

# Introduction to the Metric System

## Teacher's Guide Middle School

### Editors:

Brian A. Jerome, Ph.D.

Stephanie Zak Jerome

### Assistant Editors:

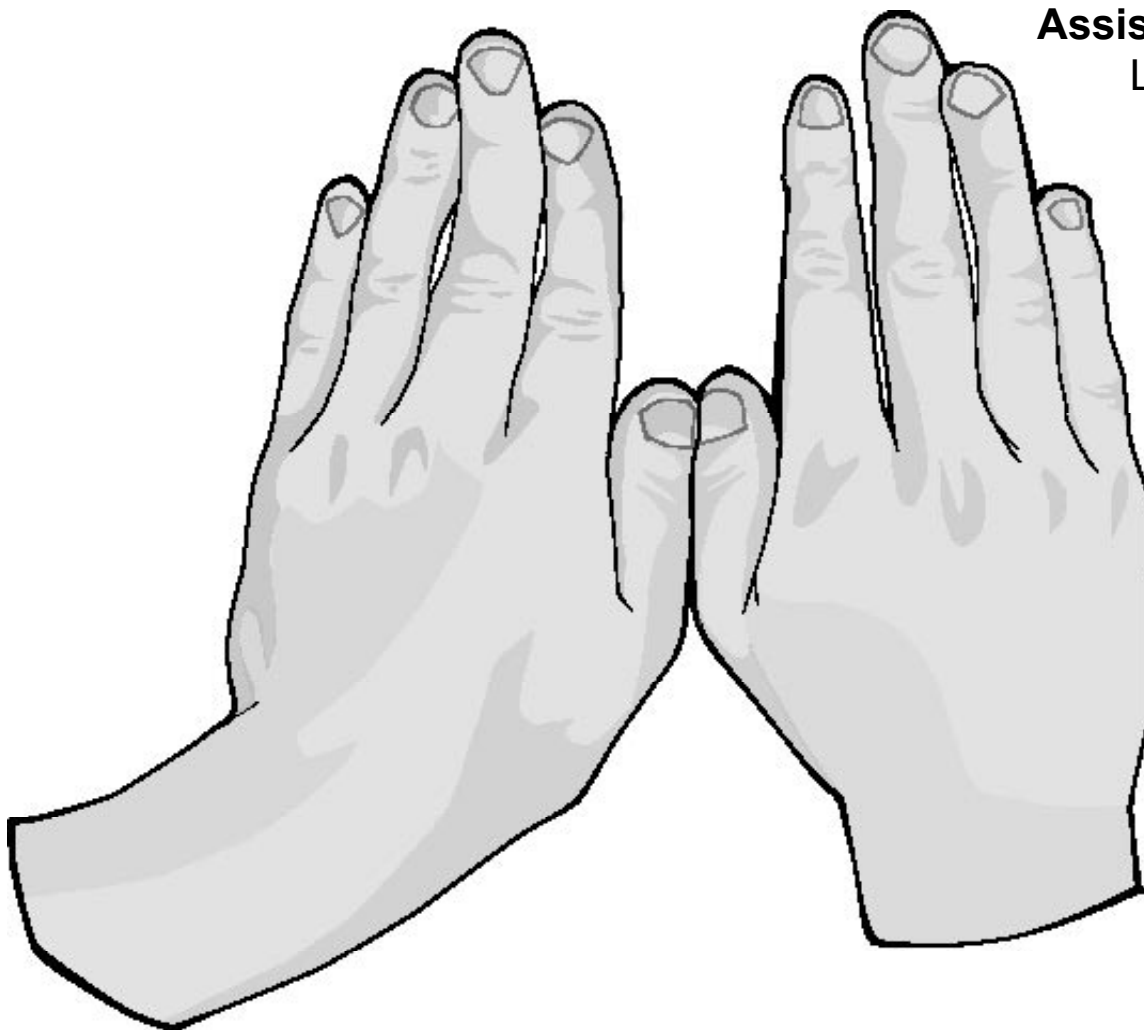
Louise Marrier

Hannah Fjeld

### Graphics:

Dean Ladago

Fred Thodal



**Visual Learning Company**

[www.visuallearningco.com](http://www.visuallearningco.com)

1-800-453-8481

25 Union Street  
Brandon, Vermont



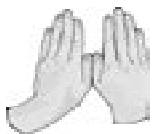
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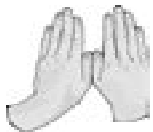
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# **A Message from our Company...**

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.

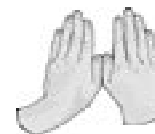
We have a long family tradition of education. Our grandmothers graduated from normal school in the 1920's to become teachers. Brian's mother was an elementary teacher and guidance counselor, and his father was a high school teacher and superintendent. This family tradition inspired Brian to become a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

### The Mathematical World - Numbers (9A)

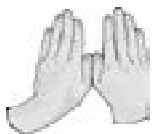
By the end of 5th grade, students should know that:

- When people care about what is being counted or measured, it is important for them to say what the units are (three degrees Fahrenheit is different from three centimeters, three miles from three miles per hour).

### Manipulation and Observation (12C)

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

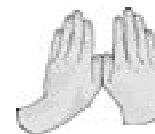
- Read analog and digital meters or instruments used to make direct measurements of length, volume, weight, elapsed time, rates and temperature, and choose appropriate units.



# Student Learning Objectives

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

- Understand the importance of measuring in science and in our daily lives.
- Explain that a measurement includes both a number and a unit of measurement.
- Understand that many countries in the world use the metric system and that the metric system is used by most scientists.
- Compare and contrast the English system and the metric system, and explain some of the benefits of using the metric system.
- Explain that the metric system is a decimal system, based on the number ten and multiples of ten.
- Identify the meter as the basic unit of metric length and describe some of the ways length is measured.
- Identify the liter as the basic unit of metric volume and describe some of the ways volume can be measured.
- Identify the kilogram as the basic unit of metric mass and describe some of the ways mass is measured.
- Generally describe the Celsius temperature scale and state that on the Celsius scale water freezes at 0 degrees and boils at 100 degrees.
- List several reasons people measure things in their every day jobs and lives.



# Assessment

## **Preliminary Assessment:**

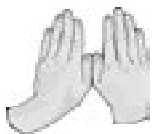
The Preliminary Assessment, provided in the Student Masters section, is an assessment tool designed to gain an understanding of students' pre-existing knowledge. It can also be used as a benchmark upon which to assess student progress based on the objectives stated on the previous pages.

## **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 asking students how tall they are. Then ask what they think the temperature is today. Explain that these numbers are all measurements we use every day. Discuss with the class other things that people measure frequently.

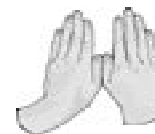
Now ask the students if they know what a system of measurement is. Ask if they can name one. Explain that in the United States the system of measurement most frequently used is the English system. Make a list of English system units of measurement on the blackboard, including pounds, inches, and degrees Fahrenheit. Now introduce the metric system, mentioning that it is used by most countries in the world and that it is the measuring system used in science. After showing the video, ask the students to add examples of metric units of measurement to the list on the board.

## **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.

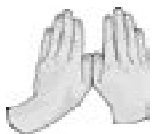
The program is approximately twenty minutes in length and includes a ten question video quiz. Answers are not provided to the Video Quiz on the video, but are included in this teacher’s guide. You may choose to grade student quizzes as an assessment tool or to review the answers in class.

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.



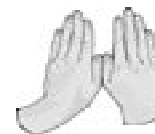
## **Video Script: Introduction to the Metric System**

1. Have you ever counted the number of seconds it takes to run a certain distance?
2. Or have you ever calculated the height . . .
3. . . or length of something?
4. You probably have looked at a thermometer to find the temperature of the air. . .
5. . . or of a liquid.
6. If you have ever done any cooking you've used special spoons and cups to calculate specific amounts of ingredients.
7. And if you've ever wanted to know your weight, you've stepped on a scale.
8. What do all these things have in common?
9. That's right, they all involve the process of measurement.
10. Measuring is a very important activity that we do every day.
11. Measuring is also an important practice in science.
12. During the next few minutes we are going to explore the process of measuring,. . .
13. . . and see how the metric system is essential in scientific measurement.
- 14. Graphic Transition – What is Measuring?**
15. We measure things every day. In fact, measuring is such a common activity, we rarely think about it.
16. What exactly is measuring? Measuring is the process of using tools to calculate the amount of something.
17. For example, we can measure our height using a tool such as a yardstick or meter stick.
18. We measure our weight using a scale.
19. Why is it important to measure things?
20. Let's take a look at some of the people involved in building a house, such as carpenters, . . .
21. . . excavators, and masons to name just a few.
22. All these people need to measure things while building a house.
23. The excavator needs to measure the dimensions of a hole to be dug for the foundation, . . .
24. . . the mason needs to measure the dimensions of the foundation, . . .
25. . . as well as other things such as the dimensions of the chimney.
26. And the carpenter needs to measure the length of boards to be cut, . . .
27. . . among many other things.
28. Similarly, in science, measurement is very important in describing observations,. . .
29. . . whether they be observations of living things such as the weight of an animal, . . .
30. . . or non-living things such as the distance a star is from Earth.



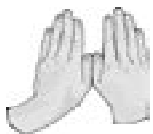
## **Script (cont.)**

31. In science, a wide range of tools are used to make measurements.
32. Whatever tool is used, units of measurement are necessary for the process of measuring.
- 33. Graphic Transition – Units of Measurement**
34. Almost everything we measure has a number, as well as a unit.
35. The unit, also called the unit of measurement, gives the number meaning.
36. In describing a person's height, the number 67 is meaningless without the units of measurement accompanying it.
37. Without the units, we don't know if the person's height is 67 inches or . . .
38. . . . 67 centimeters, and these are people of quite different height. Therefore, when making a measurement it is very important to state the unit of measurement along with the number.
39. In countries such as England and the United States common units of measurement are based on the English System of Measurement.
40. Using the English System of Measurement, length is measured in units such as inches or feet.
41. Distance is measured in yards or miles
42. Weight is measured in pounds.
43. And volume is measured in units such as ounces, quarts, or gallons.
44. In most countries in the world, and in science, another system of measurement is used.
- 45. You Decide!** What is this other system of measurement?
46. The system used by scientists and by people in many countries is called the metric system.
47. The metric system is also referred to as the International System of Units, or SI for short.
48. Even though the metric system may be unfamiliar to you, it is fun and easy to use.
49. Let's take a closer look at the metric system.
- 50. Graphic Transition – The Metric System**
51. The metric system is a decimal system.
52. This means that it is based on the number 10 and multiples of 10.
53. For example, the meter is the basic unit of length in the metric system.
54. A meter is made up of smaller units called decimeters. There are 10 decimeters in a meter.
55. A decimeter is made up of smaller units called centimeters. Your fingernail is about 1 centimeter long.
56. There are 10 centimeters in a decimeter.
57. And a centimeter is made up of yet smaller units called millimeters.



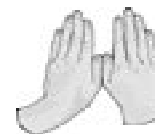
## **Script (cont.)**

58. You Decide! How many millimeters are in a centimeter?
59. That's right, there are 10 millimeters in a centimeter.
60. As you can see, the basic units of length in the metric system are based on multiples of 10.
61. The English System of Measurement is a little more difficult to use.
62. For example, in the English System, 1 yard is made up of 3 feet.
63. And each foot is made up of 12 inches.
64. And an inch is divided up into fractional components such as a  $\frac{1}{2}$  inch, or  $\frac{5}{8}$  of an inch.
65. So as you can see, compared to the English System of Measurement, the metric system makes more sense, and with a little practice, is very easy to use.
66. **Graphic Transition – Metric Length and Distance**
67. If you are a football player you are interested in the number of yards to go to make a first down.
68. If you are a runner, you are interested in the number of miles or kilometers you run.
69. If you are a golfer, you are interested in the number of yards to the hole.
70. And if you participate in track and field you might be interested in the number of centimeters jumped. . .
71. . . or the number of meters an object is thrown.
72. All these examples involve measurements of length.
73. Length is the distance between two points.
74. In the metric system, common tools such as meter sticks and metric rulers are used to measure length.
75. When measuring smaller objects such as this flower, a metric ruler can be used.
76. Centimeters or millimeters are used to describe the length of smaller objects.
77. When measuring the length of larger objects a meter stick is used. This picture frame for example, has a height of one meter.
78. Distance is another way of describing length. Kilometers are units of metric distance.
79. In most countries using the metric system, distances from place to place are described in kilometers.
80. There are 1,000 meters in one kilometer.
81. To put that another way, there are about 10 soccer fields in a kilometer.
82. **Graphic Transition – Metric Volume**
83. Have you ever measured out milk or water when cooking?
84. Or perhaps you've had to keep track of the amount of gas pumped into a car.
85. **You Decide!** What kind of measurements are these?
86. These are examples of measurements of liquid volume.
87. Volume is the amount of space matter takes up.
88. In the metric system, the basic unit of volume is the liter.



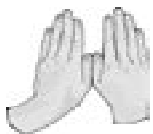
## **Script (cont.)**

89. This beaker is holding one liter of water.
90. There are 1000 milliliters in one liter. This eye dropper contains just one milliliter of medicine.
91. This bottle of water contains 500 milliliters.
92. Solids also have volume. It is possible to calculate the volume of solids such as this block of wood, . . .
93. . . . or this book.
94. In the metric system the volume of smaller objects is calculated in cubic centimeters.
95. This small cube has a volume of one cubic centimeter. It has a length of one centimeter, a height of one centimeter, and a width of one centimeter.
96. This DVD case, for example, has a volume of 385 cubic centimeters.
97. The volume of larger objects is expressed in cubic meters.
- 98. Graphic Transition – Metric Mass**
- 99. You Compare!** What has more mass, the tennis ball or the golf ball?
100. Even though the golf ball is smaller than the tennis ball, it has more mass.
101. Mass is a measurement of the amount of matter in an object. Everything we see has mass.
102. The basic unit of mass in the metric system is the gram.
103. This small weight has a mass of one gram.
- 104. You Predict!** What is the mass of this coin?
105. As you can see, this coin has a mass of 6 grams.
106. Grams are used to measure the mass of smaller objects.
107. The mass of larger objects such as this cement block is measured in kilograms. There are 1000 grams in one kilogram.
108. Scales such as this are often used to measure larger objects in kilograms.
109. The mass of yet smaller objects such as this pine needle is measured in milligrams.
110. There are 1000 milligrams in a gram.
- 111. Graphic Transition – Metric Temperature**
112. If you travel to a country in South America, Europe, . . .
113. . . . or even Canada it may be difficult for you to understand the weather forecast.
114. If you hear that the weather forecast calls for a high of 30 degrees, you may think you need a coat, hat, and gloves.
115. But if you were to wear these things you would be sweltering.
116. This is because the forecast is given in degrees Celsius, . . .
117. . . . and 30 degrees Celsius is equivalent to about 86 degrees Fahrenheit.
118. Scientists and those living in other countries using the metric system tend to record temperature in degrees Celsius.
119. In the Celsius scale, water freezes at 0 degrees Celsius, . . .



## Script (cont.)

120. . . . and water boils at 100 degrees Celsius.
121. Room temperature is between 20 and 25 degrees Celsius.
122. And normal body temperature is around 37 degrees Celsius.
- 123. Graphic Transition – Summing Up**
124. During the past few minutes we have learned a great deal about the process of measurement and the metric system.
125. We began by learning that measuring is the process of using tools to calculate the amount of something.
126. We discussed how we measure things every day, and why measurement is very important in science.
127. We saw that measurements include a number accompanied by a unit of measurement.
128. The English System and the metric system are two different systems of measurement.
129. We learned that the metric system is a decimal system based on the number ten or multiples of ten.
130. More specifically, we explored some of the different ways the metric system can be utilized.
131. For example, we saw how length and distance can be measured in the metric system in units such as meters, centimeters, and millimeters.
132. We reviewed that volume is the amount of space something takes up.
133. In the metric system, liquid volume is commonly measured in liters, or milliliters,...
134. ...whereas the volume of solids is commonly measured in cubic meters or cubic centimeters.
135. Mass is a measurement of the amount of matter in an object.
136. Mass in the metric system is measured in kilograms, grams, or milligrams.
137. Finally we briefly talked about how temperature is measured using the Celsius scale in countries using the metric system.
138. Scientists also commonly use the Celsius scale.
139. Water boils at 100 degrees Celsius and freezes at 0 degrees Celsius.
140. So the next time you read a road sign in a country using the metric system, . . .
141. . . . measure some liquid in a beaker, . .
142. . . . or read a Celsius thermometer, . . .
143. . . . think about some of the things we discussed during the past few minutes.
144. You might just think about the metric system a little differently.
- 145. Graphic Transition – Video Quiz**
- Fill in the correct word to complete the sentence. Good luck, and let's get started.
1. \_\_\_\_\_ are usually used to express a value of measurement.
  2. The \_\_\_\_\_ of measurement gives the number meaning.



## **Script (cont.)**

3. The \_\_\_\_\_ is also referred to as SI.
4. The metric system is based on multiples of \_\_\_\_\_.
5. There are 10 \_\_\_\_\_ in a meter.
6. \_\_\_\_\_ is the amount of space matter takes up.
7. In the metric system, the basic unit of liquid volume is the \_\_\_\_\_.
8. \_\_\_\_\_ is a measurement of the amount of matter in an object.
9. The basic unit of mass in the metric system is the \_\_\_\_\_.
10. In the \_\_\_\_\_ scale, water freezes at 0 degrees and boils at 100 degrees.

**Answers may be found on page 17.**



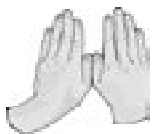
# **Student Assessments and Activities**

## **Assessment Masters:**

- Preliminary Assessment
- Video Review
- Post Assessment

## **Student Activity Masters:**

- The Origin of the Metric System
- Standard Units of Measurement
- Comparing English and Metric Units
- Vocabulary of *Introduction to the Metric System*



# Answers to Student Assessments

## Preliminary Assessment (pgs. 20-21)

1. metric
2. decimal
3. centimeters
4. measurements
5. kilograms
6. kilometers
7. Celsius
8. liters
9. milliliters
10. thermometer
11. T
12. F
13. F
14. F
15. T
16. F
17. T
18. F
19. T
20. T

## Video Review (pg. 22)

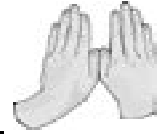
1. The other system of measurement is the metric system.
2. Measurements of the amount of milk, water, or gas are measurements of volume.
3. The golf ball has more mass than the tennis ball even though it is smaller, because it is more dense.
4. According to the reading on the scale, the mass of the coin is 6 grams.

## Video Quiz (p. 22)

1. Numbers
2. unit
3. metric system
4. ten
5. decimeters
6. Volume
7. liter
8. Mass
9. gram
10. Celsius

## Post Assessment (pgs. 23-24)

1. kilograms
2. liters
3. Celsius
4. metric
5. thermometer
6. milliliters
7. centimeters
8. kilometers
9. decimal
10. measurements
11. F
12. T
13. T
14. F
15. F
16. F
17. T
18. T
19. T
20. F



# Answers to Student Activities

## The Origin of the Metric System (p. 25)

1. The metric system was created in France, which was also the first country to institute the metric system.
2. The metric system is easy to use because its a decimal system, making it easy to convert between units.
3. The metric system is based on the meter, which was created based on a fraction of the circumference of the Earth.

## Standard Units of Measurement (p. 26-27)

	Height of desk	Width of piece of paper	Length of room
Student A			
Student B			
Student C	answers will vary		
Student D			
Student E			

	Height of desk	Width of piece of paper	Length of room
Actual measurements using metric system			

### Questions:

1. A foot has measured either 12 or 13 inches, as well as 9.8 inches in the "natural foot."
2. There are 16 ounces in the pound Americans use today.
3. The measurements were not all the same because the students measuring had different sized body parts.
4. The whole class could have agreed upon a standard tool, such as a piece of string or a book, to measure the objects.
5. We need standard units of measurement so people can measure things and come to a common agreement on their measurements.

## Comparing English and Metric Systems (p. 28 - 29)

### Comparing Length:

Type of Measurement	English System of Measurement	Metric System of Measurement
You want to measure the distance from one city to another city.	miles	kilometers
You want to measure the distance you ran in 3 minutes.	miles	meters
You want to measure the dimensions of a room.	feet	meters
You want to measure the width of a book.	inches	centimeters
You want to measure the thickness of a coin.	fraction of an inch	millimeters

### Comparing Mass:

Type of Measurement	English System of Measurement	Metric System of Measurement
You want to measure your weight.	pounds	kilograms
You want to measure the mass of flour to bake cookies.	ounces	grams
You want to measure the mass of a large basket full of apples.	pounds	kilograms
You want to measure the mass of a pill.	fractions of an ounce	milligrams

### Comparing Volume:

Type of Measurement	English System of Measurement	Metric System of Measurement
You want to measure water to make a pitcher of lemonade.	quarts	liters
You want to measure the volume of a cardboard box.	cubic inches	cubic centimeters
You want to measure the amount of milk a herd of cows produces in a day.	gallons	liters
You want to measure out a dosage of cough syrup.	ounces	milliliters

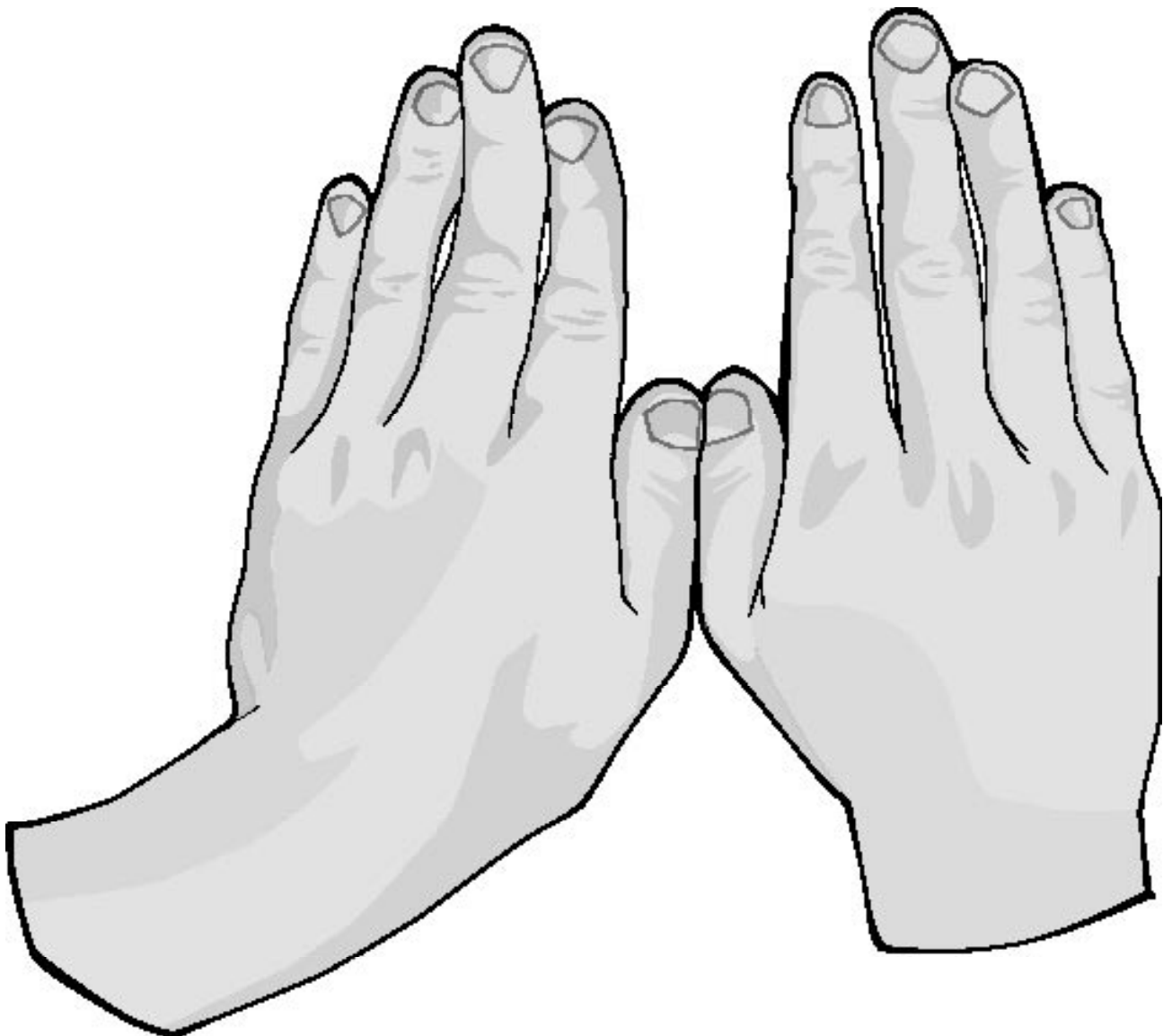
### Questions:

1. It's very important to become familiar with the metric system because it's essential to the study of science, and because someday the US will likely convert to the metric system.
2. There are 2 different kinds of units for volume, one to measure the volume of solids and the other the volume of liquids.
3. The metric system often uses prefixes like milli-, centi-, and kilo-. Milli- and centi- mean that things are smaller, while kilo- means that things are larger.

## Vocabulary of Introduction to the Metric System (p. 30)

- |                    |                         |
|--------------------|-------------------------|
| 1. d - measuring   | 6. i - volume           |
| 2. g - meter       | 7. j - cubic centimeter |
| 3. e - length      | 8. b - milligram        |
| 4. a - meter stick | 9. f - Celsius          |
| 5. c - kilometer   | 10. h - metric system   |

# **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. The \_\_\_\_\_ system is the system of measurement used in most countries around the world and in science.
2. The metric system is called a \_\_\_\_\_ system because it is based on the number ten and its multiples.
3. The best units to measure the length of a pencil would be \_\_\_\_\_ .
4. Without units, \_\_\_\_\_ are meaningless.
5. Using the metric system, you would measure your weight in \_\_\_\_\_ .
6. A metric odometer measures distance in \_\_\_\_\_ .
7. In the \_\_\_\_\_ scale, the freezing point of water is zero degrees.
8. Gasoline is measured in \_\_\_\_\_ in metric countries.
9. There are one thousand \_\_\_\_\_ in a liter.
10. In order to find the temperature of the air or a liquid, you would look at a \_\_\_\_\_ .

liters  
Celsius  
kilograms  
milliliters  
decimal

centimeters  
measurements  
thermometer  
metric  
kilometers

# Preliminary Assessment

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

- |  |   |   |
|--|---|---|
| 11. Measurement is very important in describing observations.                    | T | F |
| 12. Units are usually not necessary when reporting a measurement.                | T | F |
| 13. Only scientists use the metric system.                                       | T | F |
| 14. The English system is the most widely used system of measurement in science. | T | F |
| 15. The meter is the standard unit of length in the metric system.               | T | F |
| 16. A milliliter is 1000 times larger than a liter.                              | T | F |
| 17. Water boils at 100 degrees on the Celsius scale.                             | T | F |
| 18. Kilograms are far too large a unit to measure your body weight.              | T | F |
| 19. Metric volume can be measured in cubic centimeters or liters.                | T | F |
| 20. There are 1000 meters in a kilometer.  | 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 Decide!**

1. What is this other system of measurement?

**You Decide!**

2. What kind of measurements are these?

**You Compare!**

3. What has more mass, the tennis ball or the golf ball?

**You Predict!**

4. What is the mass of this coin?

**Video Quiz:**

1. \_\_\_\_\_ are usually used to express a value of measurement.
2. The \_\_\_\_\_ of measurement gives the number meaning.
3. The \_\_\_\_\_ is also referred to as the SI.
4. The metric system is based on multiples of \_\_\_\_\_ .
5. There are 10 \_\_\_\_\_ in a meter.
6. \_\_\_\_\_ is the amount of space matter takes up.
7. In the metric system, the basic unit of liquid volume is the \_\_\_\_\_ .
8. \_\_\_\_\_ is a measurement of the amount of matter in an object.
9. The basic unit of mass in the metric system is the \_\_\_\_\_ .
10. In the \_\_\_\_\_ scale, water freezes at 0 degrees and boils at 100 degrees.

# 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. Using the metric system, you would measure your weight in \_\_\_\_\_ .
2. Gasoline is measured in \_\_\_\_\_ in metric countries.
3. In the \_\_\_\_\_ scale, the freezing point of water is zero degrees.
4. The \_\_\_\_\_ system is the system of measurement used in most countries around the world and in science.
5. In order to find the temperature of the air or a liquid, you would look at a \_\_\_\_\_ .
6. There are one thousand \_\_\_\_\_ in a liter.
7. The best units to measure the length of a pencil would be \_\_\_\_\_ .
8. A metric odometer measures distance in \_\_\_\_\_ .
9. The metric system is called a \_\_\_\_\_ system because it is based on the number ten and its multiples.
10. Without units, \_\_\_\_\_ are meaningless.

centimeters  
measurements  
thermometer  
metric  
kilometers

liters  
Celsius  
kilograms  
milliliters  
decimal

# Post Assessment

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

- |  |   |   |
|--|---|---|
| 11. The English system is the most widely used system of measurement in science. | T | F |
| 12. Water boils at 100 degrees on the Celsius scale.                             | T | F |
| 13. Metric volume can be measured in cubic centimeters or liters.                | T | F |
| 14. A milliliter is 1000 times larger than a liter.                              | T | F |
| 15. Units are usually not necessary when reporting a measurement.                | T | F |
| 16. Kilograms are far too large a unit to measure your body weight.              | T | F |
| 17. There are 1000 meters in a kilometer.  | T | F |
| 18. Measurement is very important in describing observations.                    | T | F |
| 19. The meter is the standard unit of length in the metric system.               | T | F |
| 20. Only scientists use the metric system.                                       | T | F |

# The Origin of the Metric System

Read the following information and answer the questions:

While the metric system may seem very new to you, it actually has been around for more than 300 years! A decimal-based system has been proposed several times throughout history, first in the 1500s. A decimal system is based on the number ten and its multiples, making it easy to convert between units. However, the metric system as we know it, with the meter as its base unit, wasn't created until 1670 by a French astronomer. The first country to adopt the metric system as its national system of measurement was France. After the French Revolution of the 1780s, the National Assembly instituted the metric system as an official, legal measuring system throughout the country.

Slowly, over the next two hundred years, the rest of the world converted to the metric system as its standard system of measurement. The main benefit of using the metric system is its simplicity. Because it is a decimal system, it is relatively easy to convert between units. Through time the metric system has become an international standard for commerce, and science.

The metric system has changed throughout the time it has existed, primarily in the technical definition of the size of the units. When the metric system was first adopted, the meter was based on a fraction of the circumference of the Earth. The gram and the liter - the measurements of mass and volume - are based on the meter. The metric system was revised and restandardized in 1960, and named the International System of Units, or SI for short. Today there are seven standard units in the metric system, including the meter, the kilogram, the second, the ampere, the kelvin, and the mole. Though it has changed a little through time, the metric system remains functionally the same as when it was created more than 300 years ago.

## Questions:

1. What country first created and instituted the metric system?
2. Why is the metric system so easy to use?
3. What unit is the metric system based on? From what measurement was that unit created?

# Standard Units of Measurement

**Background:**

As you probably already know, people everywhere measure things every day. Throughout history, human beings have created systems of measurement based on many different things. Few of the systems were ever standardized. Even the English system that Americans use today has changed over time.

Did you know that a foot has not always equaled twelve inches? Hundreds of years ago there were three different, commonly used measurements of a foot: the 12-inch foot, a foot equal to about 13 inches, and a “natural foot” equal to about 9.8 inches. So, if factories had existed then, one factory could have made a part measured in natural feet and another in 12-inch feet, and the machine they were building would never fit together. There have also been different weights of pounds- either 12 or 16 ounces. This was confusing to merchants and customers in England throughout the Middle Ages. You probably had to be very careful that an untrustworthy shop owner didn't give you 12 ounces of flour when you paid for 16!

In this activity, we will experience the need for standard units of measurement by measuring with body parts. While you measure, think about why this system doesn't work very well even though everyone is using the same body parts.

**Materials:** Standard Units of Measurement worksheet, desk, sheet of paper, metric ruler, meter stick, metric tape measure

**Directions:**

1. Measure the height of the desk using your hands. Write your measurement in the Student A row of the chart on your worksheet. Ask four of your classmates for their measurements of the same desk, and write them in the rows for Students B-E.
2. Using your index finger, measure the width of a piece of paper. Write your measurement in the second column of the chart, then ask four classmates for their measurements of the same piece of paper.
3. Measure the length of the classroom using your feet, by stepping heel to toe. Record your measurement in the last column on your worksheet. Ask four classmates for their measurements of the length of the room and use them to fill in the rest of your table.
4. Now use the metric measuring tools to measure the same three objects. Write your measurements in the second data table on your worksheet.
5. Answer the questions at the bottom of the worksheet.

## Standard Units of Measurement Worksheet

	Height of desk	Width of piece of paper	Length of room
Student A			
Student B			
Student C			
Student D			
Student E			

	Height of desk	Width of piece of paper	Length of room
Actual measurements using metric system			

**Questions:**

1. What different types of measurements were equal to a foot in the past?
2. How many ounces are in the pound that Americans still use today?
3. Why weren't all of the measurements of each object the same?
4. If you hadn't had the metric measuring tools, how else could the whole class have measured the objects and obtained the same results?
5. Why do we need standard units of measurement?

# Comparing English and Metric Systems

**Background:**

Although the United States has yet to convert to the metric system, it may be that the country will convert within your lifetime. Knowing the metric system is also essential to learning science, because it is the system of measurement commonly used in science. Thus, it is important that you familiarize yourself with the units of the metric system. A good way of doing this is to learn which units are comparable to units in the English system. Study the following table which compares units in the two different systems.

To Measure	Metric Units	English Units
Volume	milliliter, liter, cubic centimeter, cubic meter	ounce, quart, gallon, cubic inch, cubic yard
Length	millimeter, centimeter, meter, kilometer	fraction of an inch, inch, foot, yard, mile
Mass	milligram, gram, kilogram	fraction of an ounce, ounce, pound

**Materials:** Comparing English and Metric Systems Worksheet

**Directions:** Complete the worksheet by filling in all of the missing units that would best measure the length, mass, or volume described in the first column. Then answer the following questions:

**Questions:**

1. Why is it important to become familiar with the metric system?
2. Why are there two different kinds of units for volume?
3. What prefixes does the metric system use often? Which ones mean things are smaller? Which ones mean things are larger?

# Comparing English and Metric Units Worksheet

## Comparing Length:

Type of Measurement	English System of Measurement	Metric System of Measurement
You want to measure the distance from one city to another city.	miles	1. _____
You want to measure the distance you ran in 3 minutes.	2. _____	meters
You want to measure the dimensions of a room.	3. _____	meters
You want to measure the width of a book.	inches	4. _____
You want to measure the thickness of a coin.	fraction of an inch	5. _____

## Comparing Mass:

Type of Measurement	English System of Measurement	Metric System of Measurement
You want to measure your weight.	pounds	6. _____
You want to measure the mass of flour to bake cookies.	7. _____	grams
You want to measure the mass of a large basket full of apples.	8. _____	kilograms
You want to measure the mass of a pill.	fractions of an ounce	9. _____

## Comparing Volume:

Type of Measurement	English System of Measurement	Metric System of Measurement
You want to measure water to make a pitcher of lemonade.	10. _____	liters
You want to measure the volume of a cardboard box.	cubic inches	11. _____
You want to measure the amount of milk a herd of cows produces in a day.	12. _____	liters
You want to measure out a dosage of cough syrup.	ounces	13. _____

# Vocabulary of the Metric System

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

- |                                    |   |
|------------------------------------|---|
| ____ 1. ismnuegra<br>_____         | a. tool used to measure length                                      |
| ____ 2. treem<br>_____             | b. unit that measures mass of very small objects                    |
| ____ 3. tnlhge<br>_____            | c. unit of metric distance  |
| ____ 4. retme icstk<br>_____       | d. the process of using tools to calculate the amount of something  |
| ____ 5. tokemirel<br>_____         | e. the distance between two points                                  |
| ____ 6. moeluv<br>_____            | f. system of measuring temperature in the metric system             |
| ____ 7. iubcc emnrctieetc<br>_____ | g. the basic unit of length in the metric system                    |
| ____ 8. aglimmril<br>_____         | h. a decimal system of measurement used widely throughout the world |
| ____ 9. iesslCu<br>_____           | i. the amount of space matter takes up                              |
| ____ 10. rmtcie eysmts<br>_____    | j. unit of volume of solid objects                                  |