Use and Copyright

The purchase of this video program entitles the user the right to reproduce or duplicate, in whole or in part, this teacher’s guide and the blackline master handouts for the purpose of teaching in conjunction with this video, Measuring Mass and Volume. The right is restricted only for use with this video program. Any reproduction or duplication, in whole or in part, of this guide and student masters for any purpose other than for use with this video program is prohibited.

The video and this teacher’s guide are the exclusive property of the copyright holder. Copying, transmitting or reproducing in any form, or by any means, without prior written permission from the copyright holder is prohibited (Title 17, U.S. Code Sections 501 and 506).

Copyright © 2006

ISBN 978-1-59234-144-6
# Table of Contents

<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>A Message From Our Company</td>
<td>5</td>
</tr>
<tr>
<td>National Standards Correlations</td>
<td>6</td>
</tr>
<tr>
<td>Student Learning Objectives</td>
<td>7</td>
</tr>
<tr>
<td>Assessment</td>
<td>8</td>
</tr>
<tr>
<td>Introducing the Video</td>
<td>9</td>
</tr>
<tr>
<td>Video Viewing Suggestions</td>
<td>9</td>
</tr>
<tr>
<td>Video Script</td>
<td>10</td>
</tr>
<tr>
<td>Student Assessments and Activities</td>
<td>16</td>
</tr>
<tr>
<td>Answers to Student Assessments</td>
<td>17</td>
</tr>
<tr>
<td>Answers to Student Activities</td>
<td>18</td>
</tr>
<tr>
<td>Assessment and Student Activity Masters</td>
<td>19</td>
</tr>
</tbody>
</table>
Viewing Clearances

The video and accompanying teacher’s guide are for instructional use only. In showing these programs, no admission charges are to be incurred. The programs are to be utilized in face-to-face classroom instructional settings, library settings, or similar instructional settings.

**Duplication rights** are available, but must be negotiated with the *Visual Learning Company*.

**Television, cable or satellite** rights are also available, but must be negotiated with the *Visual Learning Company*.

**Closed circuit rights** are available, and are defined as the use of the program beyond a single classroom but within a single campus. Institutions wishing to utilize the program in multiple campuses must purchase the multiple campus version of the program, available at a slightly higher fee.

**Discounts** may be granted to institutions interested in purchasing programs in large quantities. These discounts may be negotiated with the *Visual Learning Company*. 
Dear Educator:

Thank you for your interest in the educational videos produced by the Visual Learning Company. We are a Vermont-based, family owned and operated business specializing in the production of quality educational science videos and materials.

We have a long family tradition of education. Our grandmothers graduated from normal school in the 1920’s to become teachers. Brian’s mother was an elementary teacher and guidance counselor, and his father was a high school teacher and superintendent. This family tradition inspired Brian to become a science teacher, and to earn a Ph.D. in education, and led Stephanie to work on science educational programs at NASA.

In developing this video, accompanying teacher’s guide, and student activities, our goal is to provide educators with the highest quality materials, thus enabling students to be successful. In this era of more demanding standards and assessment requirements, supplementary materials need to be curricular and standards based - this is what we do!

Our videos and accompanying materials focus on the key concepts and vocabulary required by national and state standards and goals. It is our mission to help students meet these goals and standards, while experiencing the joy and thrill of science.

Sincerely,

Brian and Stephanie Jerome
National Standards Correlations

National Science Education Standards
(Content standards: 5-8, National Academy of Sciences, c. 1996)

Science as Inquiry (Content Standard A)
Use appropriate tools and techniques to gather, analyze, and interpret data.
• The use of tools and techniques, including mathematics, will be guided by the
  questions asked and the investigations students design.

Communicate Scientific Procedures and Explanations
• With practice, students should become competent at communicating
  experimental methods, following instructions, describing observations,
  summarizing the results of the other groups, and telling other students about
  investigations and explanations.

Benchmarks for Science Literacy
(Project 2061 – AAAS, c. 1993)

Technology and Science (3A)
By the end of the 5th grade, students should know that:

• Measuring instruments can be used to gather accurate information for
  making scientific comparisons of objects and events, and for designing and
  constructing things that will work properly.

Manipulation and Observation (12C)
By the end of the 8th grade, students should be able to:

• Read analog and digital meters or instruments used to make direct
  measurements of length, volume, weight, elapsed time, rates and temperature,
  and choose appropriate units.
Student Learning Objectives

Upon viewing the video and completing the enclosed student activities, students will be able to do the following:

• Define matter as anything that has mass and volume.

• Explain that mass is a measure of how much matter is in an object.

• Differentiate between mass and weight.

• Define a newton as the amount of force needed to cause an object with the mass of one kilogram to accelerate at a speed of one meter per second for each second of motion.

• Demonstrate the process of finding the mass of an object using a balance.

• Discuss the merits of using a spring scale versus a balance.

• Define volume as the amount of space something takes up.

• Demonstrate the process of measuring the volume of a liquid using a beaker, and a graduated cylinder.

• Explain the meniscus effect, and demonstrate how to properly read the volume of a liquid in a graduated cylinder considering the meniscus effect.

• List the units used to describe liquid volume including milliliters and liters.

• Demonstrate the process of finding the volume of a regularly shaped solid using a metric ruler.

• Demonstrate the process of finding the volume of an irregularly shaped solid using water displacement.

• List the units used to describe the volume of solids including cubic centimeters and cubic meters.
Assessment

Preliminary Assessment:
The Preliminary Assessment, provided in the Student Masters section, is an assessment tool designed to gain an understanding of students’ pre-existing knowledge. It can also be used as a benchmark upon which to assess student progress based on the objectives stated on the previous pages.

Video Review:
The Video Review, provided in the Student Masters section, can be used as an assessment tool or as a student activity. There are two main parts. The first part contains questions that can be answered during the video. The second series of ten questions consists of a video quiz to be answered at the conclusion of the video.

Post Assessment:
The Post Assessment, provided in the Student Masters section, can be utilized as an assessment tool following completion of the video and student activities. The results of the Post Assessment can be compared against the results of the Preliminary Assessment to evaluate student progress.
Introducing the Video

Before showing the video ask a student volunteer to state their weight. Ask the class if the student would weigh the same on the moon as on Earth. Explain to students that they would weigh about 1/6 of what they weigh on Earth. Next ask them if their body would actually change if they went to the moon. Tell them that the amount of matter in their body, also known as mass, would not change. Write the terms mass and weight on the board. Tell students to pay close attention to the video to learn more about mass and weight.

Next place a container of water in front of the class. Then place an empty rectangular container next to the water. Ask students how they could calculate if the empty container can hold the entire amount of water. Explain to them that in order to solve the problem, the volume of the liquid and the volume of the container need to be measured. Tell students to pay close attention to the video to see how this is done. Following the video, ask students to use the knowledge they gained by watching the video to solve the problem at hand.

Video Viewing Suggestions

The student Master “Video Review” is provided for distribution to students. You may choose to have your students complete this Master while viewing the program or to do so upon its conclusion.

The program is approximately twenty minutes in length and includes a ten question video quiz. Answers are not provided to the Video Quiz on the video, but are included in this teacher’s guide. You may choose to grade student quizzes as an assessment tool or to review the answers in class.

The video is content-rich with numerous vocabulary words. For this reason you may want to periodically stop the video to review and discuss new terminology and concepts.
Video Script: Measuring Mass and Volume

1. What do the following things have in common...
2. ...this spoon used to measure out vanilla extract used for making cookies,
3. ...this scale used to measure the weight of a fish,...
4. ...this beaker used to measure out the correct amount of solution to conduct an experiment,...
5. ...and this meter stick used to calculate the amount of space taken up by these beams?
6. That is right, all these things are tools.
7. Some of these instruments are common, everyday tools found in your home or at places of work.
8. While others are tools found in the science lab.
9. When you think of tools, you may think of things like hammers and screwdrivers.
10. But there are thousands of different kinds of tools.
11. What exactly is a tool? A tool is a device used to do a job or perform a task.
12. Different kinds of tools are used for different jobs.
13. During the next few minutes, we are going to explore some of the tools used to measure mass and volume,...
14. ...and we will discuss how you can safely and effectively use some of these tools in the science lab.

15. Graphic Transition- Mass and Weight
16. When you take a hike chances are you see trees, rocks, and maybe even animals.
17. And, when you walk down the street you see buildings, cars, and people.
18. All these things are made up of matter.

19. You Decide! What is matter?
20. Matter is anything that has mass and volume.
21. Another way of thinking about matter is that it is found in anything that has mass and takes up space.
22. Let us first talk about mass. These elk have mass.
23. This car has mass.
24. The air around us has mass.
25. And people have mass. Mass is a measure of how much matter is in an object, or is in a given amount of liquid or gas.
26. Some objects possess more mass than others. A tiger, for example, possesses more mass...
27. ...than a squirrel.
28. The amount of matter in an object, or its mass, remains constant regardless of an object’s location, but an object’s weight can vary. What do we mean?

29. **You Compare!** Will this car weigh more or less on the moon than on Earth?

30. Due to the fact that the force of gravity is about 1/6th of that on Earth, the car would weigh much less on the moon.

31. However, the mass of the car remains the same whether it is on the moon or on earth.

32. This is because the weight of an object is a measure of the force of gravity on that object.

33. When the force of gravity changes the object’s weight also changes.

34. Let us now take a look at how we go about weighing different objects.

35. **Graphic Transition - Measuring Weight**

36. As you probably already know, measurement is the process of explaining the characteristics of matter with numbers.

37. There are a number of tools you have probably used to measure the weight of matter in your home such as scales, whether they be a spring scale...

38. ...or an electronic scale such as this one.

39. Scientists also use scales to measure the weight of objects.

40. In some cases scientists use balances to measure weight. We will discuss the use of balances in a couple of minutes.

41. Scientists measure weight in units called newtons.

42. A newton is the amount of force needed to cause an object with the mass of one kilogram to accelerate at a speed of one meter per second for each second of motion.

43. To determine weight using newtons, you can plug in this formula: weight equals mass times acceleration due to gravity.

44. On Earth’s surface, the acceleration due to gravity is 9.8 meters per second per second.

45. If this rock has a mass of 20 kilograms you can figure out its weight in newtons by multiplying 20 kilograms by 9.8 meters per second per second (that is earth’s gravity) to get a sum weight of 196 newtons.

46. To put that in perspective, this book weighs about 15 newtons,...

47. …while this car weighs around 8000 newtons.

48. But when you step on a scale, you do not read your weight in newtons, you read it in pounds or kilograms.

49. For common, everyday simplicity, we usually discuss the weight of objects without changing mass to newtons.

50. **Graphic Transition – Using a Balance**

51. This tool, which you may have seen in your science classroom, is a balance.
Script Cont.

52. It works by balancing a known mass against an unknown mass. In this case, the unknown mass is a rock and the known mass is read on the beams containing the riders.

53. Let us quickly go through the process of finding the mass of this rock.

54. The first thing we need to do is to make sure the pointer is at zero and the riders are at their zero points.

55. If the pointer is not at zero then use the adjustment knob to make sure the pointer is at zero.

56. Next, place the object with the unknown mass on the pan of the balance.

57. Notice how the pan and the object on it drop downward.

58. Your goal now is to adjust the riders so that the pointer points to zero. In other words, balance needs to be achieved between the riders and the object of unknown mass.

59. Slide the largest rider to the right one notch at a time until the pointer drops below zero.

60. Then move the rider back one notch so the pointer rises above zero.

61. Do the same thing with the second largest rider.

62. Finally, carefully move the third rider, the smallest one, to the right until the pointer is pointing exactly at zero.

63. To get the mass of the object you need to add up the readings on the three beams.

64. **You Compute!** What is the mass of the rock?

65. The largest rider is on 300, the second largest rider is on 40, and the smallest rider is on 7. Added together the sum is 347.

66. Remember also to record the units. In this case the units are in grams. So the total mass is 347 grams.

67. Let us now see how to use a spring scale.

68. **Graphic Transition- Using a Spring Scale**

69. Maybe you have seen a spring scale like this in the grocery store.

70. Spring scales are sometimes used in science labs to measure the mass of objects.

71. A spring scale contains a spring that bends as a mass pulls on it.

72. A small indicator on the scale points to the mass of an object.

73. Spring scales do not usually have as wide a range of measurement as a triple beam balance.

74. They also do not have the capability of being as accurate.

75. But, they are much smaller and can be conveniently carried most anywhere.

76. Before placing an object on the hook of a spring scale it is important to make sure the indicator is set to zero.

77. It is important to keep in mind that very light objects will not exert enough force to be measured accurately.
Measuring Mass and Volume

Script Cont.

78. On the other hand, it is also important not to place heavy objects on the scale as they may damage the instrument.

79. **Graphic Transition- Volume**
80. If you have ever measured a specific amount of milk in a measuring cup,
81. ...bought a one liter bottle of water,...
82. ...or purchased a truck load of cement, you have worked with volume.

83. **You Decide! What is volume?**
84. Volume is the amount of space that something occupies.
85. This fire truck has a lot more volume than these miniature cars because it takes up more space.
86. In the metric system, the volume of liquids is measured in units of milliliters or liters.
87. The volume of solids is measured in units of cubic centimeters or cubic meters.
88. In science it is very important to measure the volume of all sorts of things from gases, to solids, to liquids.
89. Let us now take a look at how you can go about measuring liquids in the science lab.

90. **Graphic Transition- Tools for Measuring Volume**
91. We previously mentioned some common household devices used for measuring volume such as measuring spoons, and measuring cups.
92. In the science lab, beakers are commonly used to measure volume.
93. Beakers are usually made of glass, have lines with accompanying numbers, and are this general shape.
94. Beakers measure liquids in milliliters, and range in size from small to large.
95. Another common tool used for measuring the volume of liquids is the graduated cylinder.
96. Graduated cylinders are used to more precisely measure the volume of liquids. They too vary in size.
97. Let us now take a minute to see how you can use these tools effectively in the science lab.

98. **Graphic Transition- Measuring Volume of Liquids**
99. Before we actually talk about measuring the volume of liquids, a few notes about safety.
100. When using chemicals, whether they be liquids, solids, or powders, always wear safety goggles.
101. Your teacher may also want you to wear protective gloves, as well as a lab apron.
102. Be very careful when measuring or heating hot liquids. Always use beaker tongs or test tube tongs.
103. And if a spill should occur, or any other type of accident should occur, immediately tell your instructor.

104. As we mentioned earlier, a graduated cylinder is one of the better tools to use when you want to accurately measure liquid volume.

105. Before pouring liquid into a graduated cylinder make sure it is on a flat surface and away from the edge of the table.

106. Carefully pour the liquid into the cylinder. Do not hold the cylinder while pouring liquid into it.

107. Once you have poured the necessary amount of liquid, bend over until you are at eye level with the top of the liquid.

108. Notice that the liquid is higher at the sides of the cylinder than in the middle. This is referred to as the meniscus effect.

109. Read the volume at the bottom of the meniscus for an accurate reading. Do not read the higher edges of the meniscus.

110. **You Observe!** What is the volume of the liquid in this graduated cylinder?

111. That is correct. The volume is 24 milliliters.

112. Let us now take a look at the tools and processes involved in measuring the volume of solids.

113. **Graphic Transition- Measuring the Volume of Solids**

114. The easiest way to find the volume of a regularly shaped solid is to use this simple tool, a ruler.

115. In science, metric rulers are used to calculate the volume of regularly shaped solids.

116. By measuring the length, height, and width of an object, and then multiplying all three we can obtain the volume of this cube of marble.

117. Finding the volume of regularly shaped objects is straightforward.

118. But how would you go about finding the volume of irregularly shaped objects such as a rock?

119. It would not be practical to use a ruler to find this object’s volume.

120. Instead a process called water displacement is used to find the volume of irregularly shaped objects.

121. All we need to do is fill a graduated cylinder with water to a certain point such as 40 milliliters.

122. Write down 40 milliliters.

123. Then carefully place the object in the graduated cylinder so that it is entirely covered by water.

124. Note the new level of water and write it down.

125. To get the volume, all you need to do is subtract 40 milliliters from 51 milliliters.

126. **You Compute!** What is the volume of the rock?
Script Cont.

127. That is right, the volume is 11 milliliters.
128. And, since 11 milliliters of water is equivalent to 11 cubic centimeters, the volume of the rock is 11 cubic centimeters.

129. Graphic Transition-Summing Up
130. During the past few minutes we have explored the fascinating process of measuring mass and volume.
131. We began by differentiating between mass and weight. We saw that an object’s weight can change depending on its location, but its mass remains constant.
132. We discussed how scientists measure weight in units called Newtons.
133. And we explored some of the tools used to measure weight including scales, balances, and spring scales.
134. The process of using a triple beam balance in the science lab was covered in detail.
135. And the process of measuring the volume of liquids via beakers and graduated cylinders was also demonstrated.
136. We also explored how to measure the volume of regularly shaped solids with a ruler by measuring the length, height, and width and then multiplying the three numbers.
137. Finding the volume of irregularly shaped solids via the process of water displacement was also demonstrated.
138. So, the next time you weigh an object, . . .
139. . . . measure out liquids while cooking, . . .
140. . . . or find the volume of an object in the science lab, think about the things we discussed during the past few minutes.
141. You just might think about measuring mass and volume a little differently.

142. Graphic Transition - Video Assessment

Fill in the correct word to complete the sentence. Good luck and let us get started.

1. _________ is anything that has mass and volume.
2. _________ can change when the position of an object changes.
3. _________ is the amount of matter in an object.
4. This tool is called a _________.
5. This device is called a _________ scale.
6. _________ is the amount of space something takes up.
7. In the metric system, liquid volume is measured in _____________.
8. The tool used for measuring volume is a _________.
9. A _________ cylinder is a more precise tool for measuring volume.
10. Water _________ is used for finding volume of irregularly shaped solids.

Answers can be found on page 17.
Student Assessments and Activities

Assessment Masters:

• Preliminary Assessment
• Video Review
• Post Assessment

Student Activity Masters:

• Weighty Matters
• A Balancing Act
• Liquid Volume
• The Meniscus Effect
• Vocabulary of Measuring Mass and Volume
Answers to Student Assessments

Preliminary Assessment (pgs. 20-21)
1. tool
2. gravity
3. newtons
4. balance
5. bottom
6. multiply
7. volume
8. add
9. spring scale
10. ruler
11. false
12. true
13. true
14. false
15. true
16. false
17. false
18. false
19. true
20. false

Video Quiz (p. 22)
1. matter
2. weight
3. mass
4. balance
5. spring
6. volume
7. liters
8. beaker
9. graduated
10. displacement

Post Assessment (pgs. 23-24)
1. add
2. multiply
3. ruler
4. tool
5. newtons
6. spring scale
7. gravity
8. bottom
9. balance
10. volume
11. false
12. false
13. false
14. false
15. false
16. true
17. true
18. true
19. true
20. true

Video Review (pg. 22)
1. Matter is anything that has mass and volume.
2. The car will weigh much less on the moon, because the moon has only 1/6 of the gravitational force of the Earth.
3. The rock has a mass of 347 grams. To find this you add together the measurements from each of the beams, in this case 300+40+7=347.
4. Volume is the amount of space something takes up.
5. The volume of the liquid in the graduated cylinder is 24 milliliters.
6. By subtracting 40-ml from 51-ml, the volume of the rock is 11 milliliters. Because one milliliter equals one cubic centimeter, the solid volume is 11 cubic centimeters.
Answers to Student Activities

### Weighty Matters (p.25)

<table>
<thead>
<tr>
<th>Planet</th>
<th>Difference in Gravitational Force</th>
<th>Tom’s Weight</th>
<th>Your Weight</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mercury</td>
<td>3/8</td>
<td>45</td>
<td>answers</td>
</tr>
<tr>
<td>Jupiter</td>
<td>5/2</td>
<td>300</td>
<td></td>
</tr>
<tr>
<td>The Moon</td>
<td>1/6</td>
<td>20</td>
<td></td>
</tr>
<tr>
<td>Venus</td>
<td>9/10</td>
<td>108</td>
<td>8</td>
</tr>
<tr>
<td>The Sun</td>
<td>2/7</td>
<td>3240</td>
<td></td>
</tr>
<tr>
<td>Pluto</td>
<td>1/15</td>
<td>8</td>
<td></td>
</tr>
</tbody>
</table>

1. Tom should travel to Venus. There he weighs 108 pounds, which is the closest to his weight on Earth.
2. Callisto has 1/8th of the gravitational force of the Earth. To calculate this, you divide 120 (Tom’s weight on Earth) by 15 (Tom’s weight on Callisto). The answer is 8, meaning that there is eight times as much gravitational force on the Earth as compared to Callisto.
3. Tom would weigh the most on the Sun. He would weigh about 3,240 pounds there.

### Liquid Volume (p.27-28)

1. A 250-ml beaker would be the best tool to use. It would easily hold 100-ml of water and the measurement does not have to be exact.
2. A pipette would be the best tool to use in this situation. It can accurately measure three milliliters without disturbing the oil on top of the water.
3. A 25-ml graduated cylinder would be the best tool. Graduated cylinders are more exact than beakers or flasks, and precision matters a lot for this measurement.
4. A 50-ml or 100-ml flask would be the best tool to use. A flask is convenient for storing liquids because less will evaporate over time.
5. A pipette would be the best tool to use. It would easily measure one milliliter, and it would also be very easy to drip the water onto the tissue using the pipette.

### A Balancing Act (p.26)

The object weighs 226 grams. To find this, you simply add the value of each of the riders- in this case, 200 + 20 + 6 = 226 grams.

### Vocabulary of Measuring Mass and Volume (p.30)

1. f - matter
2. c - weight
3. i - measurement
4. a - newton
5. d - balance
6. b - spring scale
7. j - volume
8. g - graduated cylinder
9. e - meniscus effect
10. h - water displacement
Assessment and Student Activity Masters
Preliminary Assessment

Directions: Fill in the blank with the correct word. A list of possible answers is provided at the bottom of the page.

1. A ___________ is an object that is used to do a job or perform a task.

2. An object’s weight changes as the force of ___________ on the object changes.

3. For everyday measurements, we measure weight in pounds or kilograms, but scientists sometimes measure weight in ____________.

4. A ___________ consists of weights that balance against an unknown mass.

5. When measuring liquid in a graduated cylinder it is important to read the measurement from the ___________ of the meniscus for the most accurate reading.

6. When calculating the volume of a regularly shaped solid, you ___________ length, width, and height.

7. The ___________ of an object is the amount of space it takes up.

8. To use a balance, you must ___________ the measurements on all three beams to find the object’s mass.

9. In a grocery store you use a ___________ _________ to find the mass of fruits and vegetables.

10. A ___________ can be used to find the volume of a regularly shaped solid by measuring the length, height, and width, and then multiplying all three measurements.

   volume                  add
   spring scale            multiply
   newtons                 gravity
   tool                    bottom
   ruler                   balance
Preliminary Assessment

Directions: Decide whether the statement is true (T) or false (F).

11. A beaker is a more precise measuring tool than a graduated cylinder.  T  F

12. Whenever you are working with chemicals, it is very important to wear safety goggles.  T  F

13. Everything on Earth is made up of matter.  T  F

14. An object’s mass can vary depending on its location.  T  F

15. A balance works by weighing an object of unknown mass against objects of known mass.  T  F

16. If you brought a scale to the moon, it would tell you that you weighed exactly the same amount as on Earth.  T  F

17. A spring scale measures very light objects most accurately.  T  F

18. You must hold a graduated cylinder in your hand when using it to measure the volume of a liquid.  T  F

19. To measure the volume of liquids while cooking at home, you use tools such as measuring cups and measuring spoons.  T  F

20. It is impossible to find the volume of an irregularly shaped solid object.  T  F
Measuring Mass and Volume

Name

Video Review

Directions: During the course of the program, answer the questions as they are presented in the video. At the end of the video, answer the Video Quiz questions.

You Decide!
1. What is matter?

You Compare!
2. Will this car weigh more or less on the moon than on Earth?

You Compute!
3. What is the mass of the rock?

You Decide!
4. What is volume?

You Observe!
5. What is the volume of the liquid in this graduated cylinder?

You Compute!
6. What is the volume of the rock?

Video Quiz:
1. ___________ is anything that has mass and volume.
2. ___________ can change when the position of an object changes.
3. ___________ is the amount of matter in an object.
4. This tool is called a ___________.
5. This device is called a ___________ scale.
6. ___________ is the amount of space something takes up.
7. In the metric system, liquid volume is measured in _______________.
8. The tool used for measuring volume is a ___________.
9. A ___________ cylinder is a more precise tool for measuring volume.
10. Water _______________ is used for finding volume of irregularly shaped solids.
Post Assessment

Directions: Fill in the blank with the correct word. A list of possible answers is provided at the bottom of the page.

1. To use a balance, you must _________ the measurements on all three beams to find the object’s mass.

2. When calculating the volume of a regularly shaped solid, you _________ length, width, and height.

3. A _________ can be used to find the volume of a regularly shaped solid by measuring the length, height, and width, and then multiplying all three measurements.

4. A _________ is an object that is used to do a job or perform a task.

5. For everyday measurements, we measure weight in pounds or kilograms, but scientists sometimes measure weight in _________.

6. In a grocery store you use a _________ _________ to find the mass of fruits and vegetables.

7. An object’s weight changes as the force of _________ on the object changes.

8. When measuring liquid in a graduated cylinder it is important to read the measurement from the _________ of the meniscus for the most accurate reading.

9. A _________ consists of weights that balance against an unknown mass.

10. The _________ of an object is the amount of space it takes up.

volume  add
spring scale  multiply
newtons  gravity
tool  bottom
ruler  balance
Post Assessment

Directions: Decide whether the statement is true (T) or false (F).

11. An object's mass can vary depending on its location. T F

12. A spring scale measures very light objects most accurately. T F

13. It is impossible to find the volume of an irregularly shaped solid object. T F

14. A beaker is a more precise measuring tool than a graduated cylinder. T F

15. You must hold a graduated cylinder in your hand when using it to measure the volume of a liquid. T F

16. Everything on Earth is made up of matter. T F

17. To measure the volume of liquids while cooking at home, you use tools such as measuring cups and measuring spoons. T F

18. A balance works by weighing an object of unknown mass against objects of known mass. T F

19. Whenever you are working with chemicals, it is very important to wear safety goggles. T F

20. If you brought a scale to the moon, it would tell you that you weighed exactly the same amount as on Earth. T F
Weighty Matters

Background:
Everything on Earth has mass, and everything also has weight. You probably already know that mass and weight are not the same thing. But what exactly is the difference? Mass is a measurement of the amount of matter in an object. Mass always stays the same no matter where the object is. Weight, however, changes when an object’s location changes. This is because weight is a measurement of the pull of gravity on an object. Often we talk about weight as though it were mass, because the force of gravity on Earth is constant. But what if a person were to travel to other planets, where the force of gravity is different? The moon for example, only has about 1/6 of the gravitational force as that on Earth. Therefore, if you traveled to the moon you would weigh only 1/6 of your weight on Earth, but your mass would stay the same. Other planets have different amounts of gravitational force, which effect the weight of objects. Jupiter has about two and a half times the gravitational force of the Earth. In this activity you will calculate changes in weight on different planets.

Activity:
Tom weighs 120 pounds. He is thinking of going on a trip to visit another planet, but he is worried about changes in his weight. He wants to visit the planet where his weight would be the closest to his Earthly weight. Help him to compute his weight on each of the planets listed below. To do this, you must multiply Tom’s weight by the difference in gravitational force. Next compute your own weight on each of the planets. Then answer the following questions.

Questions:
1. To which planet should Tom travel, where his weight would be closest to his Earthly weight?

2. On Jupiter’s moon Callisto, Tom would weigh 15 pounds. What is the difference in gravitational force between Callisto and the Earth?

3. On what object in the solar system would Tom weigh the most? What would his weight be?

<table>
<thead>
<tr>
<th>Planet</th>
<th>Difference in Gravitational Force</th>
<th>Tom’s Weight</th>
<th>Your Weight</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mercury</td>
<td>3/8</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Jupiter</td>
<td>5/2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>The Moon</td>
<td>1/6</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Venus</td>
<td>9/10</td>
<td></td>
<td></td>
</tr>
<tr>
<td>The Sun</td>
<td>27</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pluto</td>
<td>1/15</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
A Balancing Act

Background:
Think back to the last time you went to the doctor. You probably stood on a balance so that a nurse could measure your weight. To do this, the nurse slid riders along beams. A balance works by balancing the known mass of the riders against an unknown mass. In the doctor’s office, the unknown mass was your weight. The doctor’s office is not the only place where balances are used. In the science lab you use a triple beam balance, such as the one pictured below, to find the weight of different objects.

Directions:
Using your knowledge of the triple beam balance, label each of the parts on the picture below. Be sure to include: weighing pan, beams, base, pointer, and riders.

In the next picture, look closely at the measurement. Read the balance and find the mass of the object on the scale.
Liquid Volume

Background:
It is very easy to measure the volume of liquids, because they take the shape of any container that you put them in. Scientists have developed many different specialized containers to measure liquid volume. You have probably seen many of them in the science lab.

A beaker is usually used to measure larger amounts of liquid. Beakers are usually made of glass, and can be used to heat liquids when placed on a hot plate. They can hold as much as 1000 milliliters or even more. On the other hand, beakers can be quite small, only holding 50 milliliters of liquid. A beaker is not the best tool for measuring a very exact amount of liquid, simply because it is not designed to do so.

A pipette measures small amounts of liquid with a great deal of precision. Pipettes look like eye droppers. They are usually large enough to measure 5 milliliters of liquid. One benefit of a pipette is that it sucks up liquid rather than having liquid poured into it. This means that you can measure liquid from the bottom of a container without mixing it.

A flask is a useful tool for measuring, mixing, or storing any amount of liquid. Flasks commonly come in sizes between 125 and 1000 milliliters. Flasks are cone-shaped, with a straight neck; you can see a picture of a flask at the top of the page. While they are very useful for storing liquids, flasks are not very precise measuring tools.

A graduated cylinder is a more precise tool for measuring small amounts of liquid. Graduated cylinders are long tubes marked in increments. The size of graduated cylinders varies a lot; the smallest ones hold only 10 milliliters, but they can be as large as 1000 milliliters. Graduated cylinders are probably the most precise tool you will use for measuring the volume of liquids in your school science lab.

Directions:
Now that you are familiar with some of the different tools used for measuring volume, it is time to practice choosing the right tool for the situation. On the next page are five different scenarios in which you need a tool to measure volume. Using the information you know about the different tools for measuring volume in science, choose the appropriate tool in each situation. Remember to include the size of the tool as well.
Liquid Volume

1. You want to create a bath of boiling water to heat a test tube. You need about 100 milliliters of water. What tool would you use?

2. You are exploring the properties of density. You floated oil on top of water. However, you now need to measure out 3 milliliters of water from underneath the oil. What tool would you use?

3. For a certain chemical reaction you need to measure out exactly 20 milliliters of a specific acid. It is essential that the measurement be as exact as possible. What tool would you use?

4. You need to measure about 50 milliliters of salt water. You will store the water in a container for a while to see whether or not the mixture is saturated. What tool would you use?

5. In order to find the best tissues available, you are testing the absorbency of several different brands of tissues. To do this, you need to precisely measure one milliliter of water which you will slowly drip onto each tissue. What tool would you use?
The Meniscus Effect

Background:
Have you ever looked at a glass of water at eye-level? The top edge of the water is higher at the sides of the container than in the middle. Scientists call this phenomenon the meniscus effect. It occurs when water molecules are attracted to the glass and are pulled up around the edges of the container. It is important to be aware of the meniscus effect when you are measuring liquids. Keep in mind that you must read the measurement at the bottom of the meniscus to get an accurate reading.

Directions:
Each of the three drawings below shows a meniscus that could prevent an accurate reading of the measurement of liquid. Look carefully at each drawing and give the correct reading of each measurement.
Vocabulary of Measuring Mass and Volume

Directions: Unscramble the vocabulary words in the first column. Match the words to the definitions in the second column.

- 1. tramte ____________
- 2. geihwt ____________
- 3. aremseneumt ____________
- 4. tnoewn ____________
- 5. labecan ____________
- 6. nrsipg lsace ____________
- 7. mevulo ____________
- 8. tdaudgare ldryecin ____________
- 9. snimuces ftceef ____________
- 10. ewtra nscipmtdleae ____________

a. The amount of force needed to cause an object with the mass of one kilogram to accelerate at a speed of one meter per second for each second of motion.
b. A tool that measures weight using a spring that bends as a mass pulls on it.
c. A measure of the force of gravity on an object.
d. A tool used to measure mass by comparing an unknown mass to a known mass.
e. Occurs when liquid is higher at the edges of a container than in the middle.
f. Anything that has mass and volume.
g. A tool used to more precisely measure the volume of liquids.
h. A process used to find the volume of irregularly shaped objects.
i. The process of explaining the characteristics of matter with numbers.
j. The amount of space that something occupies.