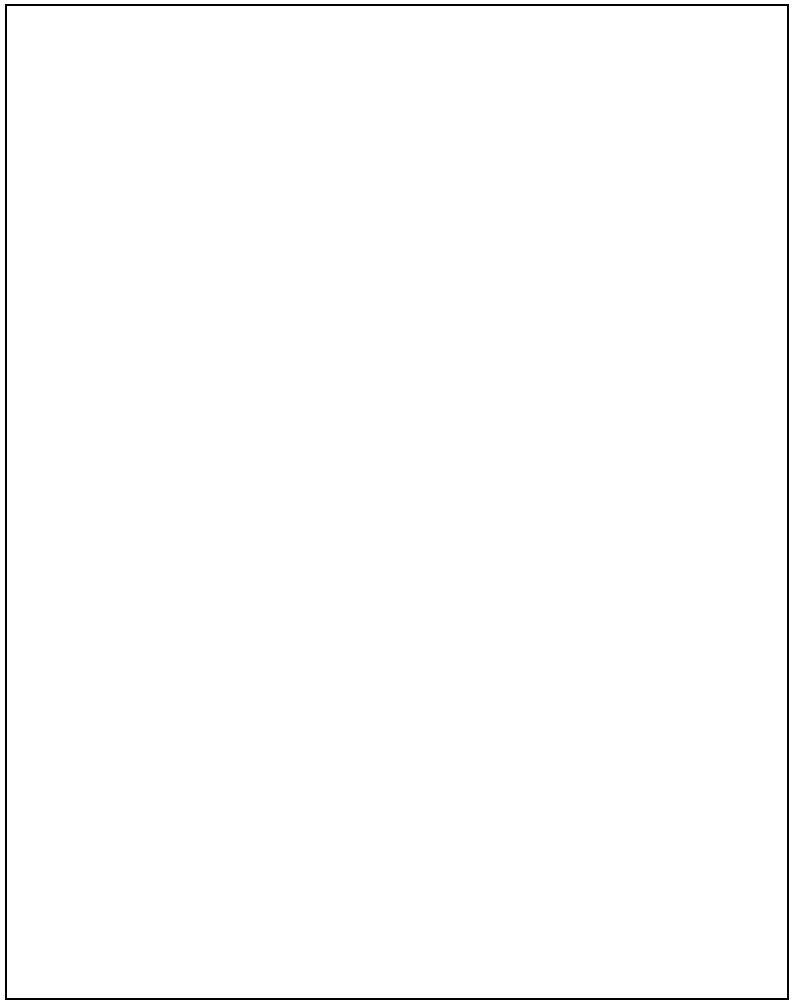
Name _____

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 model show how many quarts are in a gallon? YES NO

- Explain how your model shows how many quarts are in a gallon.
- How many quarts are in a gallon? _____

Does your model show how many pints are in a quart? YES NO

- Explain how your model shows how many pints are in a quart.
- How many pints are in a quart? _____

Does your model show how many cups are in a pint? YES NO

- Explain how your model shows how many cups are in a pint.
- How many cups are in a pint?_____

Does your model have a moving part? YES NO

- Explain how your moving part works.

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 been better? Explain your reasoning.

_____

_____

What did you learn by designing and creating this model?

_____

_____

Rubric for Measure Up!

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 model to make sure					
• it shows how many quarts are in a gallon					
• it shows how many pints are in a quart					
• it shows how many cups are in a pint					
• it has a moving part.					
The student evaluated how he/she could make it better next time.					

Rubric for Measure Up!

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
2.1 The student will demonstrate an understanding of oral language structure.					
a) Create oral stories to share with others.					
b) Create and participate in oral dramatic activities.					
c) Use correct verb tenses in oral communication.					
d) Use increasingly complex sentence structures in oral communication.					
e) Begin to self-correct errors in language use.					
2.2 The student will expand understanding and use of word meanings.					
a) Increase listening and speaking vocabularies.					
b) Use words that reflect a growing range of interests and knowledge.					
c) Clarify and explain words and ideas orally.					
d) Identify and use synonyms and antonyms.					
e) Use vocabulary from other content areas.					
2.3 The student will use oral communication skills.					
a) Use oral language for different purposes: to inform, to persuade, to entertain, to clarify, and to respond.					
b) Share stories or information orally with an audience.					
c) Retell information shared by others.					
d) Follow three- and four-step directions.					
e) Give three- and four-step directions.					

Standards of Learning

English (2010)

Oral Language

2.1 The student will demonstrate an understanding of oral language structure.
- a) Create oral stories to share with others.
- b) Create and participate in oral dramatic activities.
- c) Use correct verb tenses in oral communication.
- d) Use increasingly complex sentence structures in oral communication.
- e) Begin to self-correct errors in language use.

2.2 The student will expand understanding and use of word meanings.
- a) Increase listening and speaking vocabularies.
- b) Use words that reflect a growing range of interests and knowledge.
- c) Clarify and explain words and ideas orally.
- d) Identify and use synonyms and antonyms.
- e) Use vocabulary from other content areas.

2.3 The student will use oral communication skills.
- a) Use oral language for different purposes: to inform, to persuade, to entertain, to clarify, and to respond.
- b) Share stories or information orally with an audience.
- c) Participate as a contributor and leader in a group.
- d) Retell information shared by others.
- e) Follow three- and four-step directions.
- f) Give three- and four-step directions.

Mathematics (2009)

Focus: Money, Linear Measurement, Weight/Mass, and Volume

2.11 The student will estimate and measure
- a) length to the nearest centimeter and inch;
- b) weight/mass of objects in pounds/ounces and kilograms/grams, using a scale; and
- c) liquid volume in cups, pints, quarts, gallons, and liters.

Science (2010)

Scientific Investigation, Reasoning, and Logic

2.1 The student will demonstrate an understanding of scientific reasoning, logic, and the nature of science by planning and conducting investigations in which

a) observations and predictions are made and questions are formed;
b) observations are differentiated from personal interpretation;
c) observations are repeated to ensure accuracy;
d) two or more characteristics or properties are used to classify items;
e) length, volume, mass, and temperature are measured in metric units and standard English units using the proper tools;
f) time is measured using the proper tools;
g) conditions that influence a change are identified and inferences are made;
h) data are collected and recorded, and bar graphs are constructed using numbered axes;
i) data are analyzed, and unexpected or unusual quantitative data are recognized;
j) conclusions are drawn;
k) observations and data are communicated;
l) simple physical models are designed and constructed to clarify explanations and show relationships; 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 abilities for a technological world and be able to apply the design process.

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 *Put an X in the appropriate column:*	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. *If any of the questions above are marked other than "ready for classroom use," please provide suggestions here.*			

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. *If any of the questions above are marked other than "ready for classroom use," please provide suggestions here.*			

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. *If any of the questions above are marked other than "ready for classroom use," please provide suggestions here.*				

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. *If any of the questions above are marked other than "ready for classroom use," please provide suggestions here.*				

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. *If any of the questions above are marked other than "ready for classroom use," please provide suggestions here.*			

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. *If any of the questions above are marked other than "ready for classroom use," please provide suggestions here.*			

Additional Comments Please use this area to provide general suggestions for improving this design brief.