

Metric Length and Temperature

Teacher's Guide Middle School

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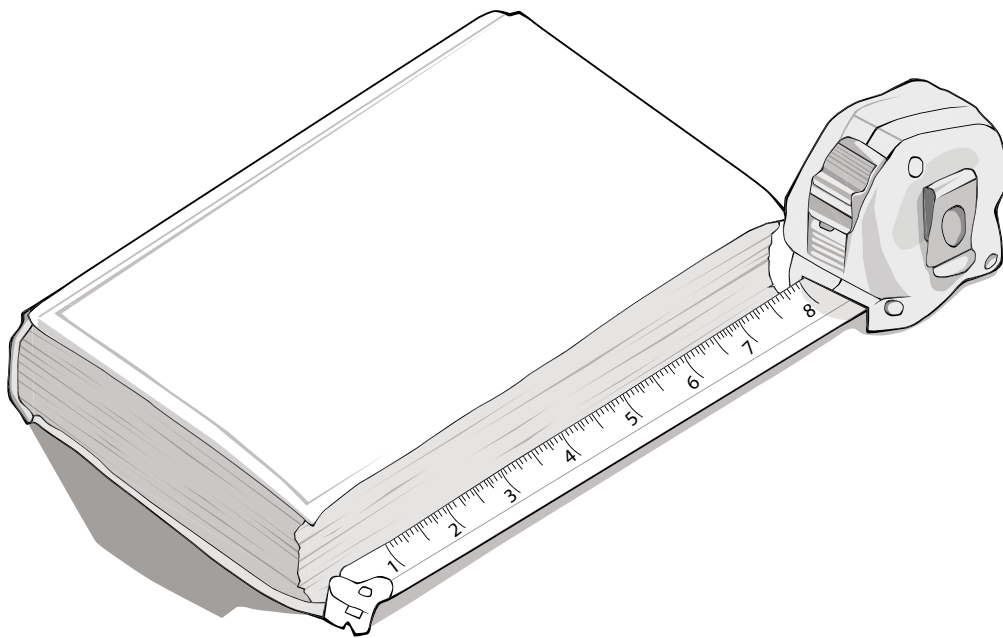
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Table of Contents

	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



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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)

Habits of Mind - 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.

Habits of Mind - Computation and Estimation (12B)

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:

- Explain the importance of standard units of measurement in giving a number meaning.
- Differentiate between a number and its unit.
- Define length as the distance between two points.
- Define temperature as a way to tell how hot or cold something is.
- List some examples of different tools used in measuring length, including rulers, tape measures, meter sticks, and odometers.
- Understand that there are different systems of measurement used around the world, but that the metric system is the most common, and is the measuring system used in science.
- Identify the various metric units of length including meters, decimeters, centimeters, millimeters, and kilometers, and describe some examples of objects each unit would best measure.
- State that a thermometer is the instrument most frequently used to measure temperature.
- Compare the Fahrenheit and Celsius temperature scales, particularly the temperatures at which water freezes and boils in each.
- Explain the usefulness of the Kelvin scale to scientists, and understand that zero Kelvin (absolute zero) is the lowest temperature that can be reached on Earth.



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 students the program, ask students why we need to measure length. Ask them to list different lengths we measure often, such as our height. Now hold up a ruler with both inches and centimeters marked on it. Ask students why there are two different systems of measurement on the ruler. Ask students to describe how the systems of measurement are different from each other. Explain that the metric system and the English system measure length using different units. Briefly review some of the metric units of measurement concerning length such as meter, centimeter, and millimeter. Write these terms on the board.

Continue to explain that the metric system also uses different units to measure temperature. Tell students the approximate temperature in the classroom in degrees Celsius. Write the following terms on the blackboard: freezing point of water, and boiling point of water. Tell students to get these values by watching the video. Finally tell students to pay close attention to the video to learn more about how length and temperature are measured using 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 Length and Temperature

1. What do you think the height is of these tall buildings?
2. Have you ever calculated the distance you traveled in a car?
3. Maybe you have used a tape measure to find out how wide a board is?
4. Or, perhaps you have used a ruler to see how long something is?
5. What do all these things have in common?
6. All these measurements involve length.
7. Length is the distance between two points. During the next few minutes we are going to discuss the process of measuring length.
8. We are also going to explore the process of measuring temperature.
9. Measuring temperature is very important. Temperature tells us how hot or cold something is.
10. If you are interested in weather, you may want to know the temperature of the air.
11. Setting the correct temperature on an oven is very important while cooking.
12. And measuring temperature is very important in science.
13. During the next few minutes we are going to discuss the process of measuring length, as well as temperature.
14. And, we will see how length and temperature are measured using the metric system.
- 15. Graphic Transition - Measuring Length**
- 16. You Compare!** What do the following have in common: the odometer in this car, this tape measure, and this ruler?
17. That is right, they are all used to measure distance or length.
18. Everyday we measure distance and length.
19. What is length? As we already mentioned, length is the distance between two points.
20. When we measure our height, we are measuring length.
21. Distance is a way of describing length that generally involves longer distances such as how far you bicycled in a day,...
22. ...or how far a boat traveled.
23. There are a variety of tools used to measure length and distance.
24. Longer distances can be measured with odometers such as the one on this bicycle.
25. While rulers, yardsticks or meter sticks,...
26. ...and tape measures are used to measure shorter units of length.
27. Before we actually talk about how length and distances are measured, let us take a look at something called units of measurement.



Script (cont.)

28. Graphic Transition - Units of Measurement

29. Suppose you want to fit a table through a doorway but you are not sure that it will fit.
30. You need to measure the width of the table and the doorway but you do not have a ruler.
31. So, you decide to use your hands as a measuring tool.
32. You measure the table to be 11 hands wide,
33. ...and your friend measures the door to be 12 hands wide. The table should fit.
34. But, when you try it, it does not fit!
- 35. You Decide!** Why doesn't the table fit through the door?
36. The reason the table does not fit is because you and your friend have hands that are very different sizes.
37. This is why, over time, people have developed standard units of measurement.
38. With standard units of measurement we can all be sure that we are talking about the same thing.
39. Most everything we measure has numbers as well as units.
40. The unit, also called the unit of measurement, gives the number meaning.
41. For example the runners in this race are on a course that is 4 kilometers long.
42. The 4 is the number and the kilometers are the units.
43. This beaker is holding 150 milliliters of liquid.
44. The 150 is the number and milliliters are the units.
45. And this thermometer states that the temperature is 33 degrees Celsius.
46. The 33 is the number and the degrees Celsius are the units.
47. What makes things confusing is that there are different systems of measurement used in the world.
48. In countries such as the United States and England, the system of measurement commonly used is the English System.
49. In the English System, length is recorded in units of inches, feet, or yards.
50. Most other places in the world, as well as in science, use the metric system.
51. The metric system, also know as the International System of Units, uses different units to describe length and distance. Let us take a closer look at metric length and distance.

52. Graphic Transition - Units of Metric Length and Distance

53. The basic unit of metric length is a meter. This is a meter stick. It is one meter long.
54. This plant is about one meter high.
55. Things commonly measured in meters are soccer fields,



Script (cont.)

56. ...the length of rope or electrical wire,...
57. ...and the height of mountains.
58. A meter is made up of smaller units called decimeters.
59. There are 10 decimeters in one meter.
60. This small book has a length of about one decimeter.
61. And this leaf has a width of about one decimeter.
62. A decimeter is made up of smaller units called centimeters. There are 10 centimeters in one decimeter.
- 63. You Compute!** If there are 10 decimeters in a meter and there are 10 centimeters in a decimeter, how many centimeters are in one meter?
64. That is right, there are 100 centimeters in a meter.
65. Smaller lengths such as the amount of material used to sew something,...
66. ...or the length of a piece of paper are measured in centimeters.
67. When measuring even smaller lengths, millimeters are used.
68. These three cards have a width of 1 millimeter.
69. As you might have guessed, there are 10 millimeters in one centimeter.
70. So, length is commonly measured in meters, decimeters, centimeters, and millimeters. What units of measurement are used to measure large distances?
71. Distances in the metric system are measured in units called kilometers.
72. The word “kilo” means 1000. Therefore, a kilometer is made up of 1000 meters.
73. The distance across this pond is about one kilometer.
74. And the distance to the end of this road is about one kilometer.
75. Let us now take a look at how length and distance are measured in the metric system.
- 76. Graphic Transition - Measuring Length and Distance**
- 77. You Decide!** What simple tool would you use to measure the length of this pencil?
78. That is right, you would use a ruler. If you wanted to measure the pencil in metric units, you would use a metric ruler.
79. Metric rulers are commonly made of wood or plastic.
80. Metric rulers are divided up into centimeters which are numbered.
81. This particular metric ruler contains 30 centimeters.
82. If you look closely, you can see that each centimeter is divided into many tiny lines. These are millimeters.
- 83. You Observe!** What is the length of this piece of thread?
84. The thread has a length of 22 centimeters and 4 millimeters.
85. We can also say it has a length of 22.4 centimeters.



Script (cont.)

86. Because the metric system is a decimal system, meaning it is based on the number 10 and multiples of 10, we can easily express fractions as decimals.
87. This is a meter stick. It is one meter long.
88. Meter sticks are convenient when measuring slightly bigger things,
89. ...such as the length of these curtains, or
90. ...the width of a door.
91. For even bigger objects, a metric tape measure is needed.
92. You might want to use a metric tape measure to measure the length of a building,...
93. ...or to measure the length of a piece of pipe.
94. Quite often metric tape measures have inches on one side, and centimeters on the other side.
95. Make sure you are using the correct side if this is the case.
96. If you use a metric tape measure to calculate the dimensions of a room, for example, you would state the measurement as follows: 6 meters and 42 centimeters or 6.42 meters.
97. As we already mentioned, long distances in the metric system are measured in kilometers instead of using miles as in the English System.
98. This road sign states the distances to certain towns in kilometers.
99. Let us now take a look at some of the ways temperature is measured in the metric system.
- 100. Graphic Transition - Temperature in the Metric System**
- 101. You Decide!** What instrument is commonly used to measure temperature?
102. That is right, a thermometer is commonly used to measure temperature.
103. Traditional thermometers consist of a glass tube containing a liquid, and a scale of numbers.
104. As the temperature fluctuates, the liquid expands and contracts, moving up and down the glass tube.
105. More recently digital thermometers have become increasingly common.
106. In the English System of measurement, temperature is measured using the Fahrenheit scale,...
107. ...where water freezes at 32 degrees Fahrenheit, and water boils at 212 degrees Fahrenheit.
108. There are 180 degrees between the freezing point and boiling point of water.
109. In countries using the Metric System, the Celsius scale is used to measure temperature.
110. In many ways the Celsius scale is easier to use.
111. Water freezes at 0 degrees Celsius,...



Script (cont.)

112. ...and boils at 100 degrees Celsius.
113. There are exactly 100 degrees between the freezing point and boiling point of water.
114. Many thermometers have the Fahrenheit scale on one side and the Celsius scale on the other.
115. This way you can easily compare Fahrenheit readings to Celsius equivalents.
116. For example, this common household thermometer states that the temperature in degrees Celsius is 28 degrees.
- 117. You Observe!** What is the Fahrenheit temperature?
118. That is right, the Fahrenheit scale on the left states that the temperature is 81 degrees Fahrenheit.
119. So, as you can see, it is quite easy to read the temperature in both Celsius and Fahrenheit degrees on the same thermometer.
- 120. Graphic Transition - The Kelvin Scale**
121. Another temperature scale that is sometimes used by scientists is the Kelvin Scale.
122. In the Kelvin Scale, temperature is measured in units called kelvins.
- 123. You Compute!** What is the temperature in Kelvins, equivalent to 15 degrees Celsius?
124. To get the answer simply add 15 to 273. The answer is 288 Kelvins.
125. One of the reasons the Kelvin Scale is useful to scientists is because the lowest reading, 0 kelvin, is the lowest theoretical temperature that can be reached, also known as absolute zero.
- 126. Graphic Transition - Summing Up**
127. During the past few minutes we have explored many of the interesting ways length, and,...
128. ...temperature are measured in the metric system.
129. We discussed the importance and necessity of standard units of measurement.
130. We explained that measurement has a number as well as a unit.
131. We briefly contrasted the English System of Measurement and the Metric System of Measurement.
132. We saw that the metric system is a decimal system based on the number 10 and multiples of 10.
133. The meter is the basic unit of length in the metric system.
134. There are 100 centimeters in a meter, and each centimeter is divided into 10 millimeters.
135. We discussed that longer distances are measured in units called kilometers. There are 1000 meters in a kilometer.



Script (cont.)

136. The Celsius scale is commonly used to measure temperature in the metric system.
137. In the Celsius scale, water freezes at 0 degrees and boils at 100 degrees.
138. Lastly, we explored the Kelvin temperature scale used by scientists.
139. So, the next time you measure something using a metric ruler,...
140. ...or read a thermometer in degrees Celsius...
141. ...think about some of the things we just discussed,...
142. ...you just might think about the metric system a little differently.

142. Graphic Transition-Video Quiz

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

1. A measurement contains a _____ and a unit.
2. _____ is the distance between two points.
3. The _____ is the basic metric unit of length.
4. There are _____ centimeters in one meter.
5. The length of a pencil is measured with a _____.
6. Longer distances are measured in _____.
7. A kilometer contains _____ meters.
8. The _____ temperature scale is used in metric countries.
9. Water boils at _____ degrees Celsius.
10. The Kelvin Scale is useful when working with very _____ temperatures.

Answers may be found on page 17.



Student Assessments and Activities

Assessment Masters:

- Preliminary Assessment
- Video Review
- Post Assessment

Student Activity Masters:

- Measuring Length in the Metric System
- A Decimal System
- Understanding Metric Temperatures
- Vocabulary of *Metric Length and Temperature*



Answers to Student Assessments

Preliminary Assessment (pgs. 20-21)

1. odometer
2. English
3. kelvin
4. decimal
5. length
6. fahrenheit
7. tape measure
8. temperature
9. thermometer
10. unit
11. true
12. false
13. true
14. false
15. true
16. false
17. false
18. true
19. true
20. false

Video Review (pg. 22)

1. The odometer, tape measure, and ruler are similar in that they all are used to measure length.
2. The table does not fit through the door because you and your friend have very different hand sizes.
3. There are 100 centimeters in a meter.
4. The most useful tool to measure the length of the pencil would be a metric ruler.
5. According to the metric ruler, the piece of thread has a length of 22 centimeters and 4 millimeters, which can also be expressed as 22.4 centimeters.
6. A thermometer is the instrument most commonly used to measure temperature.
7. The Kelvin temperature equal to 15 degrees Celsius is 288 Kelvins.

Video Quiz (p. 22)

1. number
2. length
3. meter
4. 100
5. ruler
6. kilometers
7. 1000
8. celsius
9. 100
10. cold

Post Assessment (pgs. 23-24)

1. temperature
2. length
3. tape measure
4. unit
5. kelvin
6. thermometer
7. odometer
8. fahrenheit
9. decimal
10. English
11. false
12. false
13. false
14. true
15. true
16. false
17. false
18. true
19. true
20. true



Answers to Student Activities

Measuring Length in the Metric System (p. 25 - 26)

Object Measured	Length	Units
Length of a pen -use metric ruler-		
Diameter of a button -use metric ruler-		
Width of a book -use metric ruler-		
_____	answers will vary depending on objects measured	
-use metric ruler-		

-use meter stick-		

-use meter stick-		

-use meter stick-		
Width of the classroom -use metric tape measure-		

-use metric tape measure-		

-use metric tape measure-		

A Decimal System (p. 27)

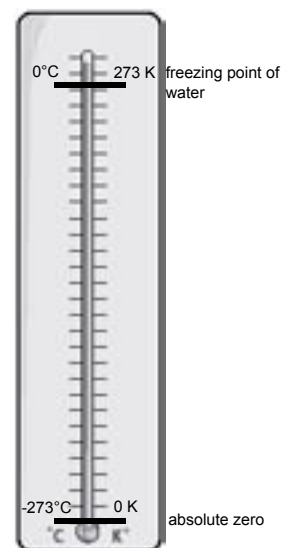
.03 kg	30 grams	3.62 kg	3620 g
74 L	74000 mL	200 m	20,000 centimeters
1.9 cm	190 millimeters	.0089 g	.0000089 kilograms
480 m	.48 km	9.4 L	9400 milliliters
6 g	600 centigrams	7623 mg	7.623 grams
982,000 cm ³	.982 cubic meters	5 cm	50 mm
.025 m	2.5 cm	17.8 mL	.0178 L
105.3 mL	.1053 liters	400.25 mm	40.025 cm

Vocabulary of Metric Length and Temperature (p. 30)

1. e - length
2. h - temperature
3. f - distance
4. b - meter
5. j - decimal system
6. a - thermometer
7. i - Kelvin
8. d - Celsius
9. g - metric ruler
10. c - unit

Understanding Metric Temperatures (p. 28 - 29)

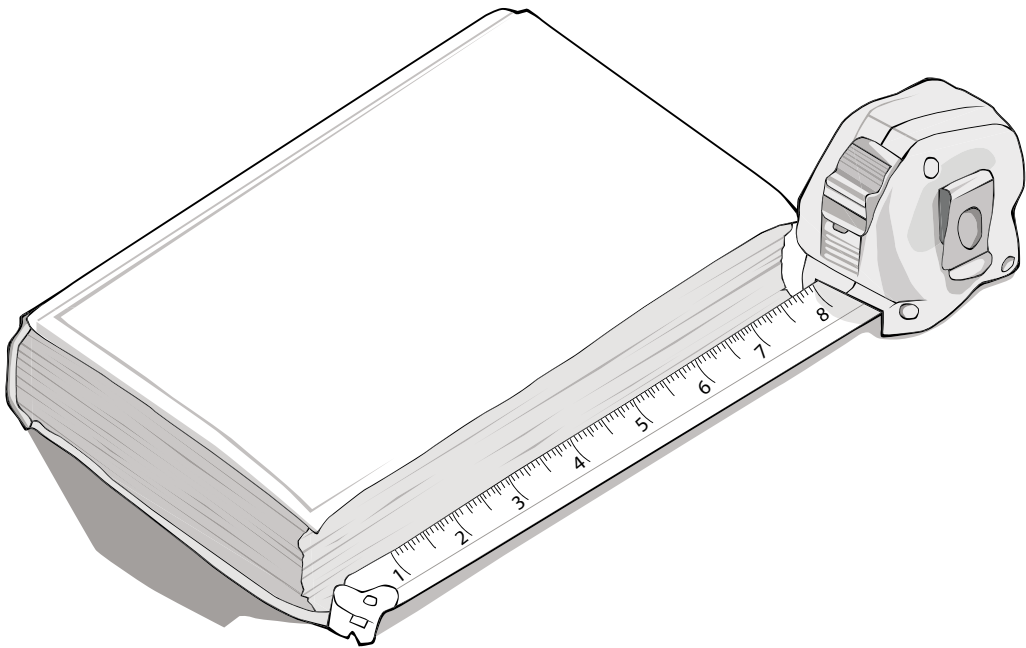
	Temperature
Room temperature	
measurements will vary	
Ice Water	
Hot Water	



Questions:

1. The two fixed points on the Celsius temperature scale are the freezing and boiling points of water, 0 degrees Celsius and 100 degrees Celsius respectively.
2. Andres Celsius arranged his original scale backwards because he wanted to avoid working with negative numbers.
3. A typical glass thermometer works when the small amount of liquid inside the tube expands or contracts visibly in response to the temperature outside, allowing an observer to read the scale printed on the tube.
4. The temperature 0 Kelvin is absolute zero. At this temperature, molecules stop moving.

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. An _____ is an instrument used to measure a distance of several kilometers.
2. Inches, feet, and yards are measurements of length in the _____ system.
3. The _____ scale is used by scientists who are measuring very cold temperatures.
4. A _____ system is based on the number ten and multiples of the number ten.
5. Measuring the height of a person is a measurement of _____ .
6. In the _____ scale, a comfortable temperature is about 72 degrees.
7. A length that is too large to be measured with a ruler would be easier to measure with a metric _____ .
8. _____ is a measure of the hotness or coldness of something.
9. To know the temperature outdoors, you would look at a _____ .
10. A _____ gives meaning to the number in a measurement.

length
fahrenheit
tape measure
temperature
decimal

thermometer
kelvin
odometer
unit
English

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 Compare!

1. What do the following have in common: the odometer in this car, this tape measure, and this ruler?

You Decide!

2. Why doesn't the table fit through the door?

You Compute!

3. If there are 10 decimeters in a meter and there are 10 centimeters in a decimeter, how many centimeters are in one meter?

You Decide!

4. What simple tool would you use to measure the length of this pencil?

You Observe!

5. What is the length of this piece of thread?

You Decide!

6. What instrument is commonly used to measure temperature?

You Compute!

7. What is the temperature in Kelvins, equivalent to 15 degrees Celsius?

Video Quiz:

1. A measurement contains a _____ and a unit.
2. _____ is the distance between two points.
3. The _____ is the basic metric unit of length.
4. There are _____ centimeters in one meter.
5. The length of a pencil is measured with a _____.
6. Longer distances are measured in _____.
7. A kilometer contains _____ meters.
8. The _____ temperature scale is used in metric countries.
9. Water boils at _____ degrees Celsius.
10. The Kelvin scale is useful when working with very _____ temperatures.

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. _____ is a measure of the hotness or coldness of something.
2. Measuring the height of a person is a measurement of _____ .
3. A length that is too large to be measured with a ruler would be easier to measure with a metric _____ .
4. A _____ gives meaning to the number in a measurement.
5. The _____ scale is used by scientists who are measuring very cold temperatures.
6. To know the temperature outdoors, you would look at a _____ .
7. An _____ is an instrument used to measure a distance of several kilometers.
8. In the _____ scale, a comfortable temperature is about 72 degrees.
9. A _____ system is based on the number ten and multiples of the number ten.
10. Inches, feet, and yards are measurements of length in the _____ system.

thermometer
Kelvin
odometer
unit
English

length
Fahrenheit
tape measure
Temperature
decimal

Post Assessment

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

- | | | |
|--|---|---|
| 11. The thermometer is a unit of temperature. | T | F |
| 12. Millimeters are very useful in measuring large distances. | T | F |
| 13. In the Celsius scale there are 200 degrees between the freezing and boiling points of water. | T | F |
| 14. Standard systems of measurement help people to be sure they're talking about the same thing. | T | F |
| 15. Water freezes at zero degrees Celsius. | T | F |
| 16. There is only one system of measurement used throughout the world. | T | F |
| 17. A meter stick is three meters long. | T | F |
| 18. Metric rulers are divided into units of centimeters and millimeters. | T | F |
| 19. Another name for the metric system is the International System of Units, or SI. | T | F |
| 20. Water freezes at 32 degrees Fahrenheit and boils at 212 degrees Fahrenheit. | T | F |

Measuring Length in the Metric System

Background:

The meter is the basic unit of length in the metric system. Originally its length was derived from the circumference of the Earth, and all of the other basic metric units are based on the size of the meter. Today one meter is defined as the distance traveled by a beam of light in a vacuum during $1/299,792,458$ th of a second. The meter is somewhat close in size to the English system yard, although the meter is about 10% bigger than the yard.

When you divide a meter into one hundred equal sections, each of those segments is called a centimeter. A centimeter is about the same size as the width of your smallest finger. The corresponding English unit is the inch. An inch is about 2.54 times larger than a centimeter. One centimeter can be divided into ten millimeters.

You are probably already familiar with some tools used for measuring length, such as a 12-inch ruler or a yard stick. The metric system has similar tools marked with measurements in centimeters and meters. In this activity, you will use metric measuring tools including metric rulers, meter sticks, and metric tape measures to measure the length of various objects.

Materials: Measuring Length in the Metric System worksheet, metric ruler, meter stick, metric tape measure, pen, button, book, variety of other objects of different sizes around the classroom

Directions:

1. Look at the chart on your worksheet. Begin by using a metric ruler to measure the length of a pen. As you record your measurement, decide what size units you want to use for your measurement. For example, you could record a measurement of 8 centimeters, 3 millimeters as 8.3 centimeters, or as 83 millimeters.
2. Use the metric ruler to measure the diameter of a button, and then the width of a book.
3. Look around your classroom and at the objects your teacher has provided. Choose one more object that would be best measured using the metric ruler.
4. Next, measure three different objects using your meter stick.
5. Practice using the metric tape measure to measure three more objects, including the width of the room.

Measuring Length in the Metric System Worksheet

Object Measured	Length	Units
Length of a pen (use metric ruler)		
Diameter of a button (use metric ruler)		
Width of a book (use metric ruler)		
_____ (use metric ruler)		
_____ (use meter stick)		
_____ (use meter stick)		
_____ (use meter stick)		
Width of the classroom (use metric tape measure)		
_____ (use metric tape measure)		
_____ (use metric tape measure)		

A Decimal System

Background:

As you probably already know, the metric system is a decimal system. But what exactly is a decimal system? A decimal system is based on the number ten and its multiples. You may have noticed that units for many different kinds of measurements begin with different prefixes such as milli, centi, or kilo. These prefixes, based on multiples of ten, are your clue to how large a unit is. Study the chart of prefixes below. You can see that, for example, a centimeter is 1/100th of a meter, and a kilogram is 1000 grams.

Now let us look at exactly how you can convert between units. Say, for example, you want to express the value of 48 centimeters in millimeters. To do this mathematically, you need to set up a ratio that is equal to one. 100 centimeters is equal to one meter, and 1000 mm is equal to one meter. Now you set up a multiplication problem that looks like this:

$$48 \text{ cm} \times \frac{1000 \text{ mm}}{100 \text{ cm}} = 480 \text{ mm}$$

Although this may seem very complicated, it is as simple as moving the decimal point one place for every level you step on the chart. If the units are smaller you move the decimal point to the right, if they are larger move the decimal point to the left. In our example 48 centimeters would become 480 millimeters.

Prefix	Amount in basic unit
milli-	1000
centi-	100
deci-	10
no prefix	1
deka-	.1
hecta-	.001
kilo-	.0001

Directions: Using your knowledge of the metric system, correctly change the decimal point as you change the units.

.03 kg	_____ grams
74 L	_____ mL
1.9 cm	_____ millimeters
480 m	_____ km
6 g	_____ centigrams
982,000 cm ³	_____ cubic meters
.025 m	_____ cm
105.3 ml	_____ liters

3.62 kg	_____ g
200 m	_____ centimeters
.0089 g	_____ kilograms
9.4 L	_____ milliliters
7623 mg	_____ grams
5 cm	_____ mm
17.8 ml	_____ L
400.25 mm	_____ cm

Understanding Metric Temperatures

Background:

Although the Celsius scale bears the name of Swedish scientist Andres Celsius, no one scientist invented it alone. The Celsius scale, which became standard in the metric system, was created in the 18th century. It has two fixed points, zero degrees Celsius is the temperature at which water freezes, and 100 degrees Celsius is the boiling point of water. When Andres Celsius originally arranged his version of the temperature scale, the points were reversed. That is to say, when it was very cold outside the temperature would have measured more than 100 degrees! He did this because it meant that in doing temperature calculations no one would ever have to work with negative numbers. Today's Celsius scale however is designed so that zero is the freezing point of water, and one hundred degrees is the boiling point of water.

Temperature, no matter what scale is used, is measured using a thermometer. Traditional glass thermometers contain a small tube with an amount of liquid inside; the liquid expands and contracts in response to the temperature of the glass and the substance outside of it. In this activity you will use a thermometer to measure several different temperatures using the Celsius scale. You will also work with the Kelvin scale.

Materials: Celsius thermometer, beakers, ice cubes, hot water

Directions:

1. The thermometer will read room temperature when it has been sitting out in the room for a while. Watch it to be sure that the reading is not changing. Then record the temperature of the room in the chart on this page.
2. Now place the thermometer in the beaker full of ice cubes. Wait until the temperature on the thermometer has steadied, then record the temperature in the chart.
3. Place the thermometer in a beaker of very hot water. When the temperature stops rising, record the measurement in the chart.

	Temperature
Room temperature	
Ice Water	
Hot Water	

Understanding Metric Temperatures

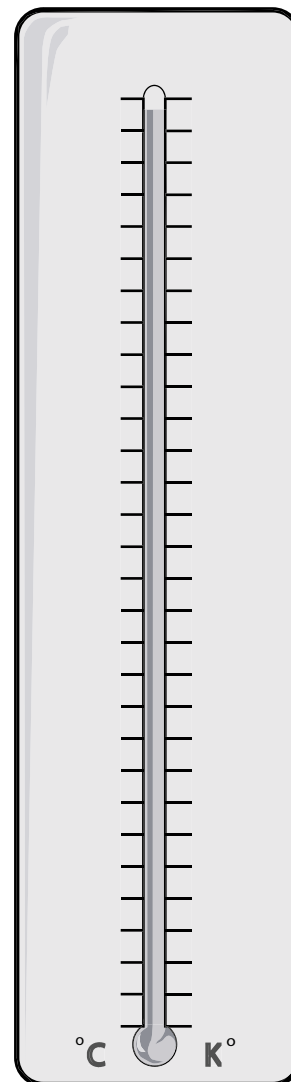
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Background: Another temperature scale used by scientists is the Kelvin temperature scale. In the Kelvin scale, zero degrees Kelvin is the lowest temperature that can exist. Also called absolute zero, this is the point at which all molecular movement stops. Thus far scientists have never been able to cool something so much that it reaches absolute zero on Earth. On the Celsius scale, absolute zero is about -273 Kelvin.

Directions: On this blank thermometer, include the freezing point of water and absolute zero by marking the measurements in both degrees Celsius and Kelvins.

Questions:

1. What are the two fixed points on the Celsius temperature scale?
2. Why did Celsius the scientist originally arrange his original scale backwards?
3. How does a typical glass thermometer work?
4. What is the temperature 0 Kelvin? What happens at that temperature?



Vocabulary of Metric Length and Temperature

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

____ 1. gehntl _____

____ 2. mrueetetpar _____

____ 3. senidcta _____

____ 4. teerm _____

____ 5. melciad yestms

____ 6. hortemertem _____

____ 7. neKliv _____

____ 8. luCssei _____

____ 9. recitm eulrr

____ 10. tuni _____

a. the instrument most commonly used to measure temperature

b. the basic unit of length in the metric system

c. the label that gives a number in a measurement meaning

d. the metric temperature scale in which water freezes at 0 degrees and boils at 100 degrees

e. a measurement of the space between two points

f. a term to describe longer lengths, like how far you drive in a car

g. a tool useful for measuring lengths of a few centimeters

h. a measurement of how hot or cold something is

i. the temperature scale used mostly by scientists in which zero degrees is the lowest temperature that can be reached

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