

Metric Conversions

Teacher's Guide Middle School

Editors:

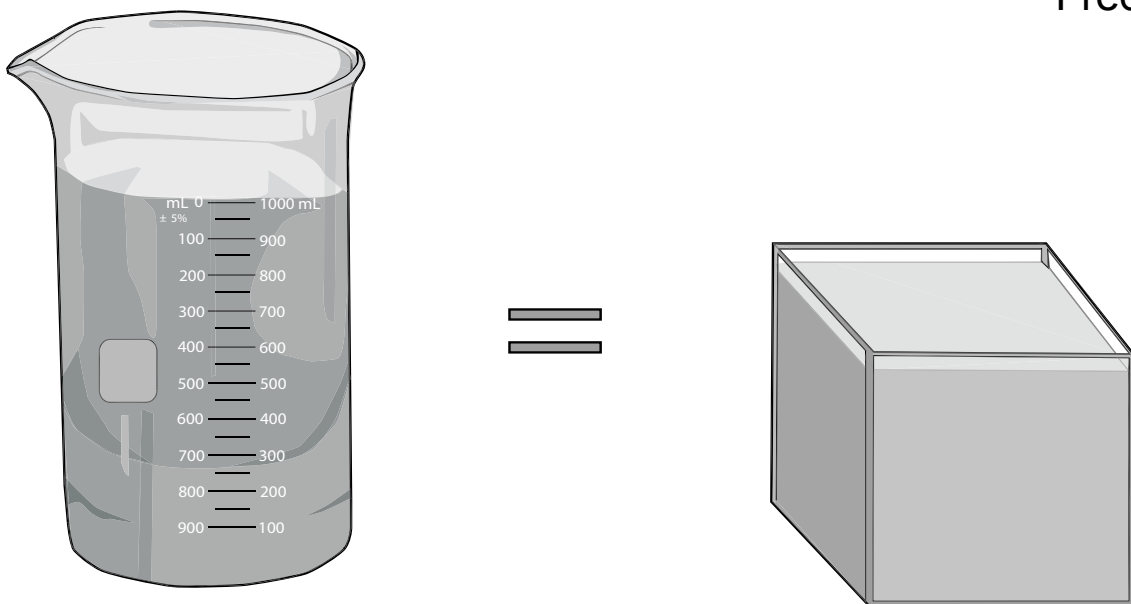
Brian A. Jerome, Ph.D.
Stephanie Zak Jerome

Assistant Editors:

Louise Marrier
Hannah Fjeld

Graphics:

Dean Ladago
Fred Thodal



Visual Learning Company

www.visuallearningco.com

1-800-453-8481

25 Union Street
Brandon, Vermont



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, *Metric Conversions*. 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 978-1-59234-134-9

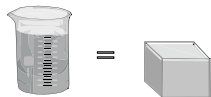
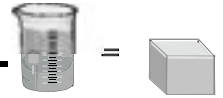


Table of Contents

	Page
A Message From Our Company	5
National Standards Correlations	6
Student Learning Objectives	7
Assessment	8
Introducing the Video	9
Video Viewing Suggestions	9
Video Script	10
Student Assessments and Activities	16
Answers to Student Assessments	17
Answers to Student Activities	18
Assessment and Student Activity Masters	19



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*.



=



A Message from our 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.

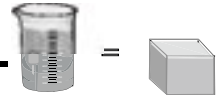
We have a long family tradition of education. Our grandmothers graduated from normal school in the 1920's to become teachers. Brian's mother was an elementary teacher and guidance counselor, and his father was a high school teacher and superintendent. This family tradition inspired Brian to become a 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)

Habits of Mind - Computation and Estimation (12B)

By the end of 8th grade, students should be able to:

Determine what unit (such as seconds, square inches, or dollars per tankful) an answer should be expressed in from the units of the inputs to the calculation, and be able to convert compound units.

By the end of 5th grade, students should be able to:

Judge whether measurements and computations of quantities such as length, area, volume, weight, or time are reasonable in a familiar context by comparing them to typical values.



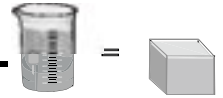
=



Student Learning Objectives

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

- Understand that different countries use different systems of measurement, and that the metric system is the most common.
- Explain that the metric system is a decimal system based on the number ten and multiples of ten.
- Provide some examples of how the metric system is easier to use than the English system of measurement.
- State that one cubic centimeter of water has a volume of one milliliter and a mass of one gram.
- Demonstrate the general mathematical process of converting between units of the English and metric systems using conversion factors.
- When provided with the correct conversion factors, demonstrate how to convert between the metric system and English system for various units of length, mass, and volume.
- Perform conversions between temperature measured in degrees Fahrenheit and temperatures measured in degrees Celsius.
- Cite some examples of resources which contain conversion factors including textbooks, encyclopedias, and the internet.



Assessment

Preliminary Assessment:

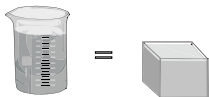
The Preliminary Assessment, provided in the Student Masters section, is an assessment tool designed to gain an understanding of students' pre-existing knowledge. It can also be used as a benchmark upon which to assess student progress based on the objectives stated on the previous pages.

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

Begin by holding an eyedropper containing 1 milliliter of water in front of the class. Ask students if they know the mass of 1 milliliter of water. Tell them that 1 milliliter of water has a mass of one gram, and occupies a volume of one cubic centimeter. Write the following on the board: 1 milliliter of water = 1 gram = 1cm³. Explain to your students that this is just one easy conversion made within the metric system. Tell your students that the metric system is a decimal system based on the number ten and multiples of ten. The fact that the metric system is a decimal system makes it easier to carry out conversions within the metric system.

Next, ask students if they have ever traveled to another country that uses a different system of measurement. Ask your students if they were confused when they heard the weather report where temperature readings were reported in an unfamiliar temperature scale. Or ask them if they understood distances on road signs when they traveled to a foreign country. Tell students to pay close attention to the program to learn how to make conversions between measurements in the English system and the metric system.

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.

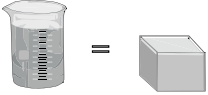
The program is approximately twenty minutes in length and includes a ten question video quiz. Answers are not provided to the Video Quiz on the video, but are included in this teacher’s guide. You may choose to grade student quizzes as an assessment tool or to review the answers in class.

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: Metric Conversions

1. As you probably already know, there are different systems of measurement.
2. In the United States the most common system is the English system of measurement,...
3. ...where length is measured in units of inches, yards, or miles.
4. But if you live in other countries such as Ecuador,...
5. ...or Canada, the most common measurement system is the metric system.
6. In the metric system, length is commonly measured in centimeters, meters, or kilometers.
7. But what do you do if you travel from a country that uses the English system,...
8. ...to a country that uses the metric system, or vice versa?
9. How do you convert Metric units of measurement to English units of measurement?
10. Or, how do you convert English units of measurement to metric units?
11. During the next few minutes we are going to try to answer some of these questions, and others.
12. But first, let us take a closer look at how different units of measurement can be converted within the metric system itself.
- 13. Graphic Transition – Simple Metric Conversions**
14. The metric system is quite common in most of the world, and...
15. ...is also the standard system of measurement in science.
16. While the metric system may seem difficult to use at first, it is actually quite easy once you get used to it.
17. One of the benefits of the metric system is that it is easy to convert between different units.
18. This is primarily due to the fact it is a decimal system, meaning metric units are based on the number ten, or multiples of ten.
19. Let us look at an example that involves measuring the length of a fence.
20. Using a metric tape measure we find it is 468 centimeters long. We want to convert this measurement which is in centimeters to meters.
21. One way to do this is with a conversion factor which is a ratio that equals one.
22. The conversion factor for this problem is 1 meter divided by 100 centimeters which equals one.
23. To convert 468 centimeters to meters we write the equation:
468 centimeters times 1 meter divided by 100 centimeters.
24. As you can see, the units of centimeters cancel out.
25. So we get a ratio of 468 meters divided by 100.
26. The length of the fence, therefore, equals 4.68 meters.



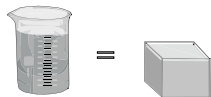
Script (cont.)

27. This method of converting between different metric lengths can be done with other types of units as well, such as with volume.
28. For example, this bottle contains 2000 milliliters of water, and we want to convert this volume to liters.
29. We know there are 1000 milliliters in one liter.
30. Using a conversion factor that equals one, we divide 1 liter by 1000 milliliters.
31. Next we multiply 2000 milliliters by this ratio.
- 32. You Compute!** What is the volume of water in liters?
33. That's right, it is 2 liters.
34. We obtain this by canceling out the units of milliliters. This leaves 2000 liters divided by 1000. When we divide this ratio we get the answer of 2 liters.
- 35. Graphic Transition – Converting Between Metric Units**
36. One of the fascinating features of the metric system is that in some cases it is possible to convert between units of volume and mass.
37. Let us see how this is possible by first computing the volume of this small cube. To find the volume of regularly shaped objects we can use the following formula:
volume = length x height x width.
38. This small cube is one centimeter long by one centimeter high by one centimeter wide.
39. If we multiply its length times its height times its width we get a volume of one centimeter cubed, or one cubic centimeter.
40. This graduated cylinder contains 1 milliliter of water.
41. Interestingly enough, one milliliter of water also occupies the volume of one cubic centimeter.
42. In other words, one cubic centimeter of water equals 1 milliliter.
43. Another interesting fact is that one milliliter of water has a mass of one gram.
44. If we were to measure out one milliliter of water and place it on a triple beam balance we would find that its mass to be one gram.
45. In summary, one milliliter of water has a volume of one cubic centimeter and has a mass of one gram.
- 46. You Compute!** What is the volume and mass of 37 milliliters of water?
47. 37 milliliters of water has a volume of 37 cubic centimeters, and a mass of 37 grams.
48. You may already know that density is a measurement of the amount of matter in a given amount of space, or volume.
49. The formula for density is mass divided by volume.



Script (cont.)

50. We can easily compute the density of water by dividing the mass of one gram by a volume of 1 cubic centimeter.
51. This gives us the density of water as one gram per cubic centimeter.
52. Objects that have a density of greater than 1 gram per cubic centimeter sink.
53. While objects with a density of less than one gram per cubic centimeter float.
- 54. Graphic Transition – Conversion of Distance and Length**
55. Let us say you are from the United States and you are used to measuring distances in miles.
56. You decide to take a vacation in Canada, and notice that the road signs are not in miles, but in kilometers.
57. Since the length of a kilometer is unfamiliar to you, you want to convert distances in kilometers to miles.
58. A kilometer is a little more than half a mile. Specifically it is 62/100ths of a mile.
59. To convert kilometers to miles we need to multiply the number of kilometers by the conversion factor of .62 mile divided by 1 kilometer.
60. For example, let us convert 10 kilometers to miles. As you can see, the units of kilometers cancel out , and 10 times .62 equals 6.2 miles.
61. Let us look at another example. This road sign tells us that it is 6 kilometers to Wabasso.
- 62. You Compute!** What is this distance in miles?
63. When we multiply 6 kilometers by the conversion factor of .62 miles over 1 kilometer we get a distance of 3.72 miles to Wabasso.
64. Let us take a look at a smaller measurement of length – converting centimeters to inches.
65. While on a ski vacation in Canada you...
66. ...hear the weather forecast calls for 20 centimeters of new snow. How many inches of snow is this?
67. To convert centimeters to inches it is necessary to multiply the number of centimeters by the conversion factor of .39 inches over 1 centimeter.
68. As you can see, the units of centimeters cancel out and we arrive at an answer of 7.8 inches.
69. Let us say we want to convert 50 inches to centimeters.
70. To convert from inches to centimeters multiply the number of inches by the conversion factor of 2.54 centimeters over 1 inch.
71. As you can see the units of inches cancel out and we arrive at our answer of 127 centimeters.



Script (cont.)

72. Keep in mind that all you need to make these conversions is the correct conversion factor. Most textbooks, dictionaries, and encyclopedias contain the necessary conversion factor.

73. Graphic Transition – Conversions of Mass

74. As you may recall, mass is the amount of matter in an object.

75. Confusion sometimes occurs when people used to measuring mass in the English system of measurement go to a country using the metric system.

76. The mass of food, boxes, and even people is often measured in kilograms.

77. Let us say a piece of cheese has a mass of 2 kilograms, but you want to know what this equals in pounds.

78. To do this you multiply the number of kilograms by the conversion factor of 2.2 pounds over 1 kilogram.

79. As you can see the units of kilogram cancel out and when multiplied we get an answer of 4.4 pounds.

80. Let us say you know your mass in pounds and want to convert it to kilograms.

81. Your mass is 104 pounds. To find how much you weigh in kilograms multiply the number of pounds by the conversion factor of .45 kilogram over 1 pound.

82. When we do the math we find the mass to be 46.8 kilograms.

83. These are just a couple of examples of ways mass is converted between the English and metric systems.

84. Graphic Transition – Conversions of Volume

85. As you probably already know, volume is the amount of space something takes up.

86. Solids, liquids, and even gases have volume. They all take up space.

87. One of the more common things we measure on a daily basis is the volume of liquids.

88. There are 8.5 liters of water in this bucket. How many gallons is this?

89. To find the number of gallons it is necessary to multiply the known liters of water, 8.5, by the conversion factor of .26 gallon over 1 liter.

90. The units of liters cancel out and after multiplying, we get an answer of 2.21 gallons.

91. What about converting gallons to liters?

92. Let us say you filled up a car with 18 gallons of gasoline.

93. To find the equivalent number of liters multiply 18 gallons by the conversion factor of 3.78 liters over 1 gallon.

94. This computes to 68.04 liters of gasoline.

95. These are just a couple of examples of the many different ways that volume can be converted.



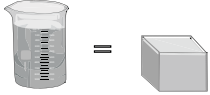
Script (cont.)

96. Graphic Transition – Conversions of Temperature

97. Everyday we experience the weather when we go outside.
98. In many places the weather is quite variable from day to day,...
99. ...being cold one day and warm the next. Temperature is a measure of how hot or cold something is.
100. Most newspapers post the weather forecast, which includes the projected high and low temperatures for the day ahead.
101. If you are used to reading the weather forecast in degrees Fahrenheit,...
102. ...you may be confused when you go to a country where the temperature is forecast in degrees Celsius.
103. To convert Celsius degrees to Fahrenheit degrees we need a mathematical equation.
104. Let us say the temperature is 22 degrees Celsius and we want to know what the equivalent temperature is in Fahrenheit.
105. We take 22 degrees Celsius and multiply it by $\frac{9}{5}$ and then add 32.
106. This gives us a temperature of 71.6 degrees Fahrenheit.
107. Therefore, if the forecast called for a high temperature of 20 degrees Celsius, you would realize that you would not need to worry about dressing in your cold weather coat, hat, and gloves.
108. What if you are used to hearing the forecast in degrees Celsius and not in Fahrenheit?
109. The equation for converting Fahrenheit to Celsius is as follows.
110. In the equation we take 20 degrees Fahrenheit and subtract 32, then multiply this number by $\frac{5}{9}$.
111. This gives us a Celsius temperature of -6.7 degrees Celsius.
112. This indeed is a typical chilly mid-winter temperature.

113. Graphic Transition – Summing Up

114. During the past few minutes we have explored some of the many metric conversion possibilities.
115. We began by investigating easy ways to convert between units in the metric system.
116. For example, we saw how easy it is to convert from centimeters to meters,...
117. and from milliliters to liters by using simple math.
118. We then discussed how the metric system is uniquely designed to easily convert between volume and mass of water.
119. And that one milliliter of water has a volume of one cubic centimeter and has a mass of one gram.



Script (cont.)

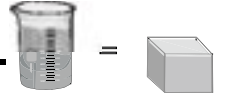
120. Next, we explored some of the ways to convert between English units of measurement and metric units.
121. We saw how each type of conversion uses different mathematical formulas that can be located in reference books.
122. So, the next time you travel to a place that uses a different system of measurement,...
123. ...and you need to convert kilometers to miles, or miles to kilometers...
124. ...think about some of the things we discussed during the past few minutes.
125. You might just think about the process of metric conversions a little differently.

126. Graphic Transition – Video Quiz

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

1. The _____ system is based on multiples of ten.
2. Two hundred centimeters is equivalent to ____ meters.
3. Five milliliters of water has a mass of _____ grams.
4. Road signs in metric countries post distances in _____ .
5. A mile is _____ than a kilometer.
6. In the metric system _____ is commonly measured in kilograms.
7. A kilogram is _____ than a pound.
8. _____ is the amount of space something takes up.
9. In the metric system, temperature is measured in degrees _____ .
10. Water has a _____ of one gram per cubic centimeter.

Answers may be found on page 17



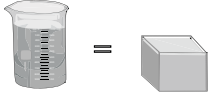
Student Assessments and Activities

Assessment Masters:

- Preliminary Assessment
- Video Review
- Post Assessment

Student Activity Masters:

- The Metric System in Our World
- Converting Distance and Length
- Converting Mass and Volume
- A Matter of Degrees
- Systems of Measurement
- Vocabulary of *Metric Conversions*



Answers to Student Assessments

Preliminary Assessment (pgs. 20-21)

1. conversion
2. metric
3. decimal
4. liter
5. centimeter
6. smaller
7. kilograms
8. larger
9. equation
10. factor
11. true
12. false
13. true
14. false
15. true
16. true
17. false
18. false
19. true
20. false

Video Review (pg. 22)

1. The volume of water in liters is two liters.
2. 37 milliliters of water has a volume of 37 cubic centimeters and a mass of 37 grams.
3. The distance is 3.72 miles to Wabasso. You multiply 6 kilometers by the conversion factor of .62 miles over one kilometer.

Video Quiz (p. 22)

1. metric
2. 2
3. 5
4. kilometers
5. longer
6. mass
7. larger
8. volume
9. Celsius
10. density

Post Assessment (pgs. 23-24)

1. centimeter
2. kilograms
3. equation
4. conversion
5. decimal
6. factor
7. liter
8. smaller
9. metric
10. larger
11. true
12. false
13. true
14. true
15. true
16. false
17. false
18. true
19. false
20. false



Answers to Student Activities

The Metric System in Our World (p. 25)

1. United States, Liberia, and Myanmar.
2. "Soft metric" means the nation has only partially adopted the metric system.
3. Communicating with countries who use the metric system is sometimes confusing and costly.

Converting Distance and Length (p. 26)

1. 1.83 meters
2. 400 centimeters
3. 5.1 kilometers
4. 6,400 meters
5. 300,000 centimeters
6. 3.72 miles
7. 16.74 miles
8. 15.6 inches
9. 48.36 inches
10. 152.4 centimeters
11. 398.78 centimeters
12. 11.27 kilometers
13. 25.75 kilometers
14. 346 kilometers

Converting Mass and Volume (p. 27)

1. .15 kilograms
2. 61,000 grams
3. 41,000 milliliters
4. 1.652 liters
5. 32 grams
6. 450 grams
7. 52 cubic centimeters
8. 10.8 kilograms
9. 160.6 pounds
10. 10.4 gallons
11. 91 gallons
12. 75.7 liters

A Matter of Degrees (p. 28)

1. 50° Fahrenheit
2. 80.6° Fahrenheit
3. 168.8° Fahrenheit
4. 212° Fahrenheit
5. 14° Fahrenheit
6. 0° Celsius
7. - 8.3° Celsius
8. 22.8° Celsius
9. -26.7° Celsius
10. 37.8° Celsius

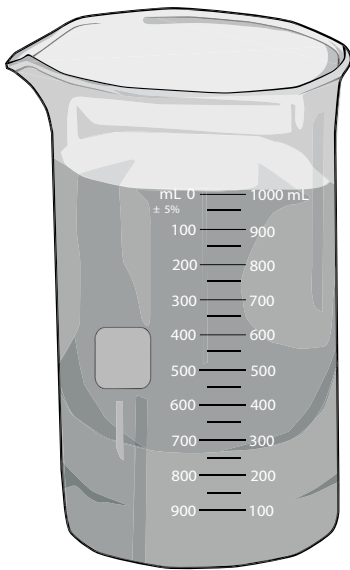
Systems of Measurement (p. 29)

Item	Units Stated on Container in Both Metric and English	Conversion Factor Needed	Is It Accurate?
Perfume			
Paint	Answers will vary		
Candy			

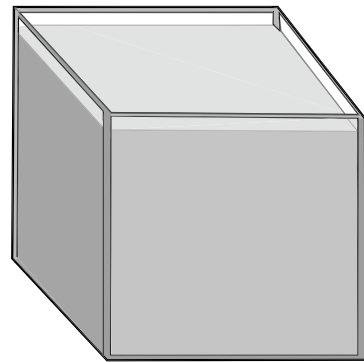
Vocabulary of Metric Conversions (p. 30)

1. c - gram
2. f - kilometer
3. i - kilogram
4. a - converting
5. j - gallon
6. b - decimal system
7. h - mile
8. e - density
9. g - centimeter
10. d - metric

Assessment and Student Activity Masters



=



Preliminary Assessment

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

- | | | |
|--|---|---|
| 11. Converting within the metric system is relatively easy because it is a decimal system. | T | F |
| 12. It is impossible to convert from metric units of volume to English units of volume. | T | F |
| 13. One milliliter of water has a mass of one cubic centimeter. | T | F |
| 14. Water has a density of one kilogram per cubic centimeter. | T | F |
| 15. There are 2.54 centimeters to every inch. | T | F |
| 16. Using the metric system, the mass of most larger objects is measured in kilograms. | T | F |
| 17. In the United States, gasoline is commonly sold by the liter. | T | F |
| 18. If the temperature was thirty degrees Celsius, you would need to wear a coat, a hat, and mittens to stay warm. | T | F |
| 19. Simple math, such as multiplying and dividing, is needed when converting between different units of measurements. | T | F |
| 20. It is very hard to find conversion factors and formulas necessary for converting between the English system and the metric system. | T | F |

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 Compute!

1. What is the volume of water in liters?

You Compute!

2. What is the volume and mass of 37 milliliters of water?

You Compute!

3. What is this distance in miles?

Video Quiz:

1. The _____ system is based on multiples of ten.
2. Two hundred centimeters is equivalent to _____ meters.
3. Five milliliters of water has a mass of _____ grams.
4. Road signs in metric countries post distances in _____.
5. A mile is _____ than a kilometer.
6. In the metric system _____ is commonly measured in kilograms.
7. A kilogram is _____ than a pound.
8. _____ is the amount of space something takes up.
9. In the metric system, temperature is measured in degrees _____.
10. Water has a _____ of one gram per cubic centimeter.

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. One milliliter of water has a volume of one cubic _____ .
2. In a metric country, a person's mass is measured in _____ .
3. To convert Fahrenheit temperatures to Celsius, you need to use a mathematical _____ .
4. The process of changing from one unit of measurement to another is called _____ .
5. The metric system is a _____ system.
6. When converting from one system of measurement to another, it is often necessary to use a conversion _____ .
7. There are one thousand milliliters in a _____ .
8. A kilometer is _____ than a mile.
9. The _____ system measures length in centimeters, meters, and kilometers.
10. A gallon is much _____ than a liter.

liter
metric
kilograms
equation
centimeter

larger
conversion
factor
decimal
smaller

Post Assessment

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

- | | | |
|--|---|---|
| 11. Simple math, such as multiplying and dividing, is needed when converting between different units of measurements. | T | F |
| 12. In the United States, gasoline is commonly sold by the liter. | T | F |
| 13. There are 2.54 centimeters to every inch. | T | F |
| 14. One milliliter of water has a mass of one cubic centimeter. | T | F |
| 15. Converting within the metric system is relatively easy because it is a decimal system. | T | F |
| 16. It is very hard to find conversion factors and formulas necessary for converting between the English system and the metric system. | T | F |
| 17. If the temperature was thirty degrees Celsius, you would need to wear a coat, a hat, and mittens to stay warm. | T | F |
| 18. Using the metric system, the mass of most larger objects is measured in kilograms. | T | F |
| 19. Water has a density of one kilogram per cubic centimeter. | T | F |
| 20. It is impossible to convert metric units of volume to English units of volume. | T | F |

The Metric System in Our World

Directions: Read the following information and answer the questions.

Perhaps you've looked recently at a 20 ounce bottle of soda, or a gallon of milk. Alongside the English units of volume is printed the volume measured in metric units of milliliters. These metric figures are necessary because the metric system has now become the global language of commerce and measurement. In fact, only three countries in the world - Liberia, Myanmar, and the United States have not officially converted to the metric system. France was the first country to adopt the metric system more than 200 years ago. Most of the nations in the world converted to the metric system during the past 30 to 40 years.

In the mid-1970's there was a movement within the United States to adopt the metric system. The Metric Conversion Act of 1975 designated the metric system as the "preferred system of weights and measures for US trade and commerce." However, the movement towards metric conversion lost momentum and the metric system failed to become the official system of measurement.

Today, on every soda can in the United States volume is stated in both systems of measurement. At this point in time, the United States is said to be "soft metric," meaning that the nation has only partially adopted the metric system. Because the metric system is not the official system of measurement, the majority of the US population still uses the English system of measurement. Only people working with the metric system on a regular basis such as scientists are familiar and comfortable with the metric system. Until the metric system is adopted as the official measurement system, communicating with the rest of the world regarding measurements will likely to continue to be a costly and confusing process.

Questions:

1. Which countries in the world still haven't converted to the metric system?

2. What does it mean if a country is "soft metric" ?

3. What is the problem with not using the metric system?

Converting Distance and Length

Background: In the English system of measurement, length is commonly measured in units of inches, feet, and yards. Longer distances are measured in miles. Units of millimeters, centimeters, and meters are common units of length in the metric system. To measure longer distances kilometers are used.

To convert units of length between the metric and English system of measurement it is necessary to use a conversion factor. A conversion factor is a ratio that equals one. For example, to convert inches to centimeters you multiply the number of inches by the conversion factor of $\frac{2.54 \text{ centimeters}}{1 \text{ inch}}$

Directions: Convert the following units of length and distance within the metric system.

- 183 centimeters = _____ meters
- 4 meters = _____ centimeters
- 5100 meters = _____ kilometers
- 6.4 kilometers = _____ meters
- 3 kilometers = _____ centimeters

Directions: Convert the following units of metric length and distance to English equivalents.

- 6 kilometers (conversion factor of $\frac{0.62 \text{ km}}{1 \text{ mile}}$) = _____ miles
- 27 kilometers (conversion factor of $\frac{0.62 \text{ km}}{1 \text{ mile}}$) = _____ miles
- 40 centimeters (conversion factor of $\frac{0.39 \text{ cm}}{1 \text{ inch}}$) = _____ inches
- 124 centimeters (conversion factor of $\frac{0.39 \text{ cm}}{1 \text{ inch}}$) = _____ inches

Directions: Convert the following units of English length and distance to metric equivalents.

- 60 inches (conversion factor of $\frac{2.54 \text{ cm}}{1 \text{ inch}}$) = _____ centimeters
- 157 inches (conversion factor of $\frac{2.54 \text{ cm}}{1 \text{ inch}}$) = _____ centimeters
- 7 miles (conversion factor of $\frac{1.6093 \text{ km}}{1 \text{ mile}}$) = _____ kilometers
- 16 miles = (conversion factor of $\frac{1.6093 \text{ km}}{1 \text{ mile}}$) _____ kilometers
- 215 miles = (conversion factor of $\frac{1.6093 \text{ km}}{1 \text{ mile}}$) _____ kilometers

Converting Mass and Volume

Background: In the English system of measurement, mass is commonly measured in units of ounces and pounds. Whereas, in the metric system, mass is measured in grams and kilograms. Volume in the English system is measured in units of cubic inches or cubic yards. Liquid volume is measured in ounces, quarts, and gallons. Volume in the metric system is measured in cubic centimeters or cubic meters. Whereas liquid volume is measured in milliliters and liters.

Directions: Convert the following units of length and distance within the metric system.

- 150 grams = _____ kilograms
- 61 kilograms = _____ grams
- 41 liters = _____ milliliters
- 1,652 milliliters = _____ liters
- 32 milliliters of water = _____ grams
- 450 cubic centimeters of water = _____ grams
- 52 grams of water = _____ cubic centimeters

Directions: Convert the following metric units of mass and volume to English equivalents.

- 24 pounds (conversion factor of $\frac{0.45 \text{ kilograms}}{1 \text{ pound}}$) = _____ kilograms
- 73 kilograms (conversion factor of $\frac{2.20 \text{ pounds}}{1 \text{ kilogram}}$) = _____ pounds
- 40 liters (conversion factor of $\frac{0.26 \text{ gallons}}{1 \text{ liter}}$) = _____ gallons
- 350 liters (conversion factor of $\frac{0.26 \text{ gallons}}{1 \text{ liter}}$) = _____ gallons
- 20 gallons (conversion factor of $\frac{3.7854 \text{ liter}}{1 \text{ gallon}}$) = _____ liters

A Matter of Degrees

Background: The Fahrenheit temperature scale is usually associated with the English system of measurement. In countries using the metric system, the Celsius temperature scale is commonly used. The Celsius temperature scale is also the preferred scale used in science.

To convert between the Celsius scale and the Fahrenheit scale it is necessary to use a mathematical equation to make conversions. To convert from a known Celsius temperature to an unknown Fahrenheit temperature, the equation is as follows:

$$\text{Fahrenheit} = (\text{Celsius temperature}) \times \frac{9}{5} + 32$$

To convert from a known Fahrenheit temperature to an unknown Celsius temperature the equation is as follows:

$$\text{Celsius} = (\text{Fahrenheit temperature} - 32) \times \frac{5}{9}$$

Directions: Convert the following temperatures in degrees Celsius to degrees Fahrenheit.

1. 10° Celsius = _____ $^{\circ}$ Fahrenheit
2. 27° Celsius = _____ $^{\circ}$ Fahrenheit
3. 76° Celsius = _____ $^{\circ}$ Fahrenheit
4. 100° Celsius = _____ $^{\circ}$ Fahrenheit
5. -10° Celsius = _____ $^{\circ}$ Fahrenheit

Directions: Convert the following temperatures in degrees Fahrenheit to degrees Celsius.

6. 32° Fahrenheit = _____ $^{\circ}$ Celsius
7. 17° Fahrenheit = _____ $^{\circ}$ Celsius
8. 73° Fahrenheit = _____ $^{\circ}$ Celsius
9. -16° Fahrenheit = _____ $^{\circ}$ Celsius
10. 100° Fahrenheit = _____ $^{\circ}$ Celsius

Systems of Measurement

Background: Has your school's cross country running team had a 5K race lately? Have you purchased candy which was weighed in grams? Have you looked at the label of a food product lately? Whether you notice it or not, you see and use the metric system every day.

Although the US is not yet a metric nation, the United States government has been moving toward using the metric system for many years. Since 1994, product labels have been marked in both English and metric measurements. Nutrition labels, for example, state the mass of things like sugars and carbohydrates not only in grams and milligrams, but also in ounces.

In order to know and understand metric measurements, it is helpful to know how to convert between different systems of measurement. To convert between different units of measurement, it is necessary to use simple math and a conversion factor. Your teacher will review the use of conversion factors.

Materials: Your teacher will provide several products such as candy, perfume, and paint.

Directions: Using conversion factors, check to see if both the English and metric units on the product labels are accurate.

Item	Units Stated on Container in Both Metric and English		Conversion Factor Needed	Is the Label Accurate?
Perfume				
Paint				
Candy				
Cereal				
Soup				

Vocabulary of Metric Conversions

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

____ 1. argm _____

____ 2. rolitkeem _____

____ 3. mikorlag _____

____ 4. tengivncor _____

____ 5. ogranl _____

____ 6. midlace mseyts _____

____ 7. emil _____

____ 8. nydiste _____

____ 9. iterentmce _____

____ 10. rctime _____

a. the process of changing between two different units of measurement

b. a measurement system based on the number ten and its multiples

c. a unit of metric mass; the mass of one milliliter of water

d. the system of measurement used most commonly throughout the world and in science

e. a measurement of the amount of matter in a given amount of volume

f. the unit of distance used in countries using the metric system

g. the metric unit of length equivalent to one one-hundredth of a meter

h. the English unit of distance equal to 1.62 kilometers

i. the metric unit of mass equal to 2.2 pounds

j. the English unit of liquid volume equivalent to 3.78 liters