# What Is Energy?
## Student Guide

National Energy Education Development Project

# Hot and Cold Bouncing

## Question

Will a sphere bounce differently after it is placed in cold or hot water?

## Data

### Room Temperature

H

Trial 1 ____ inches ____ centimeters

Trial 2 ____ inches ____ centimeters

Trial 3 ____ inches ____ centimeters

S

Trial 1 ____ inches ____ centimeters

Trial 2 ____ inches ____ centimeters

Trial 3 ____ inches ____ centimeters

### Ice Water

H

Trial 1 ____ inches ____ centimeters

Trial 2 ____ inches ____ centimeters

Trial 3 ____ inches ____ centimeters

S

Trial 1 ____ inches ____ centimeters

Trial 2 ____ inches ____ centimeters

Trial 3 ____ inches ____ centimeters

### Hot Water

H

Trial 1 ____ inches ____ centimeters

Trial 2 ____ inches ____ centimeters

Trial 3 ____ inches ____ centimeters

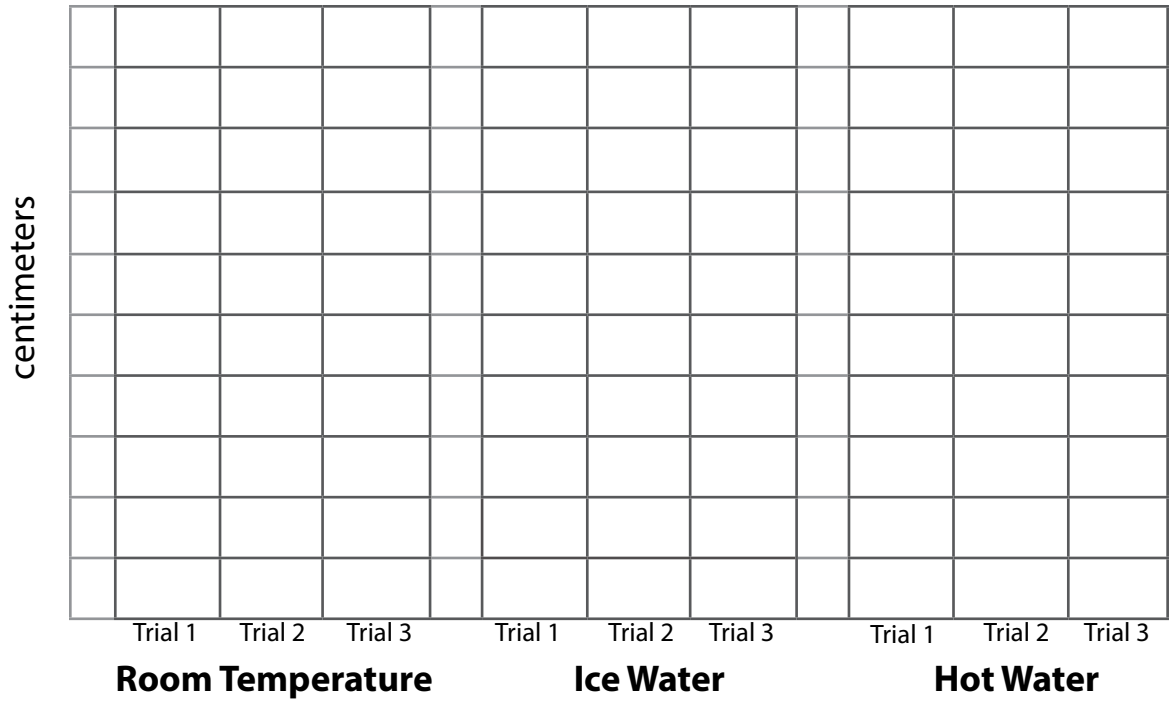
S

Trial 1 ____ inches ____ centimeters

Trial 2 ____ inches ____ centimeters

Trial 3 ____ inches ____ centimeters

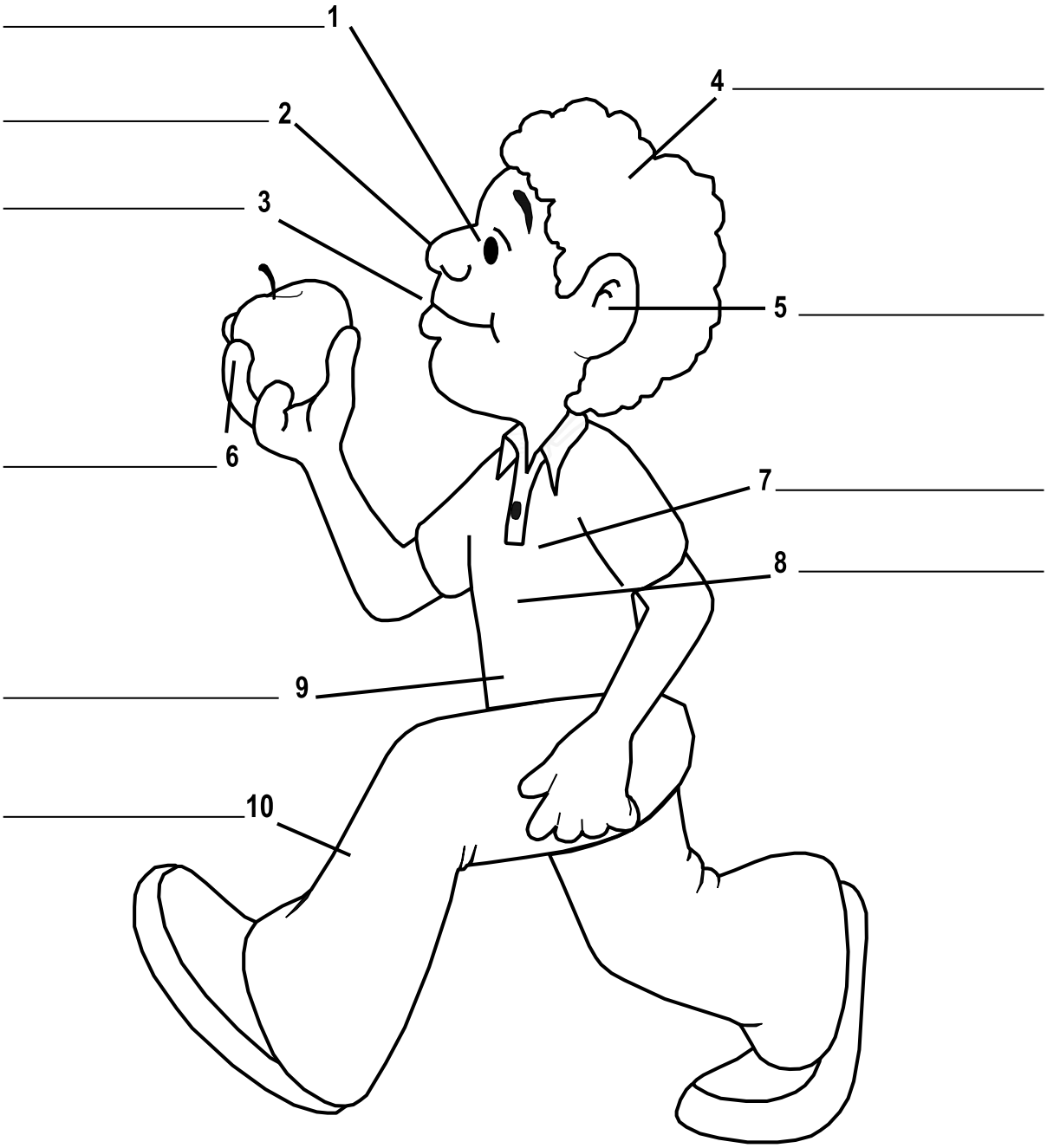
## Graph




## Conclusion

Draw a picture and use words to explain what happened.

# How Our Bodies Use Energy

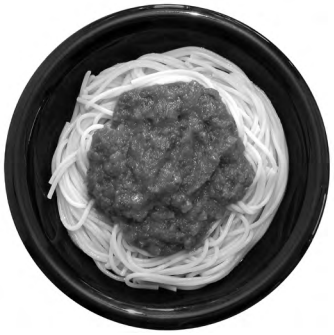



**Word Bank**

| | | | | |
|---|---|---|---|---|
| breathing | feeling | moving | seeing | tasting |
| digesting food | hearing | moving blood | smelling | thinking |

# Energy From the Sun

# Food Has Energy



# Our Five Senses

Sight

Touch

Smell

Taste

Hearing

# Measuring Length

Use a ruler to measure the length of different objects in both centimeters and inches.

**New Pencil**

centimeters _____

inches _____

**New Crayon**

centimeters _____

inches _____

**Your Hand**

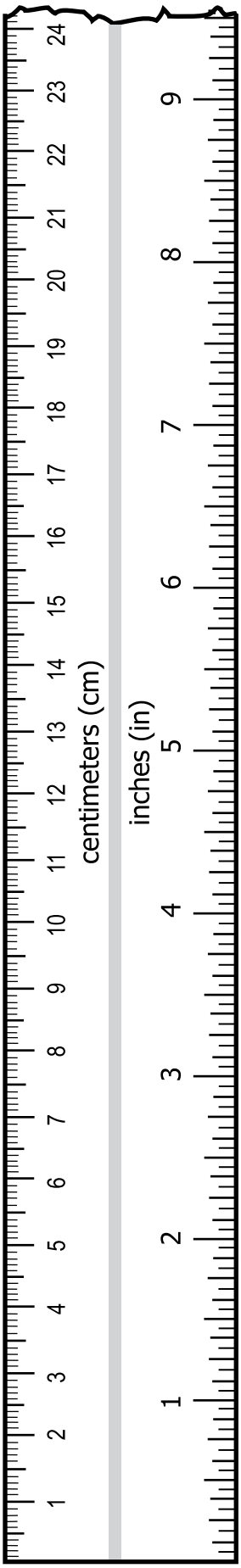
centimeters _____

inches _____

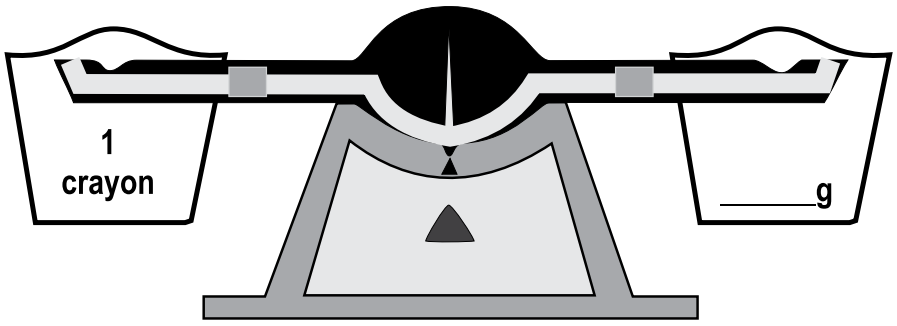
**Other:** _____

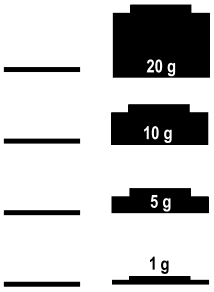
centimeters _____

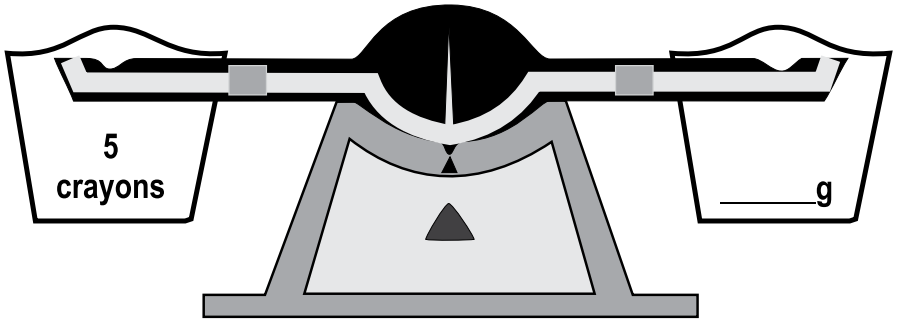
inches _____

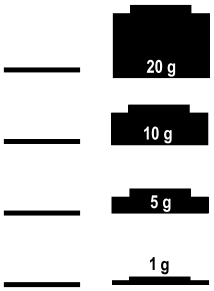


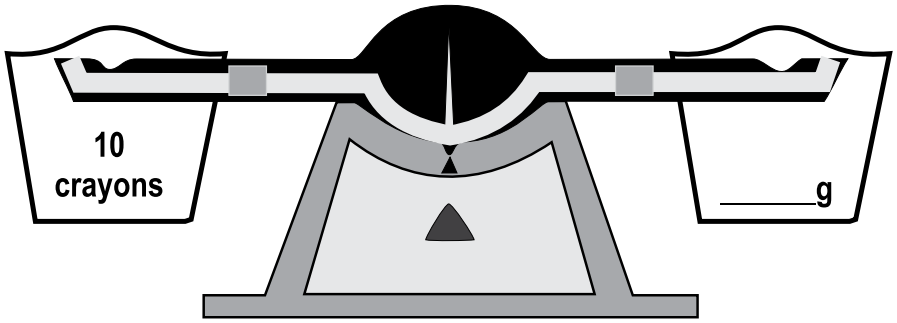
# Measuring Mass

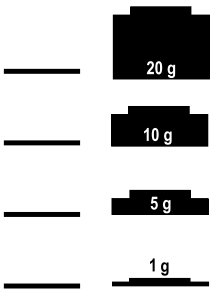


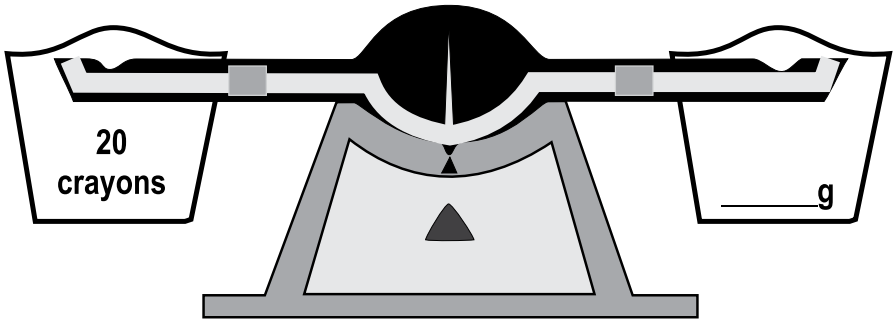



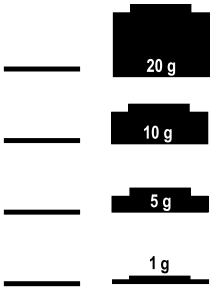



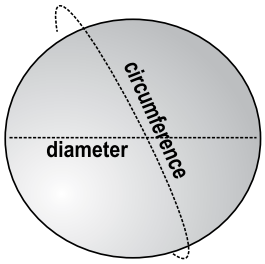



# Four Spheres—Observing and Measuring Size




1. Draw each sphere in the box that matches its letter.
2. Describe what you see and feel.
3. Measure each sphere's diameter and circumference and record the data.

**A**

I see _____

_____

I feel _____

I measure diameter _____ inches _____ centimeters

circumference _____ inches _____ centimeters

**B**

I see _____

_____

I feel _____

I measure diameter _____ inches _____ centimeters

circumference _____ inches _____ centimeters

**C**

I see _____

_____

I feel _____

I measure diameter _____ inches _____ centimeters

circumference _____ inches _____ centimeters

**D**

I see _____

_____

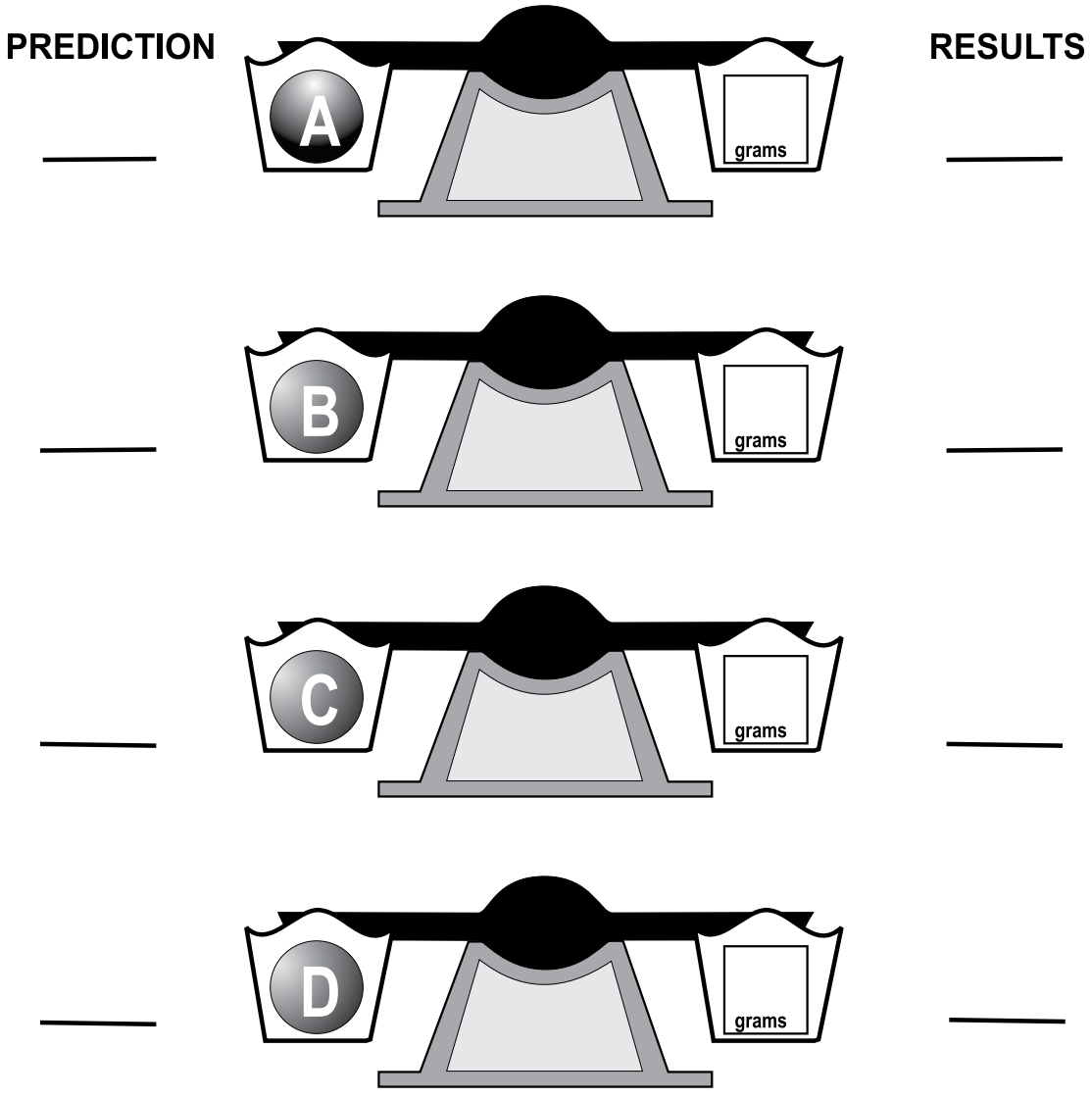
I feel _____

I measure diameter _____ inches _____ centimeters

circumference _____ inches _____ centimeters

# Four Spheres—Measuring Mass

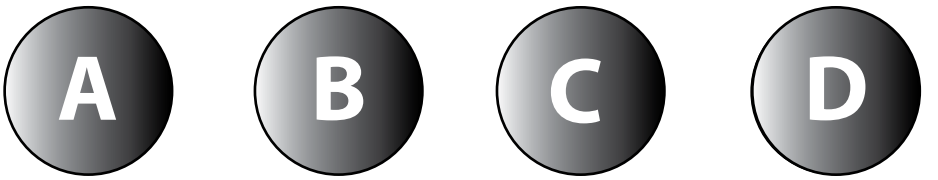
1. Hold each of the spheres in your hands. Which one feels the heaviest? In the PREDICTION column on the left, number the spheres from 1 to 4, with 1 being the heaviest.
2. Weigh each sphere and record the mass in the square on the balance.
3. In the RESULTS column, use your data to re-number the spheres from 1 to 4, with 1 as the heaviest.
4. Compare your predictions to the results. How well did you do?



# Four Spheres—Sink or Float

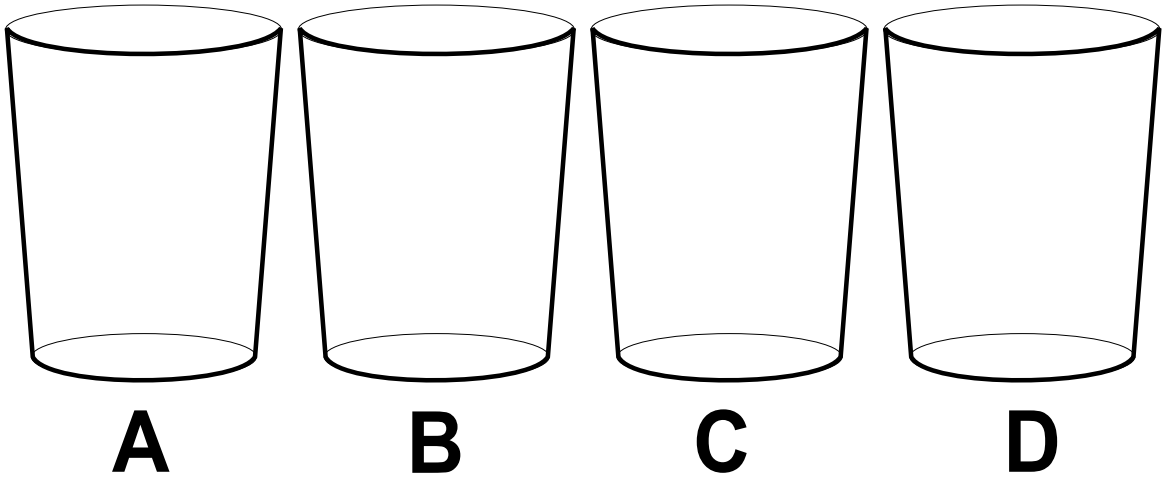
1. What do you think? Will the sphere sink or float? Write your prediction.
2. Place each sphere one at a time into a container of water.
3. In the pictures of the containers, draw how far each sphere sank into the water.
4. Did the sphere sink or float? Record the results.

**PREDICTION**

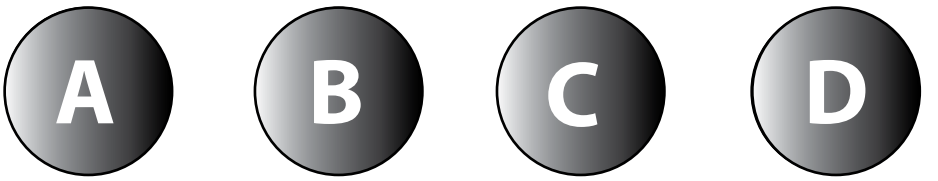



_____ _____ _____ _____

**OBSERVATIONS**




**RESULTS**

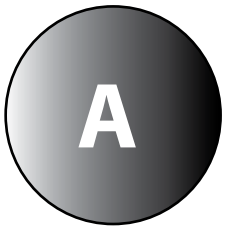



_____ _____ _____ _____

# Four Spheres—Measuring Bounce

**Question:** Which sphere will bounce the highest?

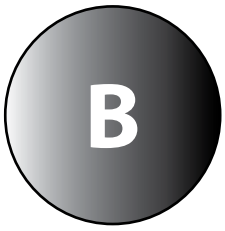
1. Hold the ruler up straight.
2. Drop each sphere 3 times from the top of the ruler and measure how high it bounces in inches and centimeters.
3. Record your results.




Trial 1 _____ inches _____ centimeters

Trial 2 _____ inches _____ centimeters

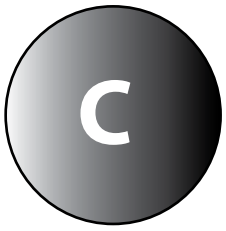
Trial 3 _____ inches _____ centimeters




Trial 1 _____ inches _____ centimeters

Trial 2 _____ inches _____ centimeters

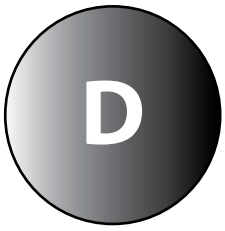
Trial 3 _____ inches _____ centimeters




Trial 1 _____ inches _____ centimeters

Trial 2 _____ inches _____ centimeters

Trial 3 _____ inches _____ centimeters




Trial 1 _____ inches _____ centimeters

Trial 2 _____ inches _____ centimeters

Trial 3 _____ inches _____ centimeters

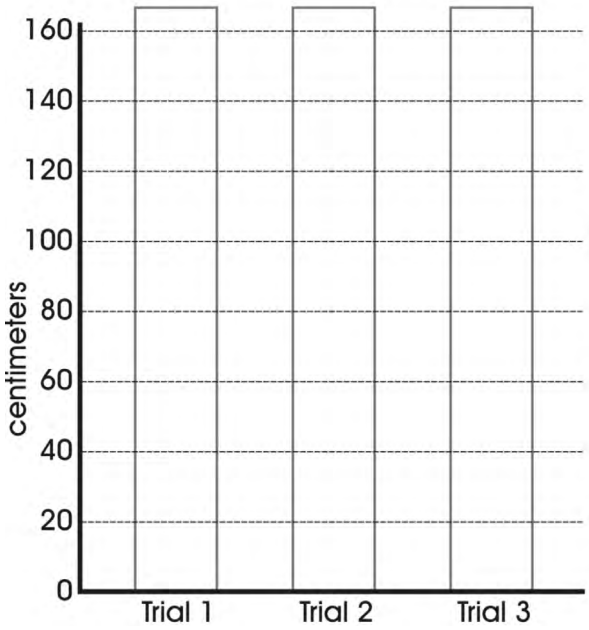
## Extension—Sound

**Question:** Which sphere makes the loudest sound when dropped?

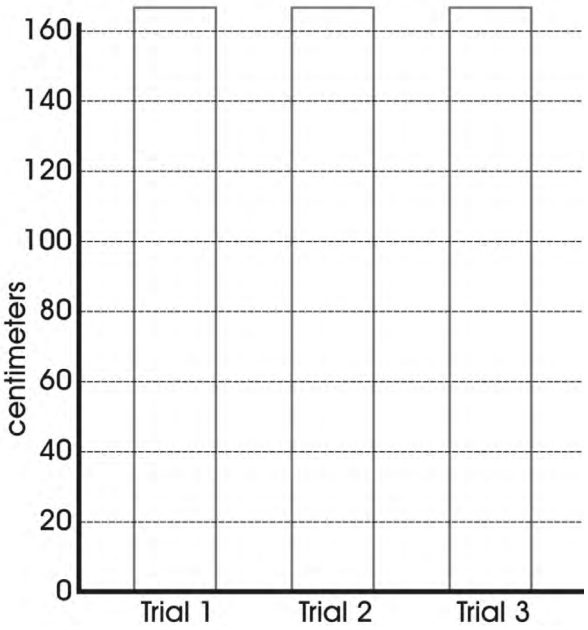
1. Drop each sphere from the same distance and listen to the sound it makes. What do you notice?

# Graphing Bounce

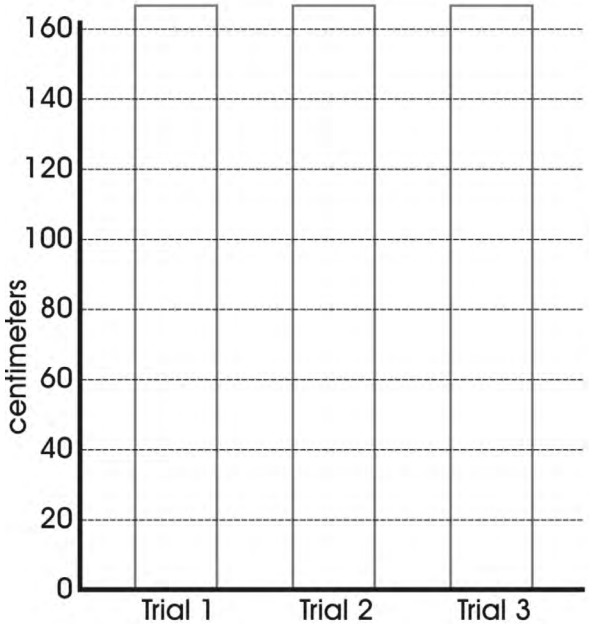
1. Graph your data from the bouncing investigation.



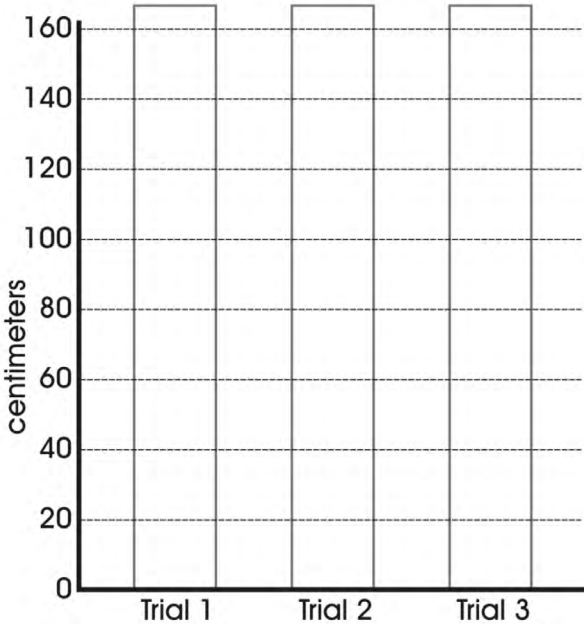

Bounce - Sphere A




Bounce - Sphere B




Bounce - Sphere C

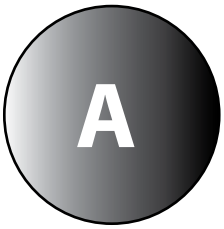



Bounce - Sphere D

# Four Spheres—Measuring Roll

**Question:** Which sphere will roll the farthest?

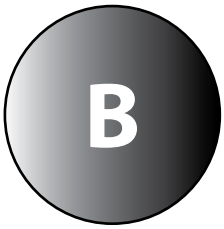
1. Make a ramp on carpet by putting one end of the ruler on a book.
2. Roll each sphere down the ramp 3 times and measure how far it rolls from the end of the ruler, using the measuring tape. Measure in inches and centimeters.
3. Record your results.




Trial 1 _____ inches _____ centimeters

Trial 2 _____ inches _____ centimeters

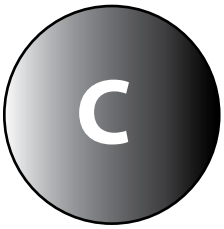
Trial 3 _____ inches _____ centimeters




Trial 1 _____ inches _____ centimeters

Trial 2 _____ inches _____ centimeters

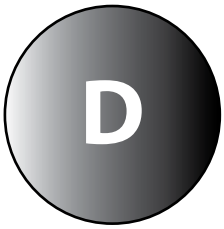
Trial 3 _____ inches _____ centimeters




Trial 1 _____ inches _____ centimeters

Trial 2 _____ inches _____ centimeters

Trial 3 _____ inches _____ centimeters



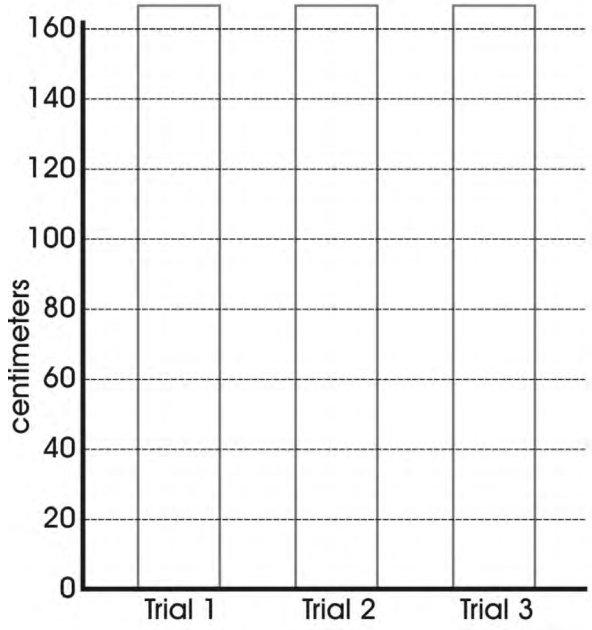

Trial 1 _____ inches _____ centimeters

Trial 2 _____ inches _____ centimeters

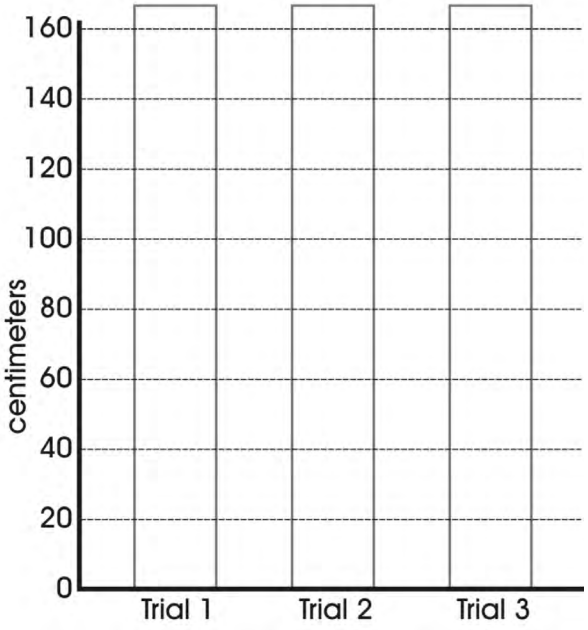
Trial 3 _____ inches _____ centimeters

# Graphing Roll

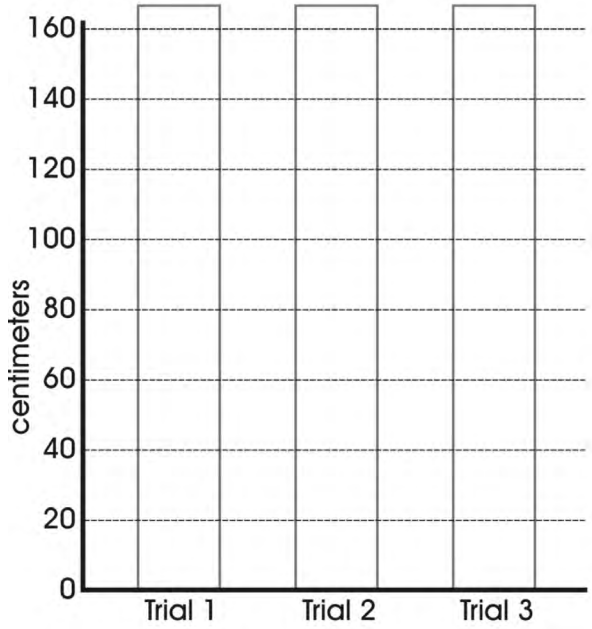
1. Graph your data from the rolling investigation.



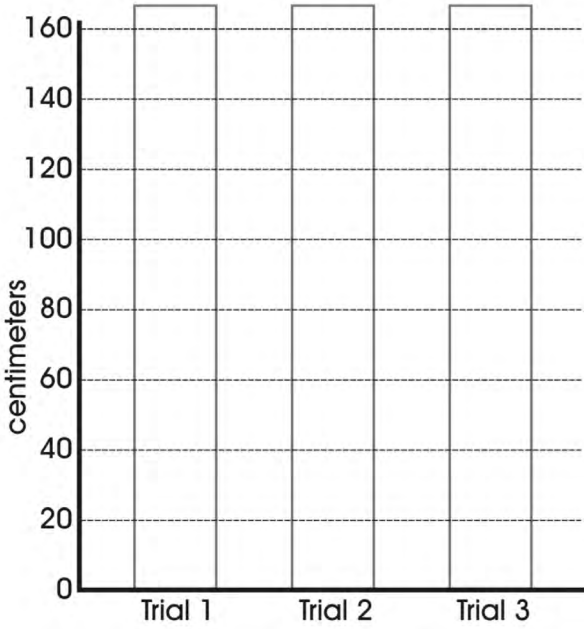

Roll - Sphere A




Roll - Sphere B

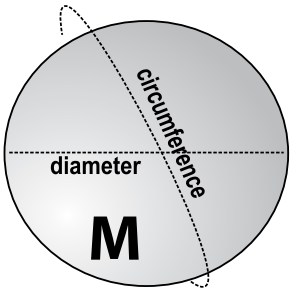



Roll - Sphere C




Roll - Sphere D

# Observing and Measuring Metal and Plastic Spheres

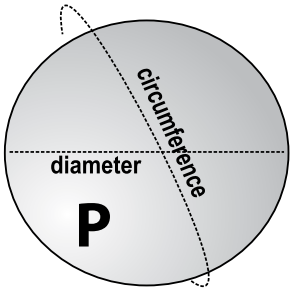



I see _____

_____

I feel _____

| | | | |
|---|---|---|---|
| I measure | diameter | _____ inches | _____ centimeters |
| | circumference | _____ inches | _____ centimeters |
| | mass | _____ grams | |
| | sink or float | _____ | |



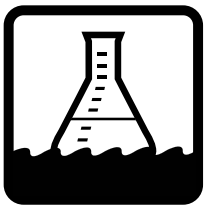

I see _____

_____

I feel _____

| | | | |
|---|---|---|---|
| I measure | diameter | _____ inches | _____ centimeters |
| | circumference | _____ inches | _____ centimeters |
| | mass | _____ grams | |
| | sink or float | _____ | |

1. Feel both spheres. Which feels warmer? _____
2. Put both spheres in ice water for 10 seconds. Which sphere feels warmer? _____
3. Put both spheres in warm water for 10 seconds. Which sphere feels warmer? _____
4. Which sphere moves heat better? _____
5. What would you use to protect yourself from heat—plastic or metal? _____



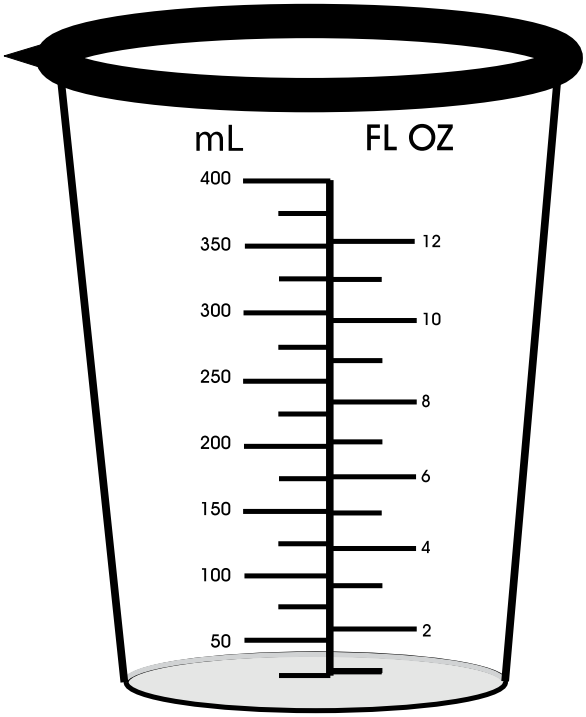
# States of Matter

Draw pictures and use words to explain how water can exist as a solid, liquid, and gas.

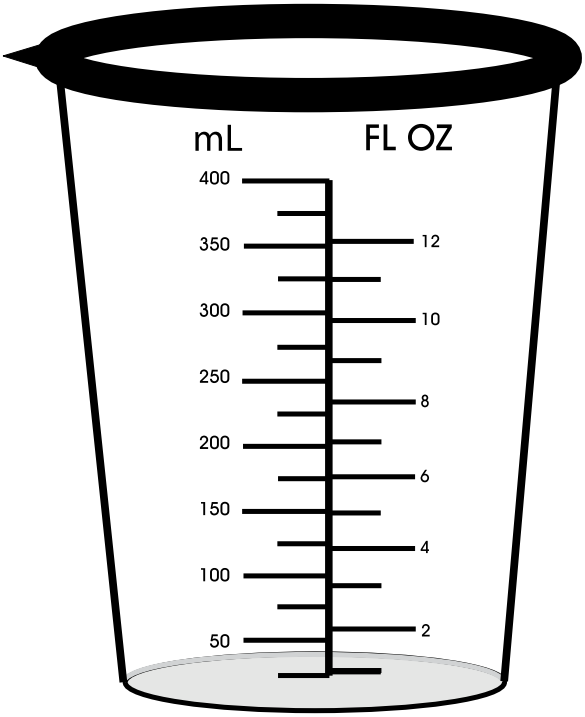
| SOLID | LIQUID | GAS |
| --- | --- | --- |
| | | |

# Volume

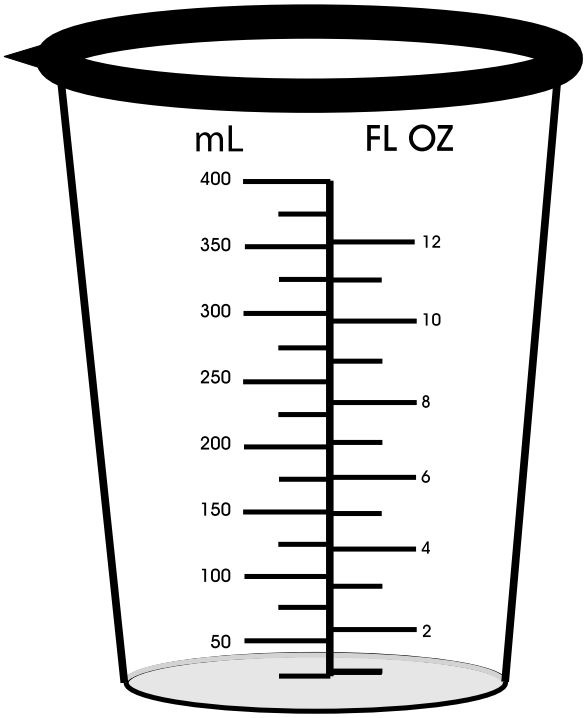
350 mL = _____ fl oz



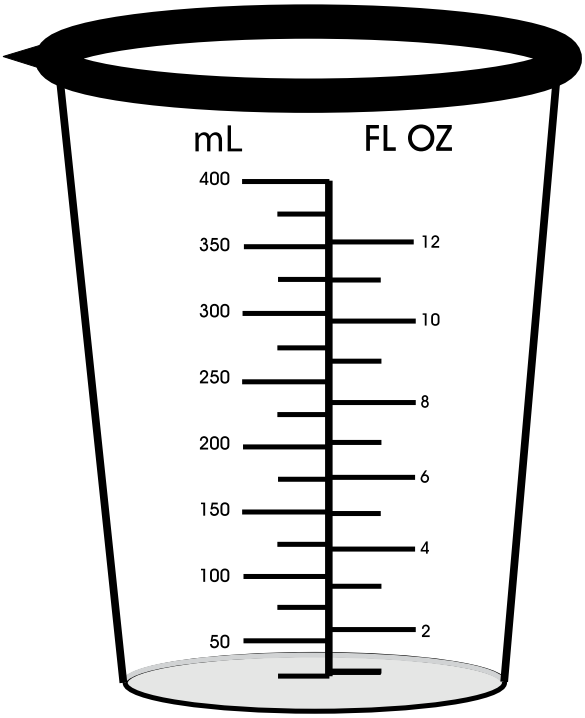

200 mL = _____ fl oz




6 fl oz = _____ mL




8 fl oz (1 cup) = _____ mL

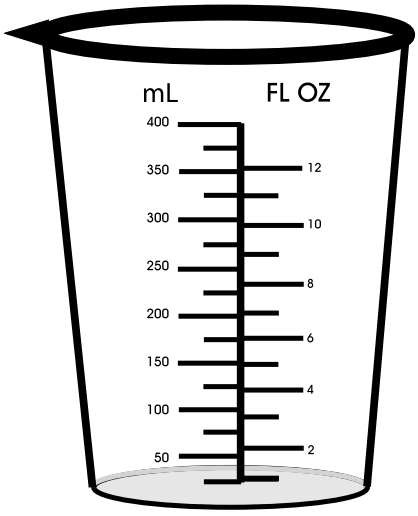


# Liquids

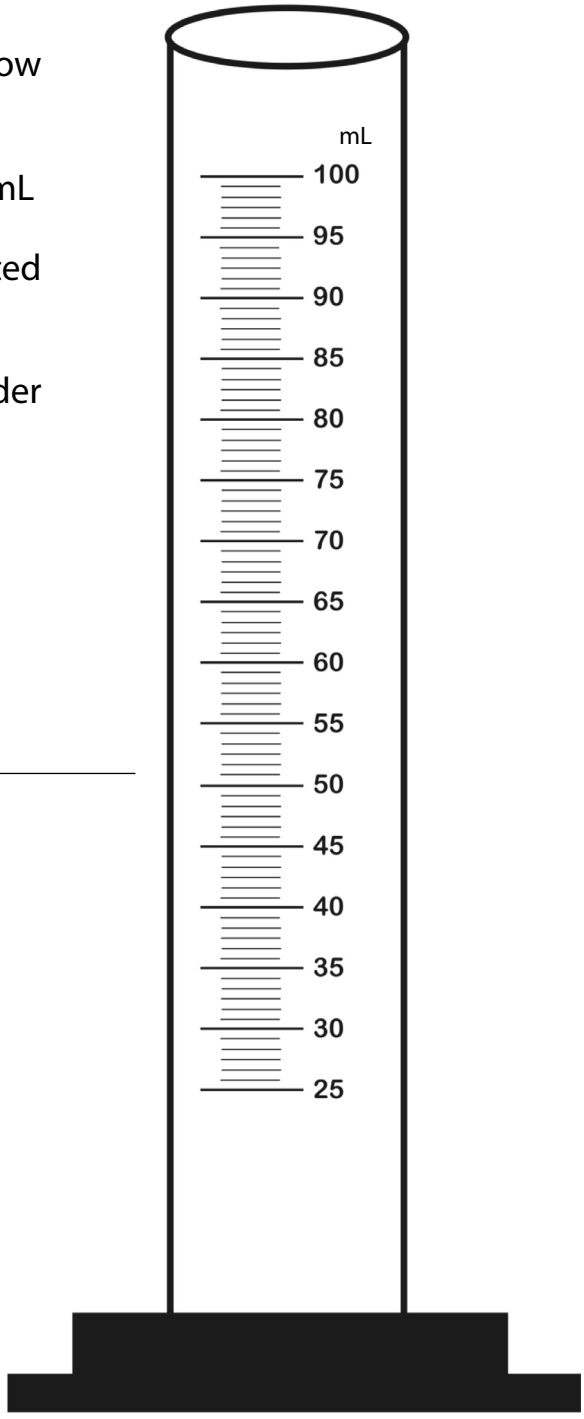
Liquids take the shape of the container.

1. Fill the beaker about half full with water.
2. Draw a line on the picture of the beaker to show how much water you put in.
3. How much water is in the beaker? _____ mL
4. Pour the water from the beaker into the graduated cylinder.
5. Draw a line on the picture of the graduated cylinder to show how much water is in it.
6. How much water is in the graduated cylinder?

   _____ mL
7. Did the water change shape? _____
8. Did the amount of water stay the same? _____

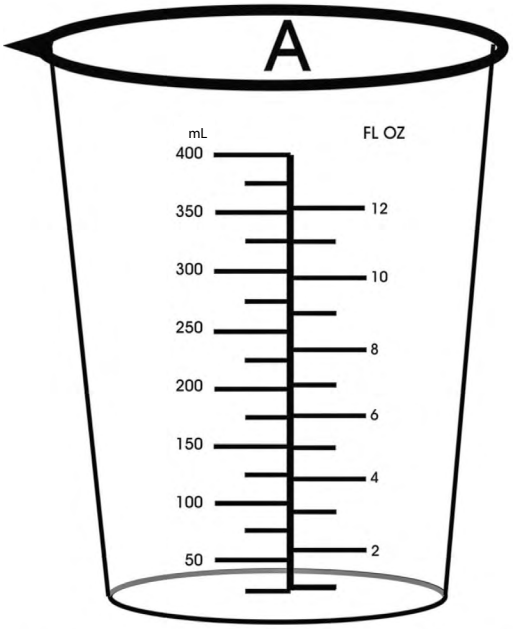


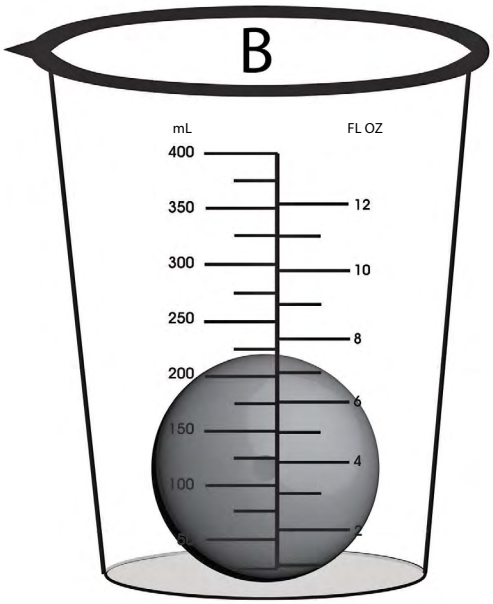

Beaker



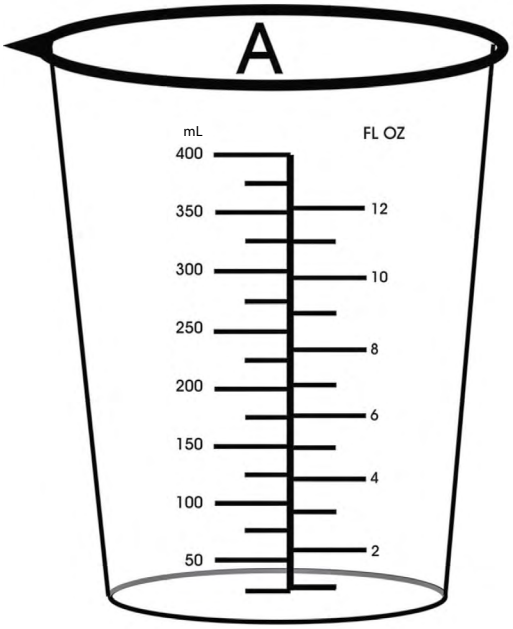

Graduated Cylinder

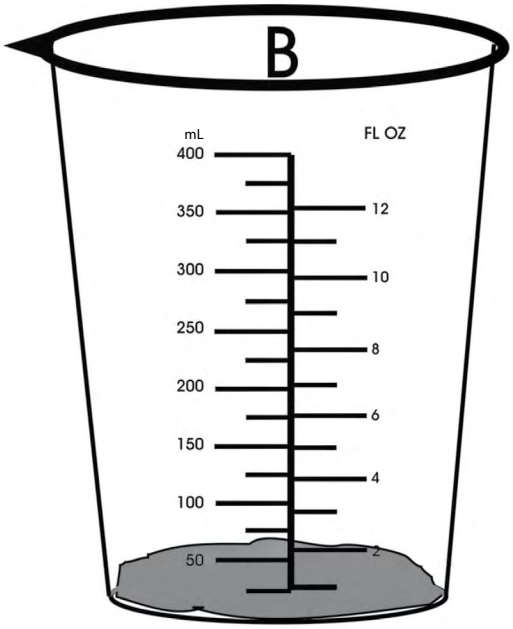
# Volume of Solids



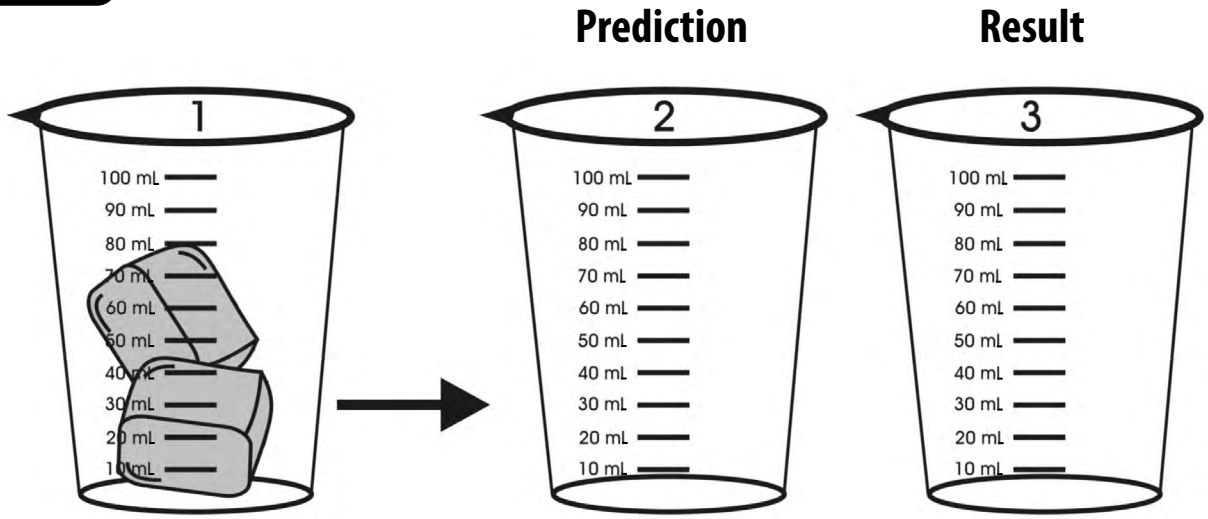

**B - A = Volume of Clay = _____ mL (cc)**

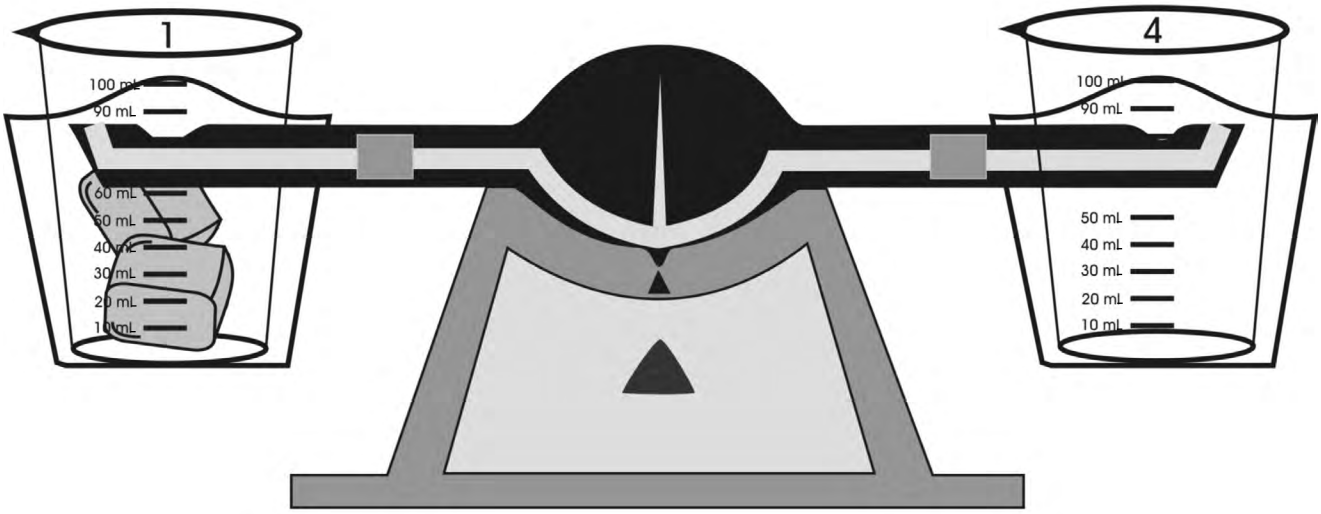



**B - A = Volume of Clay = _____ mL (cc)**

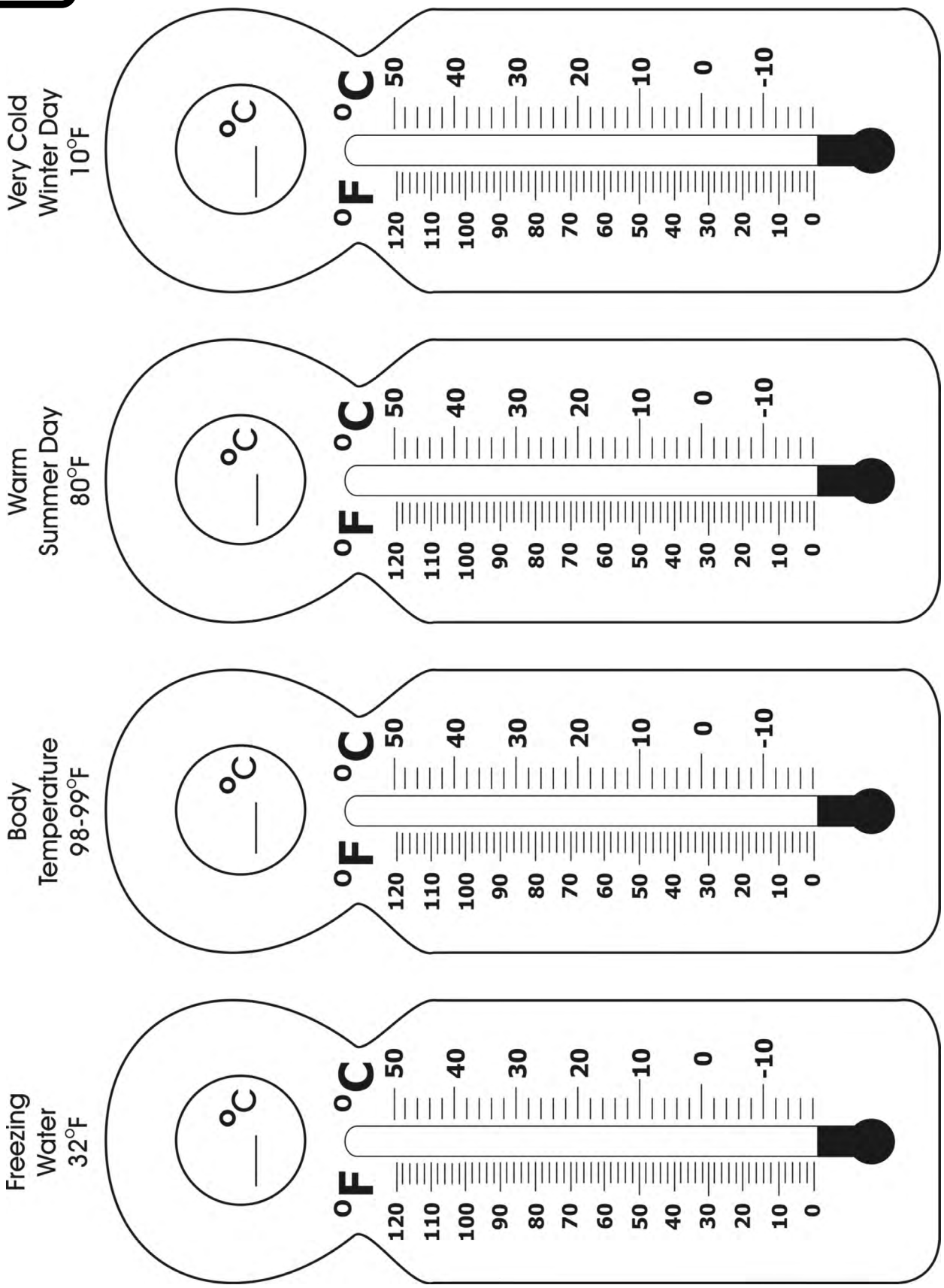
# Solids and Liquids



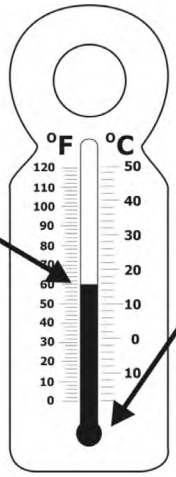

What did you learn in this investigation? _____

# Recording Temperatures



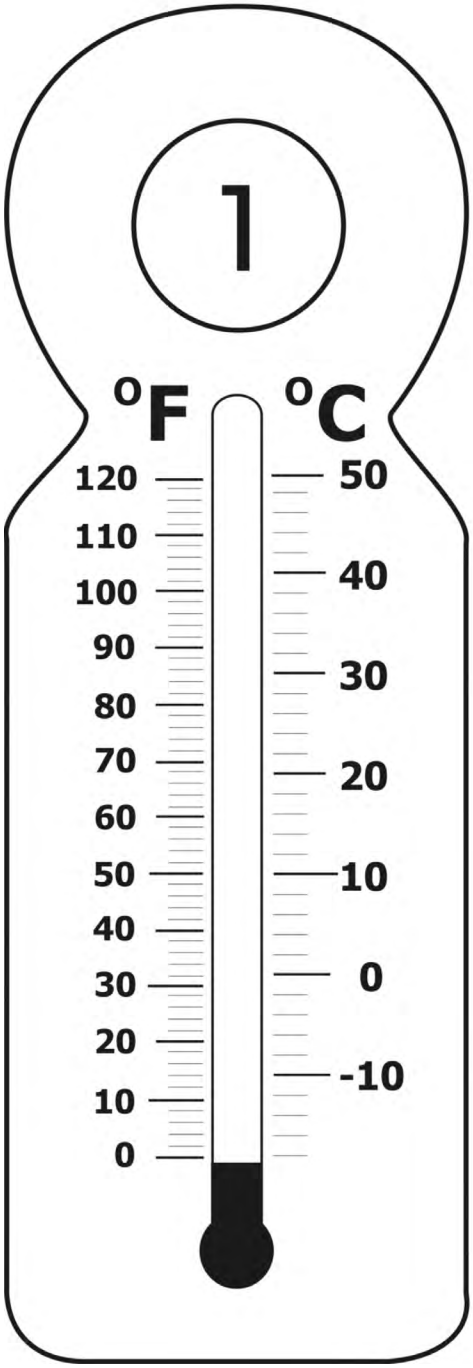
# Thermometer

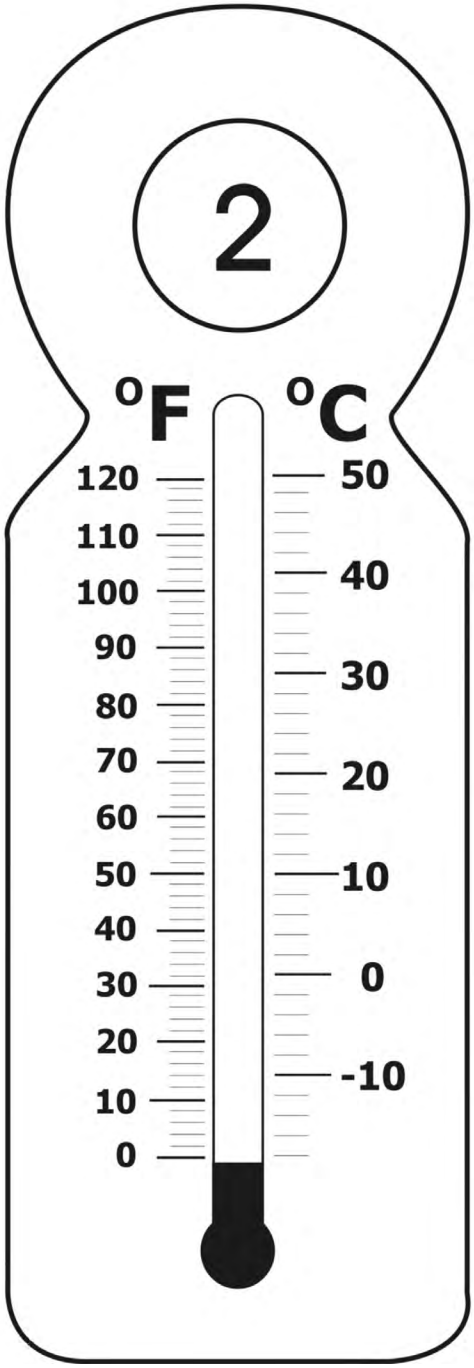
1. Look at the thermometer. Color the tube on Thermometer 1 to show the temperature of the classroom, like this:




Bulb

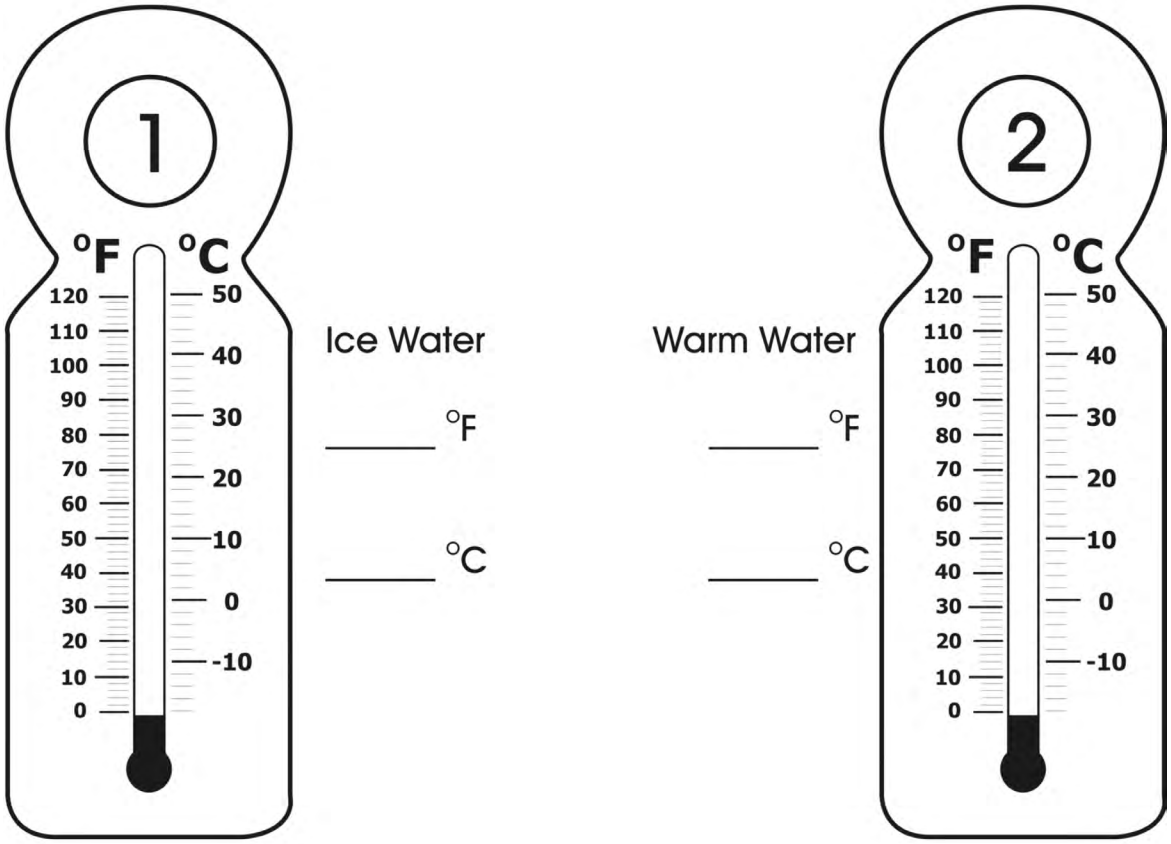
2. Hold the round bulb of the thermometer between your hands for a minute. Color the tube of Thermometer 2 to show the new temperature.

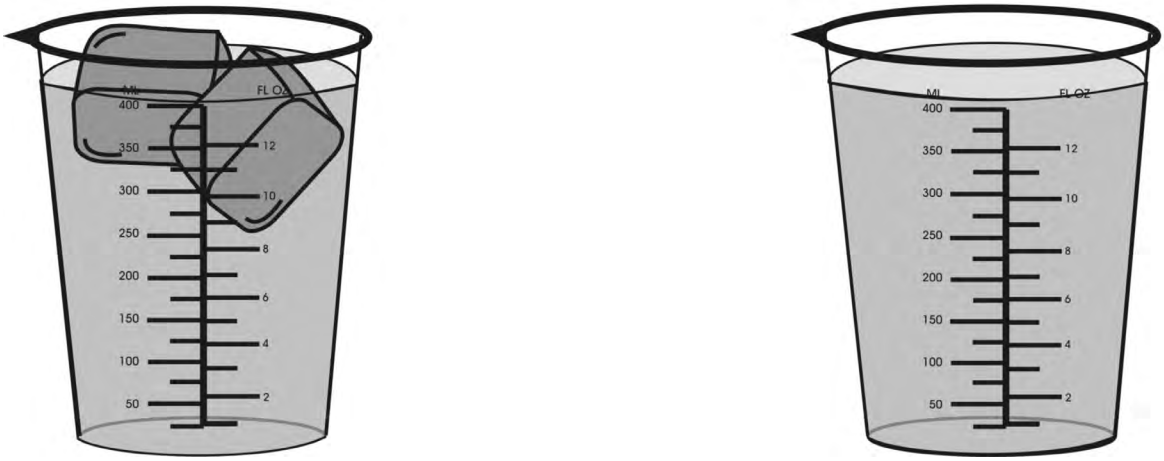


# Temperature 1

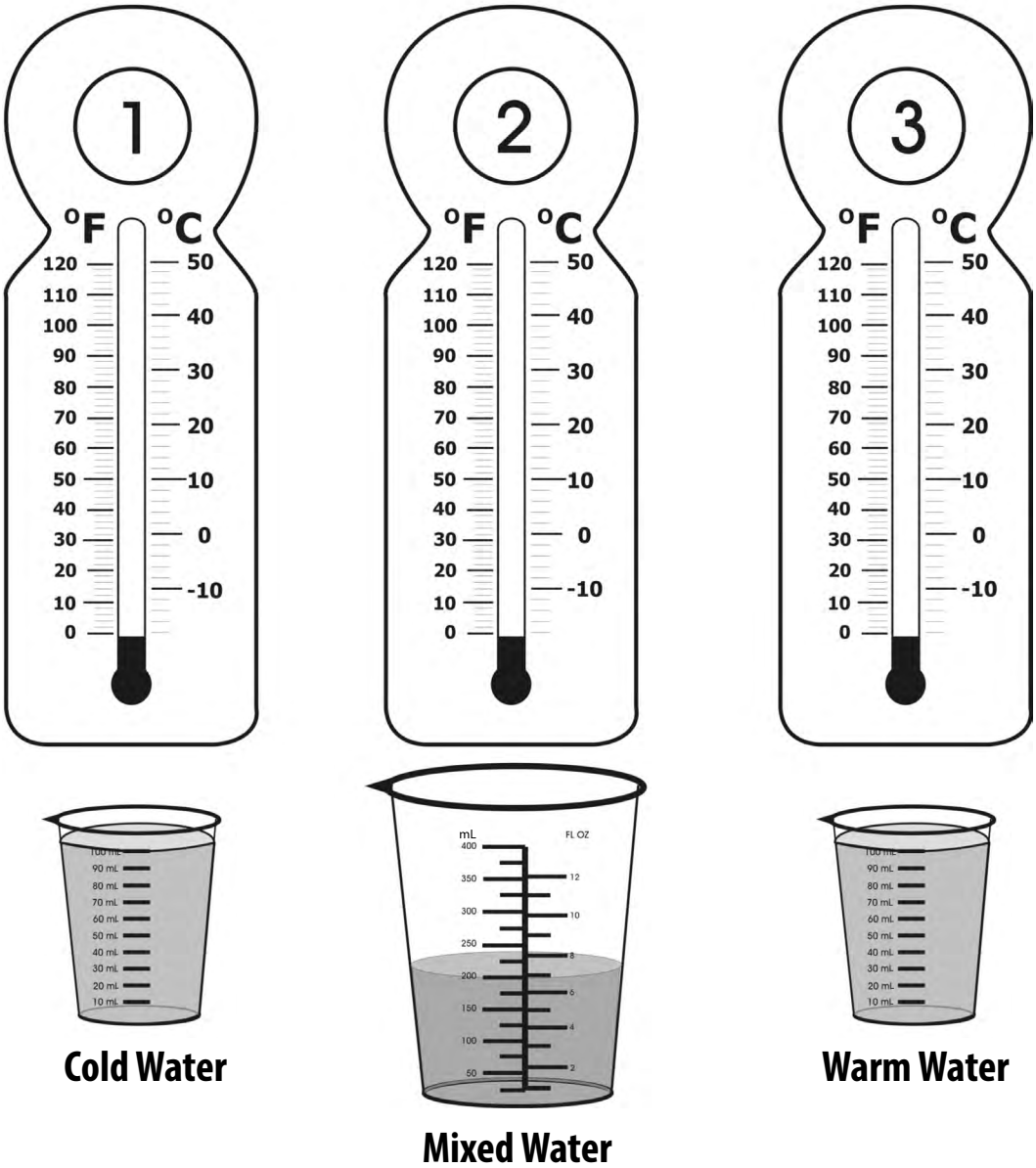
1. Fill one 400 mL beaker with ice water and one with warm water. Use the thermometer to measure the temperature of the beakers of water.
2. Draw a line on Thermometer 1 to show the temperature of the ice water.
3. Draw a line on Thermometer 2 to show the temperature of the warm water.
4. Write the temperatures on the lines besides the thermometers.



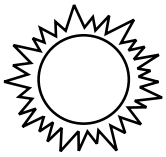
# Temperature 2

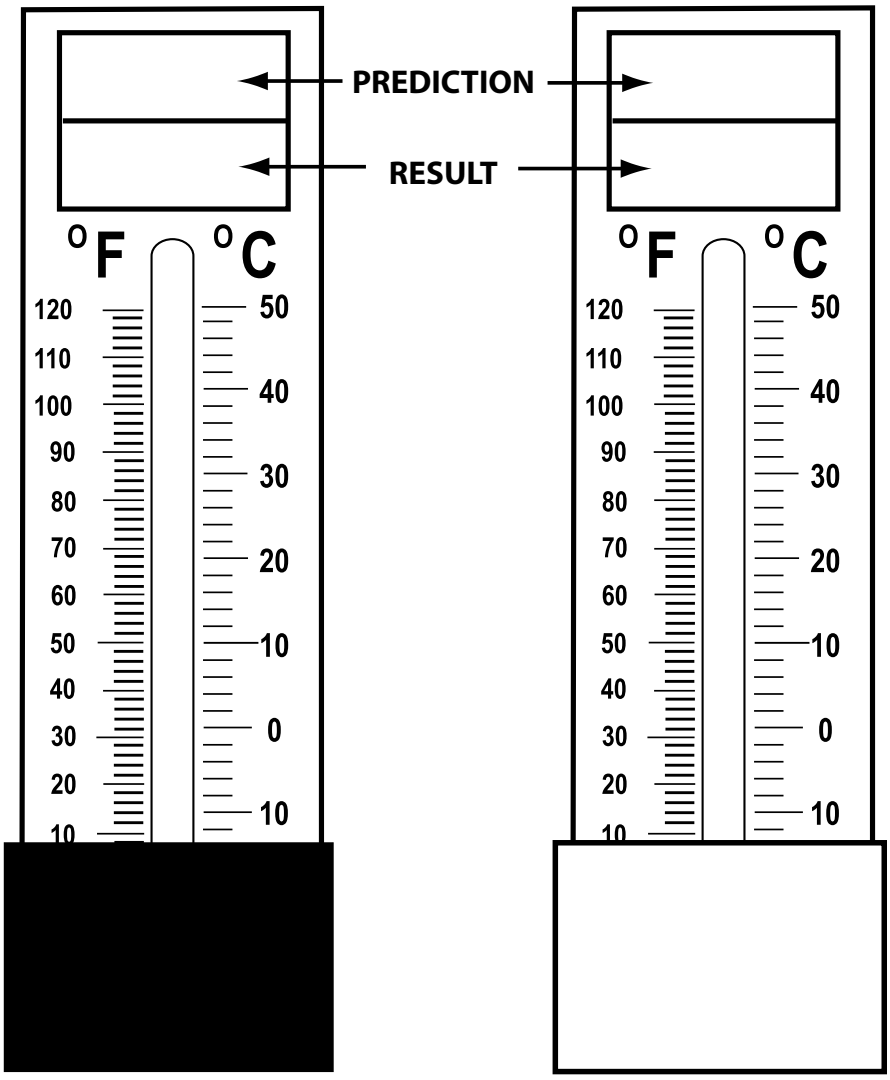
1. Fill one 100 mL beaker with cold water and one 100 mL beaker with warm water.
2. Use the thermometer to measure the temperatures of the water.
3. Color the tubes of Thermometers 1 and 3 to show the temperatures of the water in each beaker.
4. Pour both beakers of water into the 400 mL beaker. DRAW A LINE on Thermometer 2 to show what you think the temperature will be of the mixed water.
5. Use the thermometer to measure the temperature of the water in the large beaker. COLOR the tube of Thermometer 2 to show the temperature of the mixed water. Was your prediction close?



# Light 1

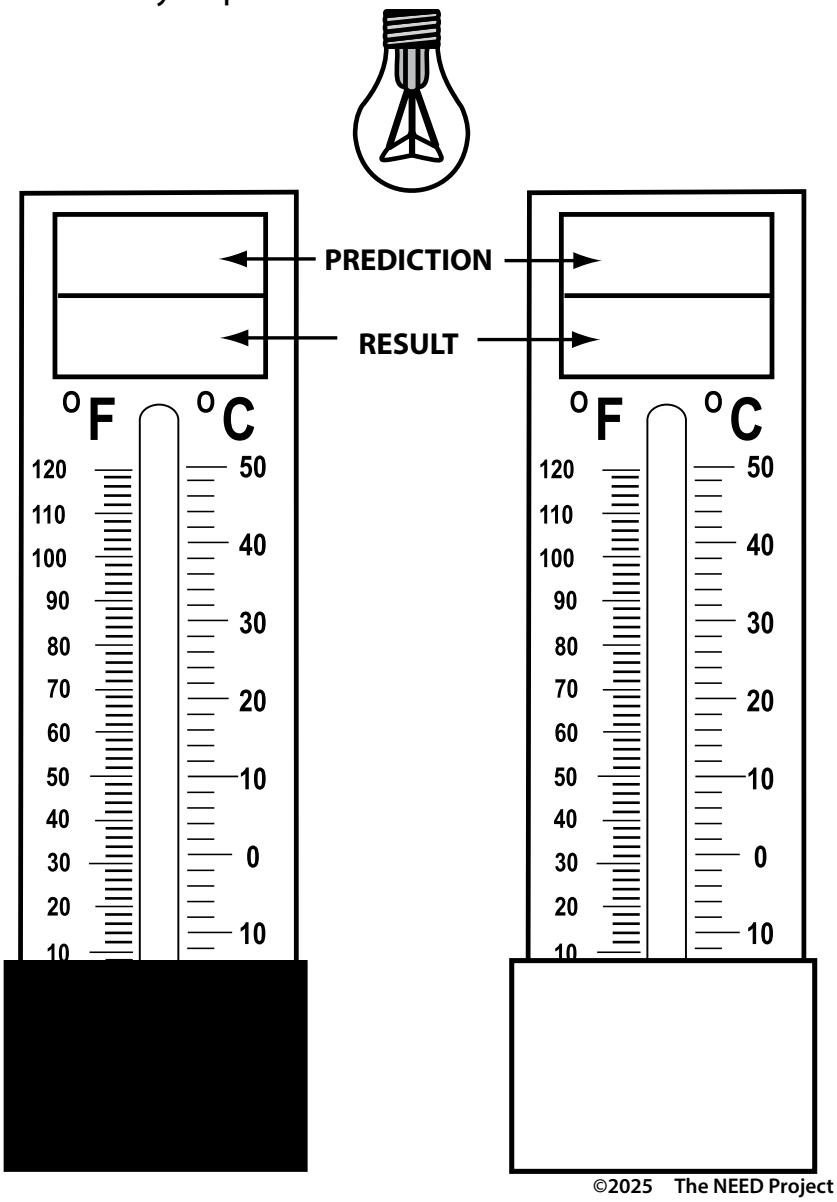
1. Put two thermometers outside in a sunny place.
2. Cover the bulb of one thermometer  with black paper. Cover the bulb of one thermometer with white paper.
3. Predict which thermometer will get hotter. Number them 1 and 2, with 1 being hotter.
4. Wait five minutes.
5. Color the tubes of the thermometers to show the temperatures.
6. Record which thermometer is hotter. Number them 1 and 2, with 1 being hotter. Was your prediction correct?





# Light 2

1. Put two thermometers about 18 inches below a bright artificial light.
2. Cover the bulb of one thermometer with black paper. Cover the bulb of one thermometer with white paper.
3. Predict how much the light bulb will raise the temperature compared to the sunlight. Write your predictions in the top box.
4. Wait five minutes.
5. Color the tubes of the thermometers to show the temperatures.
6. Record the temperatures in the bottom box. Compare the temperatures with those in the last activity. How well did you predict?

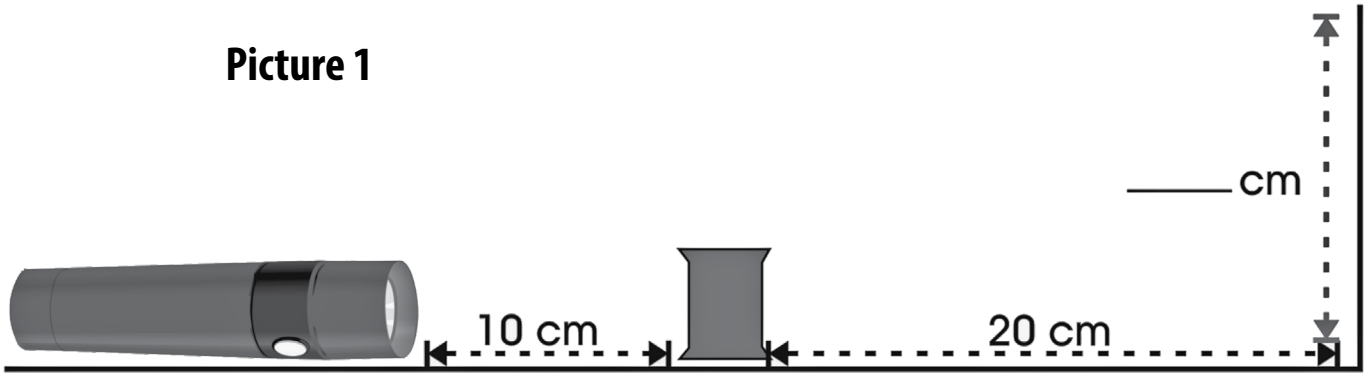


# Light 3

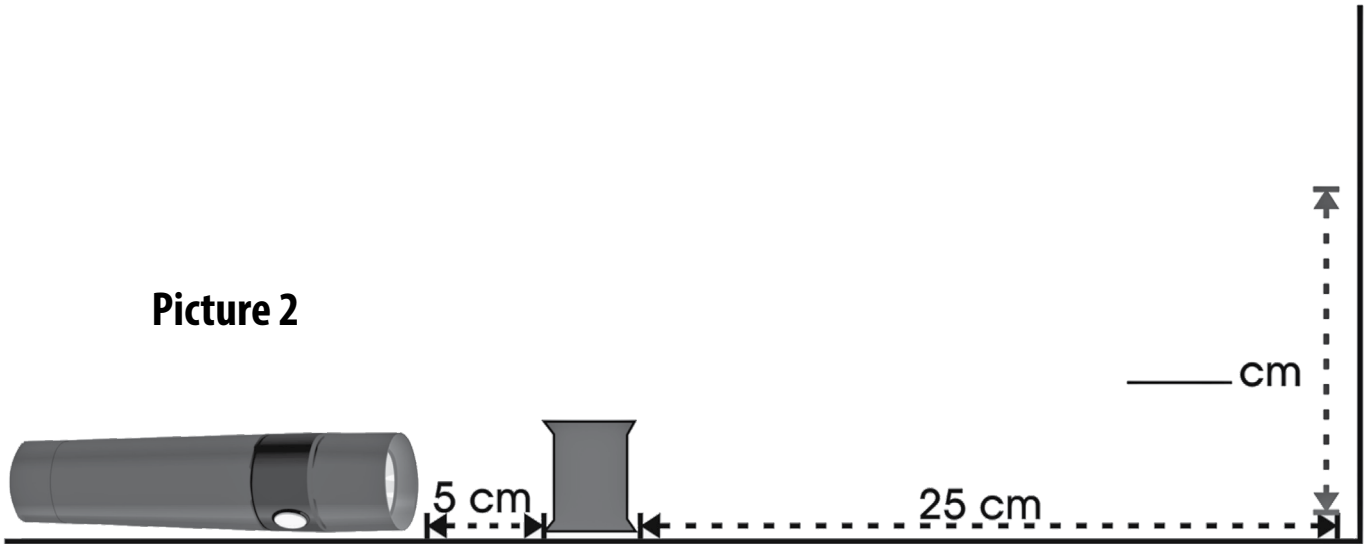
1. Measure the height of the wooden spool. Record the height here: _____ cm
2. Place the spool 20 cm from the wall. Place the flashlight 10 cm from the spool, like in Picture 1.
3. Shine the flashlight on the spool and measure the height of the shadow it makes on the wall. Record the height of the shadow on the blank line in Picture 1.
4. Place the spool 25 cm from the wall. Place the flashlight 5 cm from the spool, like in Picture 2. Do you think the shadow will be larger or smaller? Circle your prediction:

   larger smaller
5. Shine the flashlight on the spool and measure the height of the shadow it makes on the wall. Record the height of the shadow on the blank line in Picture 2.
6. Was your prediction right? Why do you think one shadow was bigger than the other?

**Picture 1**




**Picture 2**

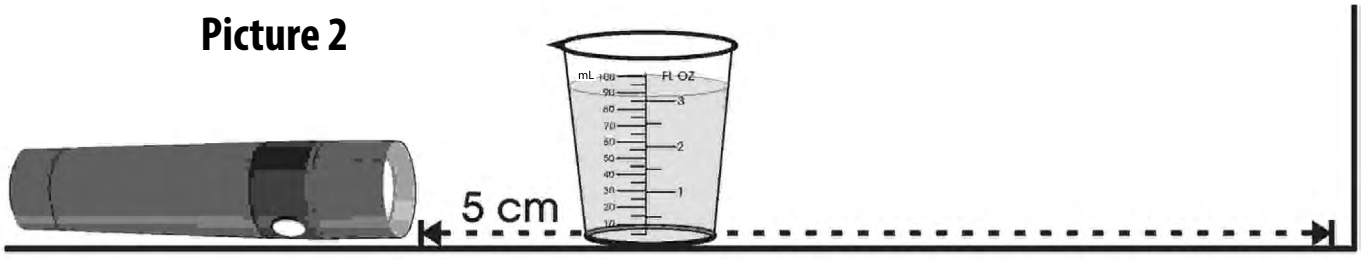


# Light 4

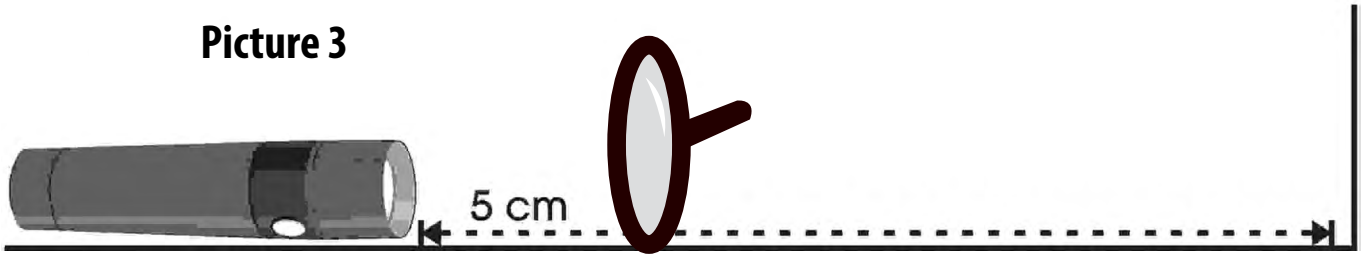
1. Place the flashlight 25 cm from the wall as shown in Picture 1. Observe the light as it shines on the wall. Describe the light in the space below next to Picture 1.
2. Place a 100 mL beaker filled with water between the flashlight and the wall, about 5 cm from the flashlight, as shown in Picture 2. Observe the light as it shines through the water onto the wall. Does the light look different when it passes through the water? Describe the light in the space below next to Picture 2.
3. Place the magnifying glass in the same place as the beaker, as shown in Picture 3. Observe the light as it shines through the lens onto the wall. Describe the light in the space below next to Picture 3.

**Picture 1**


**Picture 2**




**Picture 3**



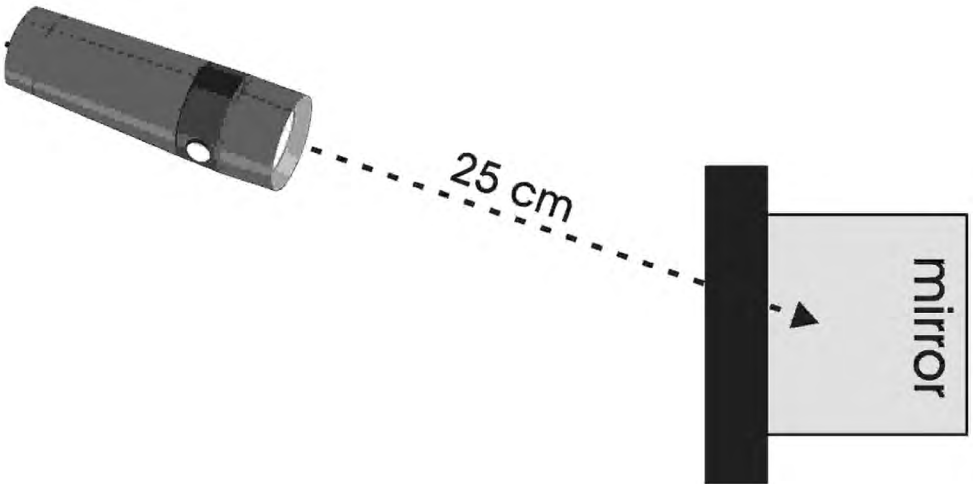
# Light 5

1. Place the flashlight 25 cm from the mirror as shown in Picture 1. Draw an 'A' in the box on the left—behind the flashlight—in the place you think you would stand to see the reflection of the light. Now, stand behind the flashlight so that you can see the reflection of the light. Was your prediction correct? Draw a 'B' where you actually saw the reflection.

2. Place the flashlight 25 cm from the mirror, shining onto the mirror at an angle, as shown in Picture 2. Draw a 'C' in the box behind the picture of the flashlight in the place you can see the reflection. Was your original prediction in step 1 correct for this trial?

**Picture 1**


**Picture 2**



# Sound 1

1. Look at the two tuning forks. How are they the same? How are they different? Record your observations in the spaces below.
2. Hold the small tuning fork with one hand and strike it with the mallet, as shown in Picture 1. Listen to the sound of the tuning fork and feel its vibration. Strike the tuning fork again and gently touch your cheek in front of your ear.
3. Strike the large tuning fork and observe the sound it makes and how it vibrates. Strike the tuning fork again and gently touch your cheek in front of your ear. Compare the two tuning forks. Record your observations in the space below.
4. Hold a piece of paper in the air by one corner, as shown by the 'X' in Picture 2. Strike the small tuning fork with the mallet and touch the paper near the bottom. Observe the sound.
5. Do the same thing with the large tuning fork. Compare the two tuning forks. Record your observations in the space below.

**Small Tuning Fork Observations**

Touching cheek:

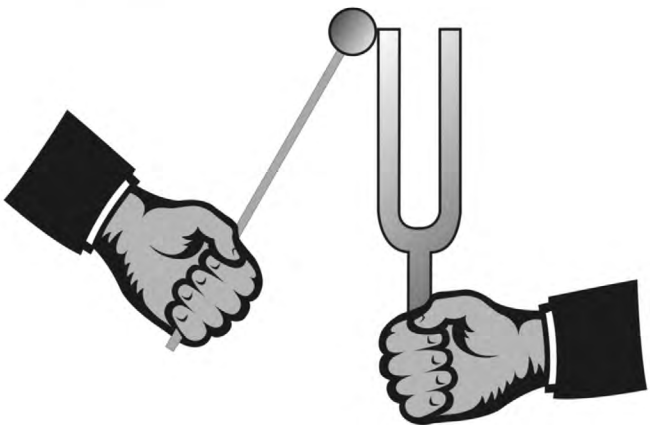
Touching paper:

**Large Tuning Fork Observations**

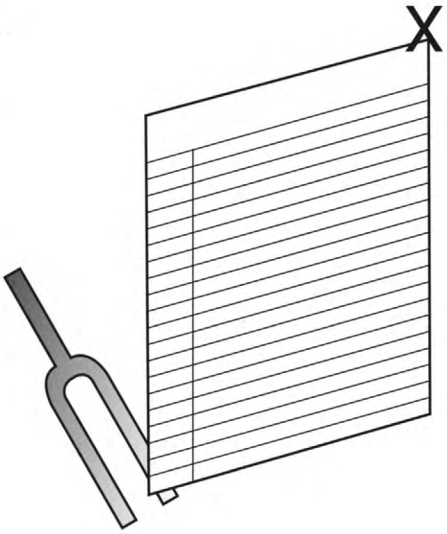
Touching cheek:

Touching paper:

**Picture 1**



**Picture 2**



# Sound 2

1. Strike the small tuning fork and carefully lower it into the empty can without touching the can, as shown with fork 1 in the picture below. Observe the sound.
2. Strike the large tuning fork and carefully lower it into the empty can without touching the can. Observe the sound.
3. Compare the sounds the tuning forks make inside the can. Record your observations in the space below.
4. Strike the small tuning fork and gently touch the outside of the can with it as shown with fork 2 in the picture below. Observe the sound. Do the same thing with the large tuning fork. Compare the two tuning forks. Record your observations in the space below.

**Small Tuning Fork Observations**

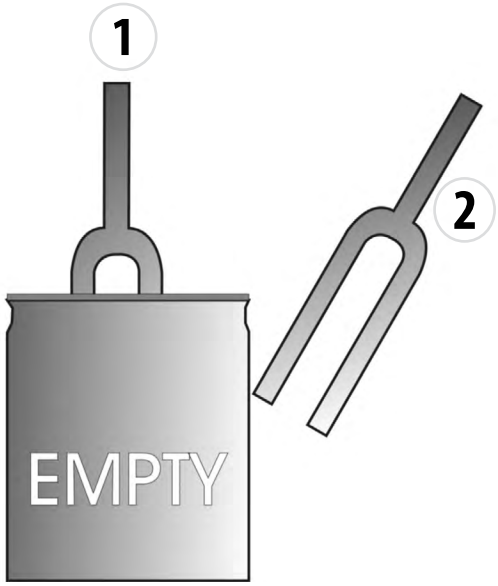
Not touching can inside:

Touching can outside:

**Large Tuning Fork Observations**

Not touching can inside:

Touching can outside:



# Sound 3

1. Sprinkle a few grains of pepper on the plastic wrap on the top of the can.
2. Strike the small tuning fork and hold it near the pepper without touching it, as shown in the picture. Observe the action of the pepper. Record your observation in the space below.
3. Strike the large tuning fork and hold it near the pepper without touching it. Observe the action of the pepper. Record your observation in the space below.
4. Shake the pepper off the top of the can onto a piece of paper. Sprinkle a few drops of water onto the plastic wrap.
5. Strike the small tuning fork and hold it near the water drops without touching them. Observe the action of the water. Record your observation in the space below.
6. Strike the large tuning fork and hold it near the water drops without touching them. Observe the action of the water. Record your observation in the space below.
7. Gently shake the water off the can.

**Small Tuning Fork Observations**

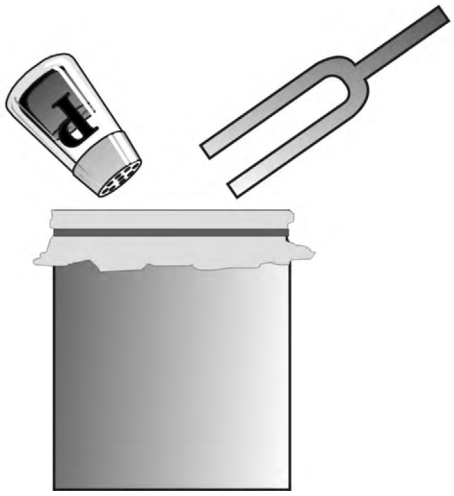
Pepper:

Water Drops:

**Large Tuning Fork Observations**

Pepper:

Water Drops:



# Sound 4

1. Fill the empty can with water. Wait until the water is still.
2. Strike the small tuning fork hard and touch the side of the can very gently. Observe the surface of the water. Record your observation in the space below.
3. Strike the large tuning fork hard and touch the side of the can very gently. Observe the surface of the water. Record your observation in the space below.
4. Strike the small tuning fork hard and touch the surface of the water as shown in the picture. Observe the water. Record your observation in the space below.
5. Strike the large tuning fork hard and touch the surface of the water. Observe the water. Record your observation in the space below.

**Small Tuning Fork Observations**

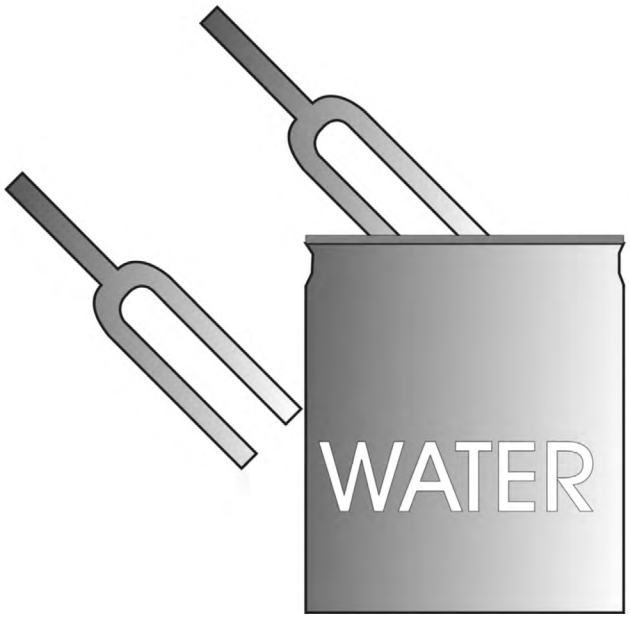
Side of Can:

Surface of Water:

**Large Tuning Fork Observations**

Side of Can:

Surface of Water:



# National Sponsors and Partners

AES
AES Clean Energy Development
American Electric Power Foundation
Appalachian Voices
Arizona Sustainability Alliance
Atlantic City Electric
Avangrid
Baltimore Gas & Electric
Berkshire Gas - Avangrid
BP America Inc
Bob Moran Charitable Giving Fund
Cape Light Compact–Massachusett
Celanese Foundation
Central Alabama Electric Cooperative
CITGO
The City of Cuyahoga Falls
Clean Virginia
CLEAResult
ComEd
Confluence
ConocoPhillips
Constellation
Delmarva Power
Department of Education and Early Childhood Development - Government of New Brunswick, Canada
Dominion Energy, Inc.
Dominion Energy Charitable Foundation
DonorsChoose
East Baton Rouge Parish Schools
East Kentucky Power Cooperative
EcoCentricNow
EDP Renewables
EduCon Educational Consulting
Elmo Foundation
Enel Green Power North America
EnergizeCT
ENGIE
Entergy
Equinix
Eversource
Exelon
Exelon Foundation
Foundation for Environmental Education
FPL
Generac
Georgia Power
Gerald Harrington, Geologist
Government of Thailand–Energy Ministry
Greater New Orleans STEM
GREEN Charter Schools
Green Power EMC
Guilford County Schools–North Carolina
Honeywell
Illinois Clean Energy Community Foundation
Illinois International Brotherhood of Electrical Workers Renewable Energy Fund
Independent Petroleum Association of New Mexico
Interstate Natural Gas Association of America Foundation
Intuit
Iowa Governor's STEM Advisory Council - Scale Up
Iowa Lakes Community College
Iowa State University
Iron Mountain Data Centers
Kansas Corporation Energy Commission
Kansas Energy Program – K-State Engineering Extension
Katy Independent School District
Kentucky Environmental Education Council
Kentucky Office of Energy Policy
Kentucky Power–An AEP Company
Liberty Utilities
Llano Land and Exploration
Louisiana State Energy Office
Louisiana State University – Agricultural Center
LUMA
Marshall University
Mass Save
Mercedes Benz USA
Minneapolis Public Schools
Mississippi Development Authority–Energy Division
Motus Experiential
National Fuel
National Grid
National Hydropower Association
National Ocean Industries Association
National Renewable Energy Laboratory
NC Green Power
Nebraskans for Solar
NextEra Energy Resources
Nicor Gas
NCi – Northeast Construction
North Shore Gas
Offshore Technology Conference
Ohio Energy Project
Oklahoma Gas and Electric Energy Corporation
Omaha Public Power District
Ormat
Pacific Gas and Electric Company
PECO
Peoples Gas
Pepco
Performance Services, Inc.
Permian Basin Petroleum Museum
Phillips 66
PowerSouth Energy Cooperative
PPG
Prince George's County Office of Human Resource Management (MD)
Prince George's County Office of Sustainable Energy (MD)
Providence Public Schools
Public Service of Oklahoma - AEP
Quarto Publishing Group
The Rapha Foundation
Renewable Energy Alaska Project
Rhoades Energy
Rhode Island Office of Energy Resources
Salal Foundation/Salal Credit Union
Salt River Project
Salt River Rural Electric Cooperative
Schneider Electric
C.T. Seaver Trust
Secure Solar Futures, LLC
Shell USA, Inc.
SMUD
Society of Petroleum Engineers
South Carolina Energy Office
Southern Company Gas
Snohomish County PUD
SunTribe Solar
TXU Energy
United Way of Greater Philadelphia and Southern New Jersey
United Illuminating
Unitil
University of Iowa
University of Louisville
University of North Carolina
University of Northern Iowa
University of Rhode Island
U.S. Department of Energy
U.S. Department of Energy–Office of Energy Efficiency and Renewable Energy
U.S. Department of Energy - Solar Decathlon
U.S. Department of Energy - Water Power Technologies Office
U.S. Department of Energy–Wind for Schools
U.S. Energy Information Administration
United States Virgin Islands Energy Office
Vineyard Wind
Virginia Cooperative Extension
Virginia Natural Gas
Vistra Energy
We Care Solar
West Virginia Office of Energy
West Warwick Public Schools
Williams