DATE: NAME: CLASS:

UNIT 3

# Unit 3 Summary

BLM 3-1

**Goal** • Use this summary to review the concepts in Unit 3, Fluids.

## Chapter 7 Viscosity describes fluid's resistance to flow.

- The particle theory of matter states that solid particles, liquid particles, and gas particles behave differently. (7.1)
- Viscosity is a fluid's resistance to flow. (7.2)
- The viscosity of a fluid is affected by temperature. (7.3)

## Chapter 8 Density describes the amount of mass in a given volume of substance.

- Density is a measure of the mass contained in a given volume. (8.1)
- Substances with a lower density will float on substances with a higher density. (8.1)
- The density of a substance can be determined by dividing the object's mass by its volume. (8.2)
- Changes in temperature affect the density of a substance. (8.3)

## Chapter 9 Forces influence the motion and properties of fluids.

- Fluids exert forces on objects in their environments. (9.1)
- The density of fluids determines how they will react with other fluids or solids. (9.1)
- Compression of fluids and gases can be used to produce force. (9.2)
- Temperature, pressure, and volume of a gas influence one another. (9.3)

DATE: NAME: CLASS:

UNIT 3

# Unit 3 Key Terms

BLM 3-2

**Goal** • Use this page to review the Unit 3 Key Terms.

| Chapter 7 Key Terms | Chapter 8 Key Terms | Chapter 9 Key Terms |
|---|---|---|
| boiling | density | Archimedes' principle |
| boiling point | displacement | average density |
| change of state | mass | balanced forces |
| concentration | mass-to-volume ratio | buoyancy |
| condensation | volume | buoyant force |
| deposition | | compressibility |
| evaporation | | controlled variable |
| flow rate | | force |
| fluid | | hydraulics |
| freezing point | | hydraulic multiplication |
| gas | | hydraulic systems |
| kinetic energy | | incompressible |
| liquid | | mass |
| melting | | neutral buoyancy |
| melting point | | pascal |
| particle theory of matter | | pneumatic systems |
| solid | | pressure |
| solidification | | static pressure |
| sublimation | | unbalanced forces |
| viscosity | | weight |

DATE: NAME: CLASS:

UNIT 3

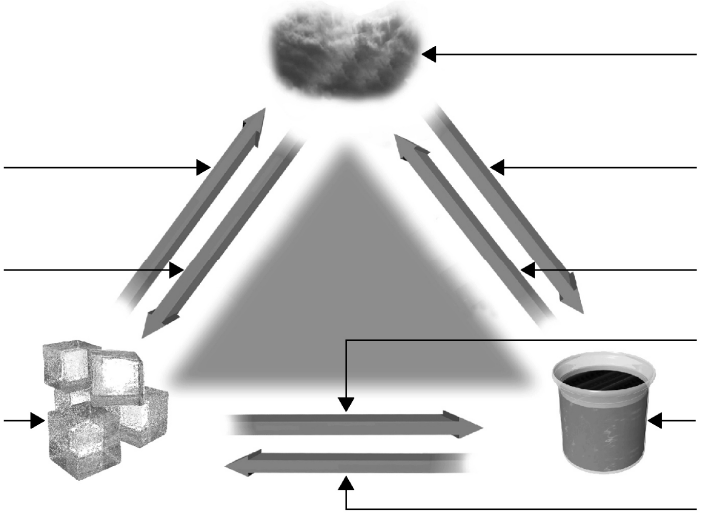
# Chapter 7 Key Terms

BLM 3-3

**Goal** • Use this page to review the Key Terms in Chapter 7.

1. Use Key Terms from this list to label the diagram below.

| | | | |
|---|---|---|---|
| boiling | boiling point | change of state | concentration |
| condensation | deposition | evaporation | flow rate |
| fluid | freezing point | gas | kinetic energy |
| liquid | melting | melting point | particle theory of matter |
| solid | solidification | sublimation | viscosity |



2. Use Key Terms to complete each sentence.

- _____ describes how easily a fluid flows, whereas _____ describes a fluid's resistance to flow.
- The _____ helps us understand that as particles gain _____ they move more quickly and take up more space.
- A substance changes from liquid to solid at its _____ point.
- A substance changes from solid to liquid at its _____ point.
- A substance changes from liquid to gas at its _____ point.
- All moving objects have _____.
- When a gas changes to a liquid, the process is called _____.
- When a gas becomes a solid without becoming a liquid first, the process is called _____.

DATE: NAME: CLASS:

**UNIT 3**

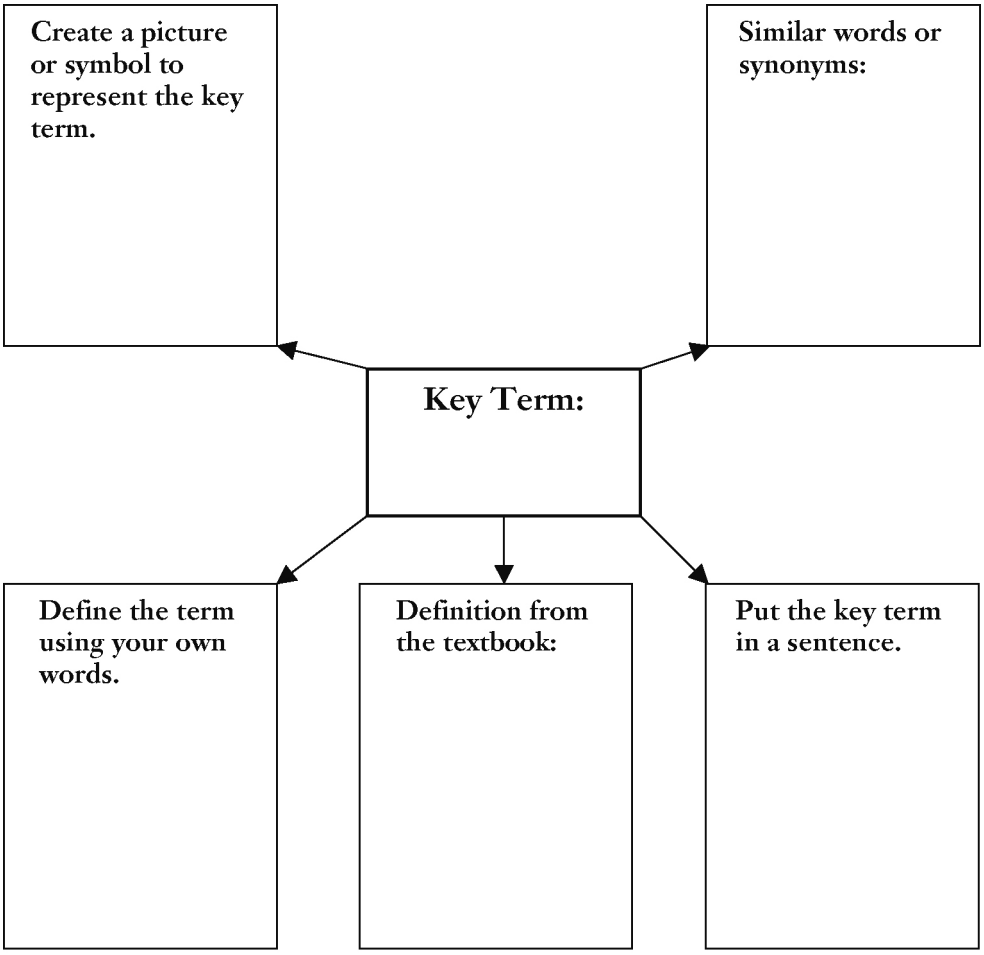
# Chapter 8 Key Terms

**BLM 3-4**

**Goal** • Use this list to help you review Key Terms in Chapter 8.

Work with two other students. Each student should choose one list of key terms and complete this page once for each term in that list. Then add anything you can to help complete your group members' pages. Be sure all three team members are satisfied with all three pages.

| **List 1** | **List 2** | **List 3** |
|---|---|---|
| density | volume | mass |
| mass-to-volume ratio | displacement | |



DATE: NAME: CLASS:

UNIT 3

# Chapter 9 Key Terms

BLM 3-5

**Goal** • Use the graphic organizer below to help you learn and review the Key Terms in Chapter 9.

Create a list of 10 words or phrases from the descriptions below. Then find the words and phrases in the puzzle.

| | |
|---|---|
| 1. The pull, or force, of gravity acting on an object (6 letters) | |
| 2. The upward force on objects submerged in or floating on fluids (8 letters) | |
| 3. The total mass of all substances that make up the object divided by the total volume (7 letters, 7 letters) | |
| 4. The force acting on a certain area of a surface (8 letters) | |
| 5. The unit for pressure (6 letters) | |
| 6. The ability to be squeezed into a smaller volume, or space (15 letters) | |
| 7. Anything that causes a change in the motion of an object (5 letters) | |
| 8. The amount of matter in an object (4 letters) | |
| 9. Systems that use gasses to transmit forces (9 letters, 7 letters) | |
| 10. The study of pressure in liquids (10 letters) | |

DATE: NAME: CLASS:

**BLM 3-5 continued**

H Y D R A U L I C S E R B S C S Y D O

C D E N S I T Y C U R R U N O T R I C

A V E R A G E D E N S I T Y M S I S E

A S M W Q O D A E S P I Y E P P M P A

R M A E E I O I G N I R A U R S A L N

D K S I M I N U S T C C N R E O I A R

I F S O R G G N N G I H C A S E Y C E

A O Y S S A L H L A R N Y M S R C E R

C R R I O L I S T F I E P T I T K M U

C C N P R O E N T A D S R E B F E E S

L E R Y A B U O Y A N C Y A I H T N S

C O N T I S E N T A U D T I L M S T E

X S M T A E C N M L M L K T I O A E R

W O P N E U M A T I C S Y S T E M S P

Q L M M U P W V L L I N G S Y S Y S S

DATE: NAME: CLASS:

**UNIT 3**

# Fluids or Non-fluids?

**BLM 3-6**

**Goal** • Use this page for practice in identifying fluids and non-fluids.

## What to Do

Draw a circle around each picture that shows a fluid. Then answer the question at the bottom of the page.


List at least three other fluids that you can identify in your own environment.

DATE: NAME: CLASS:

UNIT 3

# The Particle Theory of Matter

BLM 3-7

**Goal** • Use this page to check your understanding of the particle theory of matter.

## What to Do

Read the points listed below, which make up the particle theory of matter. Use them to help you explain the statements that follow.

## The Particle Theory of Matter

- All matter is made up of very small particles.
- All particles in a pure substance are the same. Different substances are made of different particles.
- There is space between the particles.
- The particles are always moving. As the particles gain energy, they move faster.
- The particles in a substance are attracted to one another. The strength of the attractive force depends on the type of particle.

## Statements

1. Solids have a definite shape because _____

_____

_____

2. Liquids and gases flow because _____

_____

_____

3. Ice cubes form in the freezer because _____

_____

_____

4. Ice cream melts quickly on a hot day because _____

_____

_____

5. Gases do not have a definite shape because _____

_____

_____

DATE: NAME: CLASS:

UNIT 3

# Identifying Changes of State

BLM 3-8

**Goal** • Build your skills in recognizing and defining the changes of state.

## What to Do

Match each description with the correct change of state. Write the letter for the change of state in the space at the end of the descriptions. You may use some changes of state more than once.

**Changes of State**

| | | |
|---|---|---|
| (a) sublimation | (b) condensation | (c) evaporation |
| (d) deposition | (e) melting | (f) solidification |

**Descriptions**

1. Ice is left out on the counter. _____
2. Frost forms on the window on a cold day. _____
3. Water is left in a freezer. _____
4. Clothes are left out to dry. _____
5. Dry ice is used to create fog. _____
6. The bathroom mirror gets fogged up after a shower. _____
7. A pond gets shallower at the end of a long, hot summer. _____
8. Your hair was wet when you left the house, but is dry by the time you get to school.

   _____
9. The ice cream you are eating drips down your arm. _____
10. A full pot of soup fills only half of the pot after simmering for 2 h. _____
11. Liquid glass cools and hardens. _____
12. A cold drink is wet on the outside of the glass. _____

DATE: NAME: CLASS:

UNIT 3

# Magical Morphing

BLM 3-9

**Goal** • Read this page to learn more about "morphing," a special effect used in videos and movies.

## What Is "Morphing"?

Science fiction script writers often feature changes of state in imaginary ways. "Morphing" has become one of the most popular special effects developed for science fiction movies.

The term "morphing" comes from "metamorphosing" or "metamorphosis." Many living organisms (for example, some amphibians and insects) experience slow metamorphosis. Over time, they change form as they go through the stages of their life cycle. If we could videotape a person's entire lifetime, and then play back the tape at a higher speed, the person would appear to be morphing! The changes that take years to occur would seem to go much faster on the video.

The morphing that we see in movies or on video is an animation technique that slowly changes one image into another. The animation artists use computer-generated graphics to make the characters change, or morph, into someone or something else. In the middle of the morphing, the image appears fluid. Sometimes a solid being appears to morph into a liquid that can creep under doors, or slip through cracks, and then quickly re-solidify.

## What to Do

Do one or more of the following projects.

### Project A

Use your understanding of morphing to create a scene in which morphing takes place. Write a short summary of the scene, then illustrate it, using flip-book technology. In a flip book, the images are "animated." The reader flips through the pages of the book from beginning to end in the same way a person flips through a deck of cards. The image on each page changes very slightly. The reader's eyes catch only a glimpse of each image, so it looks like the image has moved.

### Project B

If you have access to software for computer animation, see if you can create a morphing scene with your program. Remember the key is a gradual transformation.

### Project C

Investigate some of the specialized morphing software that is available. (Is it expensive? Who is using it these days, and for what?)

DATE: NAME: CLASS:

UNIT 3

# The Value of Viscosity

BLM 3-10

**Goal** • Use this page to complete Find Out Activity 7-2A, The Value of Viscosity.

| Name Brand of Product | Cost ($) | Volume (mL) | Cost per Volume (¢/mL) | Relative Viscosity (high, medium, low) |
|---|---|---|---|---|
| | | | | |
| | | | | |
| | | | | |
| | | | | |

## What Did You Find Out?

1. Is there a relationship between cost per volume and viscosity? If so, describe it. How is viscosity related to the product's usefulness?

_____

_____

_____

_____

_____

2. List three products that are more useful because their viscosity is high, and three products that are more useful because their viscosity is low.

| Valuable because viscosity is high | Valuable because viscosity is low |
|---|---|
| _____ | _____ |
| _____ | _____ |
| _____ | _____ |

DATE: NAME: CLASS:

UNIT 3

# The Flow Rate of Liquids

BLM 3-11

**Goal** • Use this page to complete Conduct an Investigation 7-2B, The Flow Rate of Liquids.

## What to Do

Record your results in the data table.

| Liquid | Time (s) | Flow Rate (cm/s) | Ranked Flow Rate | Ranked Viscosity |
|---|---|---|---|---|
| Water | | | | |
| Substance 2 | | | | |
| Substance 3 | | | | |

## Analyze, Conclude, and Apply

1. Describe two sources of error that might affect your results. Are these errors due to the equipment or to human factors? How could you reduce or eliminate these errors?

_____

_____

2. How is flow rate of a liquid related to its viscosity?

_____

_____

_____

3. Which liquids were more difficult to measure with the viscosity ramp? What could you have done to the ramp to make it easier to measure these liquids?

_____

_____

_____

_____

4. Make a bar graph showing flow rate (in cm/s) along the vertical axis (*y*-axis), and the various liquids along the horizontal axis (*x*-axis). Plot the data for each liquid on this graph, using a different colour for each liquid. Include a legend on your graph.

DATE: NAME: CLASS:

UNIT 3

# Viscosity and the Real World

BLM 3-12

**Goal** • Apply your knowledge and understanding of viscosity.

## What to Do

Answer the following questions by applying your knowledge of viscosity. You may need to do some research to find the answers to some of the questions.

## Questions

1. A straw that is served with a soft drink is usually different from a straw served with a milkshake. Explain how and why the straws are different.

_____

_____

2. (a) If you had to design a pipeline to transport molasses from one part of a factory to another, how would the diameter of the pipeline for molasses differ from the diameter of the water pipes in the factory? Why?

_____

_____

_____

(b) What could you do to make the molasses flow more quickly?

_____

_____

3. (a) Some viscous liquids come in squeeze bottles. Identify several examples and list them here.

_____

_____

_____

(b) Does this type of bottle make it easier or harder to use the product? Explain your answer.

_____

_____

DATE: NAME: CLASS:

UNIT 3

# Controlling Viscosity

BLM 3-13

**Goal** • Apply your understanding of viscosity and the factors that affect viscosity to design a method to control the viscosity of different fluids.

## Think About It

You can measure flow rate by measuring the time it takes for a certain liquid to flow down a 10-cm track. Could you do it the other way around—that is, make the liquid flow at a specific or desired flow rate?

## What to Do

1. The table below lists three liquids and a desired flow rate for each. Work with a partner to design a procedure to make these liquids flow at the desired rate.

| Liquid | Desired Flow Rate |
|---|---|
| Ketchup | 1.0 cm/s |
| Honey | 3.0 cm/s |
| Cooking oil | 0.5 cm/s |

2. Outline your procedure. Include any necessary safety precautions. Identify the apparatus, materials, and amounts of materials you need.

_____

_____

_____

_____

3. Decide how you will record your results (for example, in a table or as a list).
4. Your teacher must approve your procedure before you test it.
5. Try out you procedure and analyse your results. Then answer the questions on the next page.

## Questions

1. Describe how you changed the flow rate of each of the liquids.

   ketchup:

   _____

   _____

   _____

   honey:

   _____

   _____

   _____

   cooking oil:

   _____

   _____

   _____

2. What types of things make a fluid more viscous?

   _____

   _____

   _____

3. What types of things make a fluid less viscous?

   _____

   _____

   _____

4. Which liquid was the easiest to manipulate to get the desired flow rate? Explain why.

   _____

   _____

   _____

DATE: NAME: CLASS:

UNIT 3

# Viscosity in Action

BLM 3-14

**Goal** • Demonstrate your knowledge and understanding of viscosity by developing a new product.

## Think About It

The right viscosity can make a product appealing. It is important for people who develop a new product to make sure the viscosity is right for the product's use.

## What to Do

You will work as part of a team employed by a large cosmetics company. Your team has been asked to develop a new shampoo with an ideal viscosity and container. When you have developed your product, you will have an opportunity to present your product to the company's president and executives.

You will need to submit the following materials as part of the evaluation.

- shampoo recipe
- sample of shampoo
- sample label for container
- sketch of design for container
- report (half-page to one full page) describing how your team developed the product, its label, and its container

Use the steps that follow as a guideline for your team's product development.

1. Discuss the following issues with your team:
   (a) the steps for washing hair

_____

_____

   (b) how viscosity is related to the steps

_____

_____

   (c) how viscosity is related to the container, and how the container is related to the product

_____

_____

2. (a) Create a sample of "shampoo" using flour and water. Begin with 200mL of each substance. (Note: You must submit a recipe for your shampoo, so keep track of how much extra water or flour you add.)
   (b) Write a brief description of the viscosity and the recipe for it. Explain why you think this viscosity is perfect for your new shampoo.

_____

_____

_____

3. (a) Draw a sketch of the ideal container for your shampoo. Use labels and a caption to explain how it works. Look at pictures or samples of containers to help you.

   (b) Create a product label for your new shampoo. Look at pictures or sample containers with labels for ideas.

4. Prepare a three-minute presentation about your new shampoo that summarizes your development process and outlines the advantages of your new product.

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UNIT 3

# Viscosity Plunge

BLM 3-15

**Goal** • Use this data table to record your data from Conduct an Investigation 7-3C, Viscosity Plunge.

## What to Do

Record your data in the table.

| Temperature (°C) | Depth of Corn Syrup (cm) | Time (s) | Rate of Fall (cm/s) |
|---|---|---|---|
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
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| | | | |

## Analyze, Conclude, and Apply

1. In this experiment, what is

   the independent variable? _____

   the dependent variable? _____

   the controlled variable? _____

2. Create a line graph of your results by plotting the rate of fall of the marbles versus the temperature of the corn syrup. Draw a best-fit line through your data.

3. How is the marbles' rate of fall related to the temperature of the corn syrup?

   _____

4. How is the marbles' rate of fall related to the viscosity of the corn syrup?

   _____

5. How does viscosity change with temperature?

   _____

6. Use the graph you drew in question 2. Suppose the corn syrup was at 55°C. How quickly would the marble fall? _____
   Show your work on your graph.

DATE: NAME: CLASS:

UNIT 3

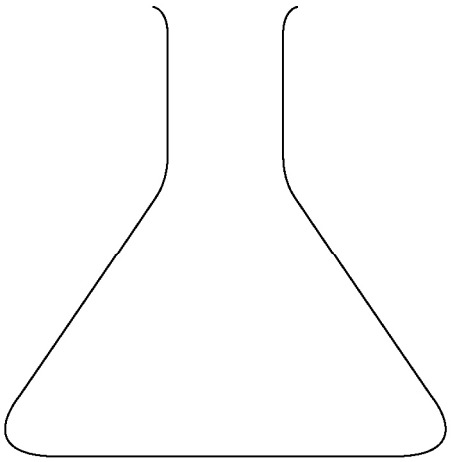
# Cool Contraction

BLM 3-16

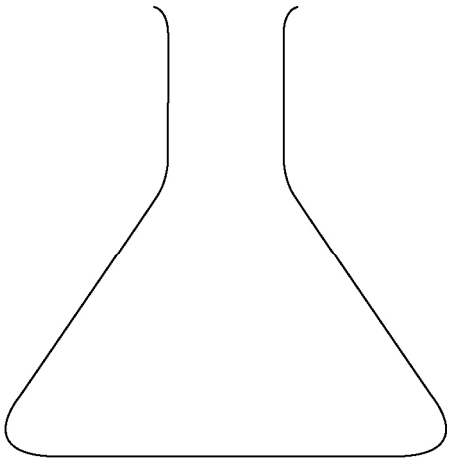
**Goal** • Use this page to help you show what you found out in Find Out Activity 7-3D, Cool Contraction.

## What to Do

Use these two drawings of Erlenmeyer flasks to illustrate the results of cooling the flask in Find Out Activity 7-3D. Show the behaviour of the particles of air and the position of the balloon before and after you cooled the flask.



BEFORE



AFTER

DATE: NAME: CLASS:

UNIT 3

# The Effect of Concentration on Viscosity

BLM 3-17

**Goal** • Use this page to help you complete Conduct an Investigation 7-3E, The Effect of Concentration on Viscosity.

## What to Do

Record your data in the table.

| Concentration of Sugar in Water | Time (s) | Flow Rate (cm/s) | Ranked Flow Rate | Ranked Viscosity |
|---|---|---|---|---|
| 0 g/mL | | | | |
| 0.20 g/mL | | | | |
| 0.45 g/mL | | | | |

## Analyze, Conclude, and Apply

1. Describe two sources of error that might affect your results. Are these errors due to the equipment or to human factors? How could you reduce or eliminate these errors?

_____

_____

_____

2. How is the flow rate of a liquid related to the concentration?

_____

_____

_____

3. What conclusion can you come to about the relationship between concentration and viscosity?

_____

_____

_____

DATE: NAME: CLASS:

UNIT 3

# Chapter 7 Review

BLM 3-18

**Goal** • Check your understanding of Chapter 7.

## What to Do

Circle the letter of the best answer.

1. The particles in a substance are closely spaced and in contact with each other, but they can slip and slide past one another. What is this substance?
   A. air
   B. ice
   C. water
   D. water vapour

2. As particles have more energy, which of the following applies?
   A. The object has a higher mass.
   B. There are more particles per unit volume.
   C. They move faster.
   D. They move slower.

3. Which of the following applies to particles in a solid?
   A. They can move freely in all directions.
   B. They have no motion.
   C. They have very large spaces between them.
   D. They vibrate in a fixed position.

4. When the temperature of a solid, liquid, or gas decreases, the particles do which of the following?
   A. move faster, gain more energy, have more space between them
   B. move faster, lose energy, have less space between them
   C. slow down, gain more energy, have more space between them
   D. slow down, lose energy, have less space between them

5. Which of the following describes a change in state?
   A. kinetic energy
   B. melting point
   C. sublimation
   D. thermal expansion

6. Which of the following does not describe a change in state?
   A. condensation
   B. evaporation
   C. solidification
   D. thermal energy

7. What is the temperature at which a solid turns to a liquid?
   A. 0° C
   B. boiling point
   C. freezing point
   D. melting point

8. Which of the following occurs when frost forms on windows on cold days?
   A. deposition
   B. evaporation
   C. melting
   D. solidification

9. Which of the following is not a fluid?
   A. air
   B. dry ice
   C. liquid oxygen
   D. magma

**Match the Term on the left with the best Descriptor on the right.**
**Each Descriptor may be used only once.**

| Term | Descriptor |
|---|---|
| _____ 10. boiling point | A. any substance that flows |
| _____ 11. deposition | B. can be a liquid or gas |
| _____ 12. evaporation | C. change in state from gas to solid |
| _____ 13. fluid | D. change in state from liquid to gas |
| _____ 14. sublimation | E. change in state from solid to gas |
| _____ 15. volume | F. temperature at which liquid turns to gas |
| | G. the amount of space taken up by a substance |

## Short Answer Questions

16. Explain why a cold drinking glass cracks when it is placed in very hot water.

_____

_____

_____

17. (a) List two substances that can be found in your school that have a low viscosity.

_____

_____

(b) List two substances that can be found in your school that have a high viscosity.

_____

_____

18. Explain how temperature affects viscosity.

_____

_____

_____

19. Explain how concentration affects viscosity.

_____

_____

_____

20. Explain how particle size affects viscosity.

_____

_____

_____

DATE: NAME: CLASS:

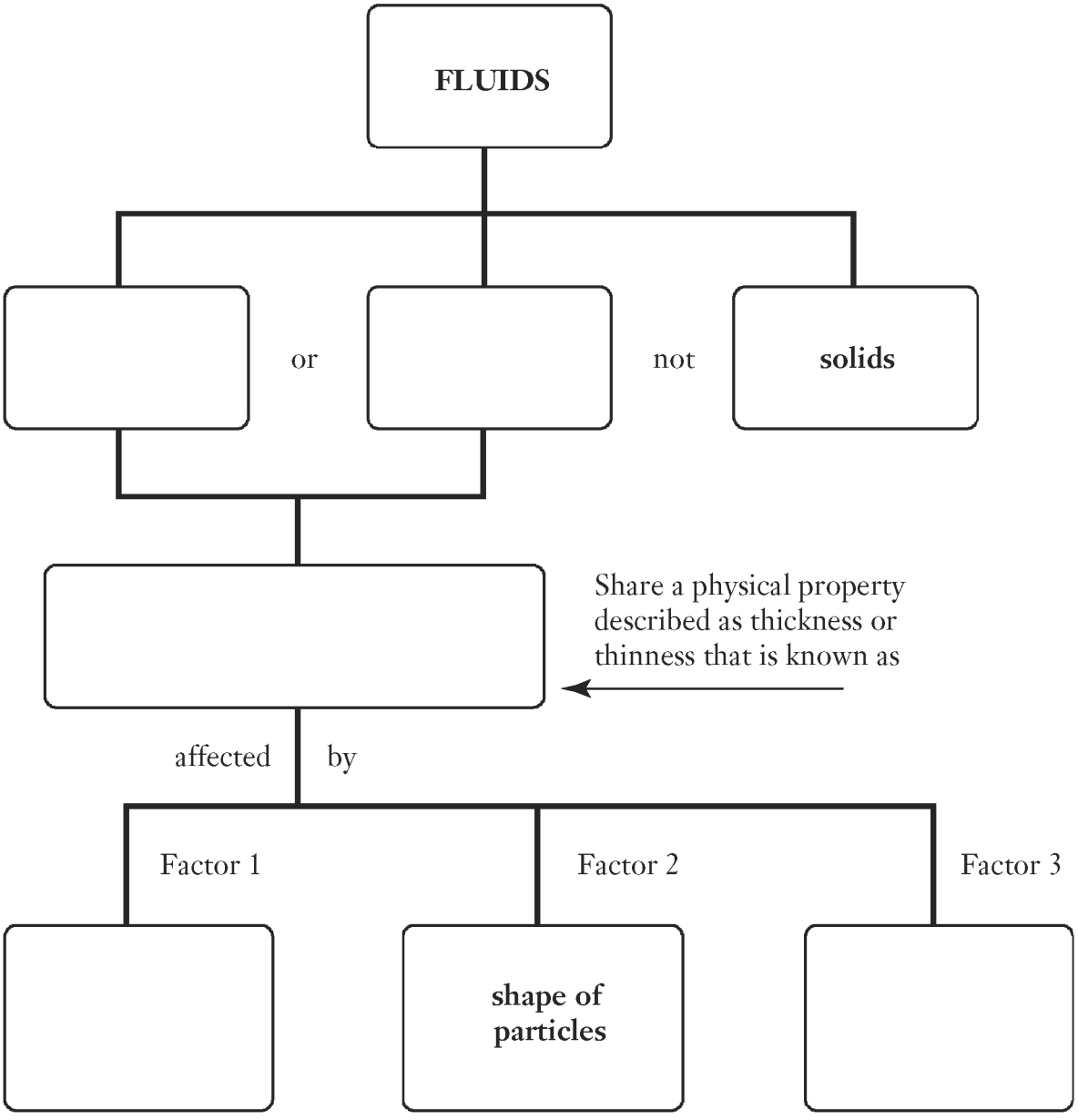
UNIT 3

# Chapter 7 Concept Map

BLM 3-19

**Goal** • Use this page to help you review what you learned in Chapter 7.

Complete the concept map for question 8 on page 298 of the textbook using key ideas you learned in Chapter 7.



DATE: NAME: CLASS:

UNIT 3

# Differing Densities

BLM 3-20

**Goal** • Use this page to complete Find Out Activity 8-1A, Differing Densities.

## What to Do

Record your results in the table.

| Sample (letter) | Rank (ordered heaviest to lightest) | Substance | |
|---|---|---|---|
| | | Prediction | Actual |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |

## What Did You Find Out?

1. Which substances did you predict correctly (or closely)? Which substances, if any, surprised you?

_____

_____

_____

_____

2. The volumes of the substances were identical because each container was filled to the top. Why is it important to keep the volumes equal in this activity?

_____

_____

_____

_____

DATE: NAME: CLASS:

UNIT 3

# Calculating Density Practice Problems

BLM 3-21

**Goal** • Use these questions to check your understanding of how to calculate density.

## What to Do

Answer these questions after you have read pages 311 and 312 of your textbook.

1. A student measures the mass of an 8 $cm^3$ block of brown sugar to be 12.9 g. What is the density of the brown sugar?

$$D = \frac{m}{V}$$
$$= \frac{12.9\ g}{8\ cm^3}$$
$$= \_\_\_\_\_$$

2. A chef fills a 50 mL container with 43.5 g of cooking oil. What is the density of the oil?

3. A machine shop worker records the mass of an aluminum cube as 176 g. If one side of the cube measures 4 cm, what is the density of the aluminum?

4. Based on the density values on page 312 of your student textbook, list how the following liquids would layer in a beaker from top to bottom: glycerol, ethyl alcohol, mercury, seawater, machine oil, water.

| | |
|---|---|
| 5. A teacher performing a demonstration finds that a piece of cork displaces 23.5 mL of water. The piece of cork has a mass of 5.7 g. What is the density of the cork? | 6. A carver begins work on a block of granite that measures 20 cm by 10 cm by 5 cm. If the block of granite has a mass of 2700 g, what is the density of the granite? |
| 7. A piece of PVC plumbing pipe displaces 60 mL when placed into a container of water. If the pipe has a mass of 78 g, what is the density of PVC? | 8. A solid magnesium flare has a mass of 1300 g and a volume of 743 $cm^3$. What is the density of the magnesium? |
| 9. An ice cube has a volume of 12 $cm^3$, and a mass of 11 g. What is the density of the ice? | 10. Gold is one of the densest substances on Earth. A gold bar 20 cm by 5 cm by 5 cm has a mass of 9.7 kg. What is the density of gold? Express your answer in $g/cm^3$. |

DATE: NAME: CLASS:

UNIT 3

# Working with Density Measurements

BLM 3-22

**Goal** • Find the identities of the mystery substances in the questions below.

## What to Do

Calculate the density of each substance. Then find the substance in the table on page 312 of your textbook.

| | |
|---|---|
| 1. A substance has a mass of 144 g and a volume of 600 $cm^3$. What substance is it? | 2. A substance has a mass of 6923 g and a volume of 880 $cm^3$. What substance is it? |
| 3. A substance has a mass of 725 g and a volume of 575 mL. What substance is it? | 4. A substance has a mass of 1220 g and a volume of 90 mL. What substance is it? |
| 5. A substance has a mass of 1771 g and a volume of 820 $cm^3$. What substance is it? | 6. A substance has a mass of 45 g and a volume of 9000 $cm^3$. What substance is it? |
| 7. A substance has a mass of 250 g and a volume of 22 $cm^3$. What substance is it? | 8. A substance has a mass of 455 g and a volume of 650 $cm^3$. What substance is it? |
| 9. A substance has a mass of 87.55 kg and a volume of 85 000 $cm^3$. What substance is it? | 10. A substance has a mass of 3950 g and a volume of 5000 mL. What substance is it? |

DATE: NAME: CLASS:

UNIT 3

# Densities Calculations

BLM 3-23

**Goal** • Use this page to calculate the mass and volume of different substances.

## What to Do

Use the table and the following formula to solve the following problems. Rewrite the formula for mass and for volume.

$$\text{density} = \frac{\text{mass}}{\text{volume}}$$

mass = volume =

| Fluid | Density (g/mL) | Solid | Density (g/cm$^3$) |
|---|---|---|---|
| hydrogen | 0.000 09 | Styrofoam™ | 0.005 |
| helium | 0.000 2 | cork | 0.24 |
| air | 0.001 3 | oak | 0.70 |
| oxygen | 0.001 4 | sugar | 1.59 |
| carbon dioxide | 0.002 | salt | 2.16 |
| ethyl alcohol | 0.79 | aluminum | 2.70 |
| machine oil | 0.90 | iron | 7.87 |
| water | 1.00 | nickel | 8.90 |
| seawater | 1.03 | copper | 8.92 |
| glycerol | 1.26 | lead | 11.34 |
| mercury | 13.55 | gold | 19.32 |

1. Calculate the mass of 550 mL of air.

_____

_____

_____

2. Calculate the mass of 50 cm$^3$ of copper.

_____

_____

_____

3. What is the volume of a 2 g piece of gold?

_____

_____

_____

4. How much space would 1 kg of air occupy?

_____

_____

_____

5. In an experiment, two students find that 500 g of water occupies a space of 50 mL. Is this result accurate? Explain.

_____

_____

_____

6. In the same class, two students find that a piece of wood with a mass of 70 g has a volume of 103 $cm^3$. They conclude that the wood is oak. Is this conclusion accurate? Explain.

_____

_____

_____

DATE: NAME: CLASS:

UNIT 3

# What is the Density of a Tennis Ball?

BLM 3-24

**Goal** • Use this page to determine the density of a tennis ball.

## What to Do

Fill in the blanks with the information you need to calculate the mass, volume, and density of a tennis ball.

## What I Will Need

_____

_____

_____

## What I Will Do

I will determine the mass of the tennis ball by

_____

_____

I will determine the volume of the tennis ball by

_____

_____

I will calculate the density of the tennis ball by

_____

_____

## Do It!

Mass of tennis ball = _____ g

Volume of tennis ball = _____ $cm^3$

Density of tennis ball = _____ $g/cm^3$

Does it make sense? The density that I calculated for the tennis ball is reasonable because

_____

_____

_____

DATE: NAME: CLASS:

UNIT 3

# Determining Density

BLM 3-25

**Goal** • Use these charts to record the mass and volume of different substances in Conduct an Investigation 8-2B, Determining Density.

## What to Do

Predict how the substances will rank according to density. Rank the substances from least dense (1) to most dense (5).

water ___ oil ___ glycerol ___ molasses ___ sand ___

Record your results in the charts.

**Substance Tested:**

| A | B | C | D | E |
|---|---|---|---|---|
| **Volume (mL)** | **Mass of Beaker Only (g)** | **Mass of Beaker and Substance (g)** | **Mass of Substance Only (g)** | **Ratio of Mass to Volume (g/mL)** |
| 100 | | | | |
| 200 | | | | |
| 300 | | | | |
| 400 | | | | |
| 500 | | | | |

**Class Results**

| Substance | Mass (g) | Volume (mL) | Mass-to-volume Ratio (g/mL) |
|---|---|---|---|
| Water | | | |
| Oil | | | |
| Glycerol | | | |
| Molasses | | | |
| Sand | | | |

Make a line graph of the class results.

- Place the volume scale along the horizontal axis (*x*-axis), and the mass scale along the vertical axis (*y*-axis). Draw a line for each substance on the same graph.
- Plot the average results for the first substance on the graph. Draw a line through these points in one colour. Plot the results for the other substances on the same graph, using different colours.
- Make a legend for your graph.

## Analyze, Conclude, and Apply

1. Describe the lines on your graph. Are they straight or curved? Are some lines steeper than others? Are some lines closer together than others?

_____

_____

2. Look back at the data table you made for your substance. What happens to the mass-to-volume ratio for each volume measurement of your substance? Why do you think this happens?

_____

_____

3. Compare your hypothesis to the final results.

_____

_____

4. (a) Suggest ways to improve how you performed this investigation (more accurate measurement, avoidance of spilling, etc.).

_____

_____

(b) Suggest ways to improve how you calculated results (possible math errors).

_____

_____

(c) Suggest ways to improve how you graphed your results.

_____

_____

5. Why are some lines in the graph similar to each other while some are different?

_____

_____

6. How can you tell from your mass-to-volume ratios and your graph which substance is the least dense and which is the most dense?

_____

_____

7. Look at the mass-to-volume ratios in the Class Results table. Compare these values with the steepness of the lines in the graph, which correspond to the ratios. How does the steepness of a line change as the mass-to-volume ratio changes?

_____

8. Add a sixth line to your graph for a substance that is denser than water, but less dense than sand. Between which values would its mass-to-volume ratio be?

_____

9. Use the particle theory to explain the relationship between the mass, volume, and density of the substances you examined in this investigation.

_____

_____

DATE: NAME: CLASS:

UNIT 3

# Comparing Densities

BLM 3-26

**Goal** • Use this page to compare and apply the densities of different substances in Think About It 8-2C, Comparing Densities.

## What to Do

Use the information in the table to answer the following questions.

| Fluid | Density (g/mL) | Solid | Density (g/cm$^3$) |
|---|---|---|---|
| hydrogen | 0.000 09 | Styrofoam™ | 0.005 |
| helium | 0.000 2 | cork | 0.24 |
| air | 0.001 3 | oak | 0.70 |
| oxygen | 0.001 4 | sugar | 1.59 |
| carbon dioxide | 0.002 | salt | 2.16 |
| ethyl alcohol | 0.79 | aluminum | 2.70 |
| machine oil | 0.90 | iron | 7.87 |
| water | 1.00 | nickel | 8.90 |
| seawater | 1.03 | copper | 8.92 |
| glycerol | 1.26 | lead | 11.34 |
| mercury | 13.55 | gold | 19.32 |

1. You drop three things into a glass of water: a piece of Styrofoam™, a piece of oak, and a gold ring.
   (a) Which will float? Why?

   _____

   _____

   (b) Which will sink? Why?

   _____

   _____

2. Which is denser:
   (a) carbon dioxide or air? _____
   (b) oxygen or air? _____
   (c) hydrogen or air? _____

3. You find a white granular substance in a jar in your cupboard. You suspect that it may be either sugar or salt. How could you find out without tasting the substance?

_____

_____

4. Why is it easier to swim in seawater than it is to swim in fresh water?

_____

_____

5. A student comes to the conclusion that solids are denser than liquids. Is this conclusion true? Explain.

_____

_____

DATE: NAME: CLASS:

UNIT 3

# Bone Density

BLM 3-27

**Goal** • Read this page to learn about bone density.

Density is an important concept in medicine. This fact is illustrated by the disease called osteoporosis, which means "bones with more pore." This disease results in decreased bone mass, which makes the bones more brittle and easier to break. These brittle bones can result in painful, disabling fractures, especially of the spine, hips, and wrists.

Bone mass, which is also called bone mineral density, reaches a peak around age 35. Testosterone (in males) and estrogen (in females) are hormones that help build bone density. Also necessary for building bones are vitamin D, calcium, and exercise.

It is important to build up bone density while still young. The rate of bone loss increases after age 35. Approximately twice as many women as men get osteoporosis. Factors that increase the risk of osteoporosis include a family history of the disease, smoking, and excessive caffeine and alcohol consumption.

Osteoporosis can be measured in different ways. Sometimes the bone loss is so severe that it can be seen on X rays. However, the bone mineral density must be greater than 30 percent to be seen this way. A more accurate way to measure bone mineral density is to use a Dual Energy X-ray Absorptiometry (DEXA) Scanner. This machine measures bone density by measuring the amount of X-ray energy that penetrates the bones of the spine and hips. The denser the bones, the less energy that penetrates them. The measurements are standardized by comparing them to those of healthy young adults.

(a) Normal bone is dense and strong.

(b) Bone with osteoporosis has thinned out and become more porous, making it more likely to break.

DATE: NAME: CLASS:

UNIT 3

# Chapter 8 Review

BLM 3-28

**Goal** • Check your understanding of Chapter 8.

## What to Do

Circle the letter of the best answer.

1. Which of the following is correct?
   A. Displacement is a mass-to-volume ratio.
   B. Displacement is measured with a balance.
   C. Displacement is the amount of matter in a substance.
   D. Displacement is the amount of space that an object takes up when placed in a fluid.

2. Which of the following units are used to express the density of liquids?
   A. $g/cm^3$
   B. g/mL
   C. mL
   D. $mL/cm^3$

3. Which of the following statements is NOT true?
   A. Gases are less dense than liquids.
   B. Gases are less dense than solids.
   C. Liquids are less dense than solids.
   D. Solids are less dense than gases.

4. Which of the following statements is true?
   A. Attractive forces among particles of a gas are stronger than those between liquid particles.
   B. Attractive forces among particles of a liquid are stronger than those between solid particles.
   C. In solids, particles cannot be easily pushed apart.
   D. Liquid particles have more space between them than gas particles.

5. As the thermal energy of a substance increases, its particles move farther apart. As a result, which of the following occurs?
   A. Density decreases.
   B. Density does not change.
   C. Density increases.
   D. Mass increases.

| Match the Term on the left with the best Descriptor on the right. Each Descriptor may be used only once. | |
|---|---|
| **Term** | **Descriptor** |
| _____ 6. displacement<br>_____ 7. mass<br>_____ 8. mass-to-volume ratio<br>_____ 9. volume | A. attraction of particles for each other<br>B. does not change<br>C. the amount of matter in a substance<br>D. the amount of space an object takes up when placed in a fluid<br>E. the amount of space occupied by a substance<br>F. used to calculate density |

## Short Answer Questions

10. Calculate the density of the following substances:

(a) 40 $cm^3$ of brown sugar with a mass of 62.8 g

_____

(b) 135 g of aluminum that has a volume of 50 $cm^3$

_____

(c) 12 mL of oil with a mass of 10.5 g

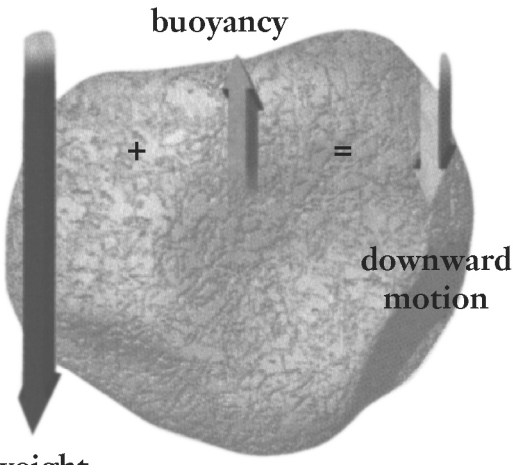
_____

DATE: NAME: CLASS:

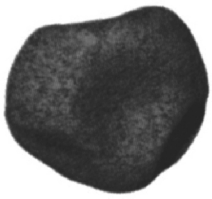
UNIT 3

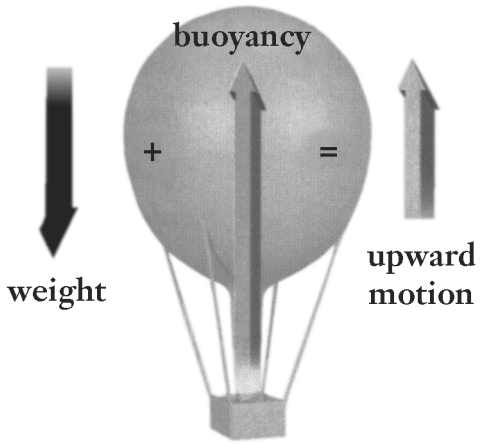
# Buoyancy Diagram

BLM 3-29

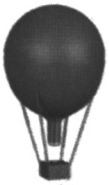


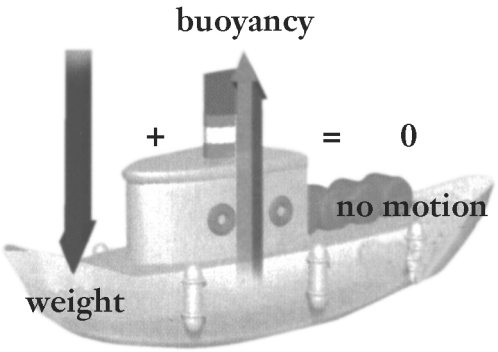

A Sinking, e.g., a rock






B Rising, e.g., a helium balloon






C Floating, e.g., a boat

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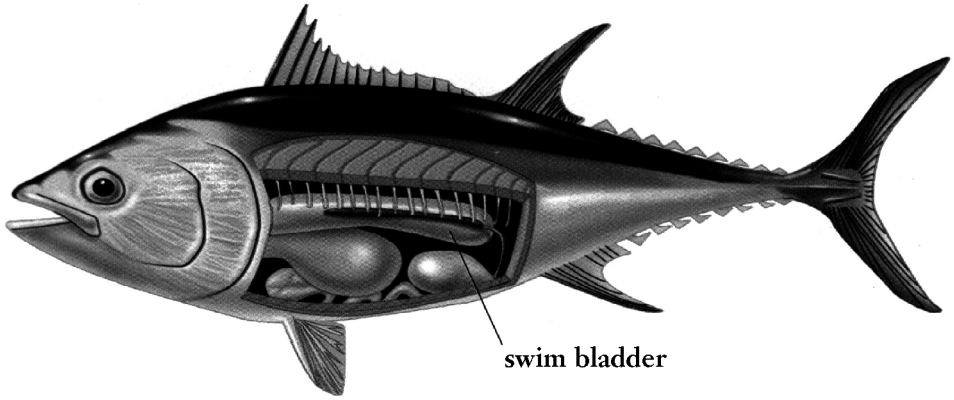
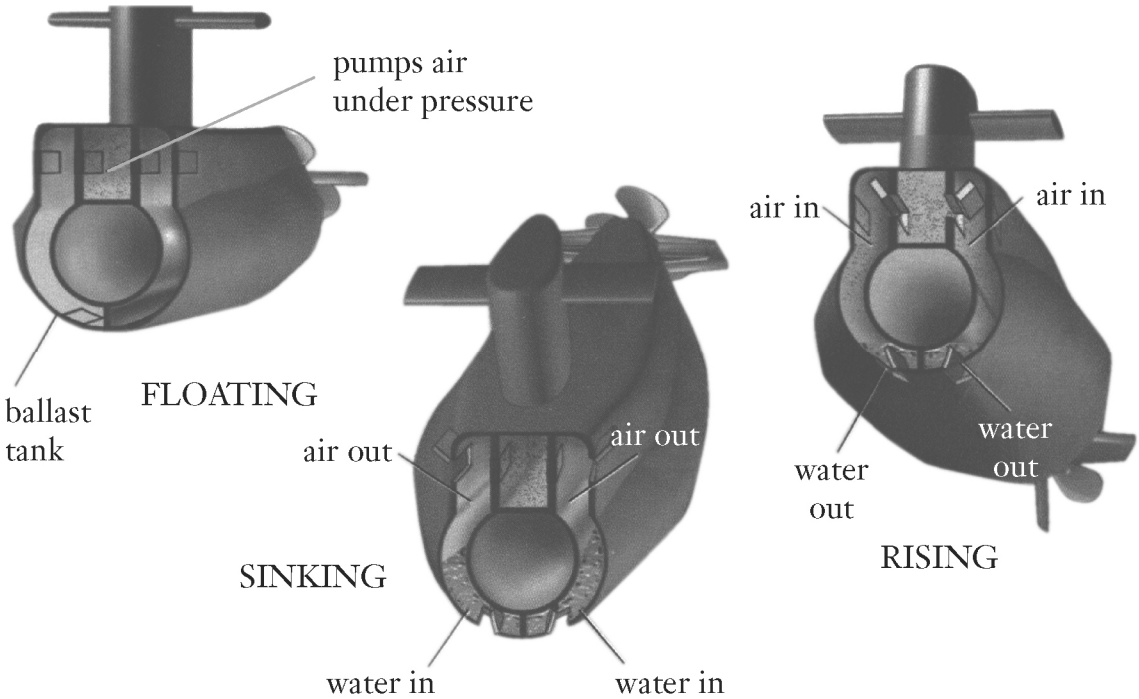
UNIT 3

# Swim Bladder and Submarine

BLM 3-30



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UNIT 3

# Mass vs. Weight Calculations

BLM 3-31

**Goal** • Use the following format to determine your weight on each of the planets.

## What to Do

Fill in the blanks with your mass and weight. Then use this information to calculate (in the chart) changes in your mass and weight if you were on different planets.

My mass on Earth is _____ kg.

Force of gravity of Earth is 9.8 N/kg.

My weight on Earth is _____ N.

My mass on the Moon is _____ kg.

Force of gravity on the Moon is 1.6 N/kg.

My weight on the Moon is _____ N.

| Planet | Force of Gravity (N/kg) | My Mass (kg) | My Weight (N) |
|---|---|---|---|
| Mercury | 3.8 | | |
| Venus | 9.0 | | |
| Mars | 3.8 | | |
| Jupiter | 27.0 | | |
| Saturn | 12.0 | | |
| Uranus | 9.0 | | |
| Neptune | 11.0 | | |

DATE: NAME: CLASS:

**UNIT 3**

# Identifying Buoyancy

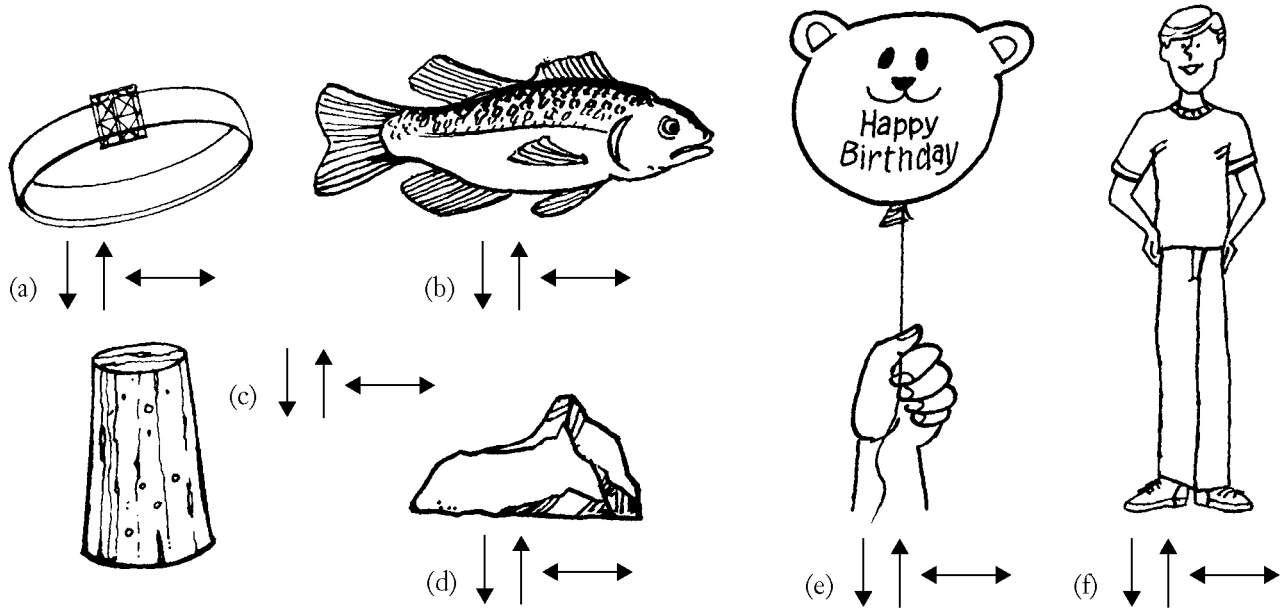
**BLM 3-32**

**Goal** • Apply your understanding of density and buoyancy.

## What to Do

**Answer the following questions.**

1. When an object is placed in water, it may sink, rise, or remain in place. What will happen with each of the following objects? Circle the appropriate arrow.




(a) Ring (b) Healthy fish (c) Cork (d) Rock (e) Helium-filled balloon (f) Person

2. Would it be correct to circle more than one arrow for (f )? Why?

_____

_____

3. A student places a piece of wood in a glass of water and finds that it floats. A few days later it has sunk to the bottom of the glass. Explain.

_____

_____

_____

DATE: NAME: CLASS:

UNIT 3

# Zebra Mussels

BLM 3-33

**Goal** • Find out more about zebra mussels.

## Think About It

The freshwater zebra mussel has invaded the waterways of North America. This tiny mollusc sticks to underwater surfaces such as water-intake pipes and docks. Zebra mussels can attach themselves to buoys and ships' hulls. Sometimes they form densely layered colonies of over one million mussels per square metre. Thus, they can alter the average density and the stability of floating objects. Buoys have been known to sink with the added weight of thousands of zebra mussels. An unbalanced distribution of zebra mussels can interfere with a ship's stability, especially when it is being tossed about in a storm.

## What to Do

Use the Internet to find information on zebra mussels. Then answer the questions on this page.

## Questions

1. When and how did the zebra mussel come to North America?

_____

_____

2. What types of problems do zebra mussels cause in our waterways?

_____

_____

3. What groups are working on the solutions?

_____

_____

4. What would you do to solve the problem?

_____

_____

DATE: NAME: CLASS:

UNIT 3

# Build a Density Tower

BLM 3-34

**Goal** • Use this page to help you complete Conduct an Investigation 9-1C, Build a Density Tower.

## What to Do

1. Sketch and label the tower and its contents in the space to the right.

2. Shake the tower and allow the substances to settle again. If the shaken tower appears different, draw a new, labelled sketch in the space to the right.

## Analyze, Conclude, and Apply

1. Rank the substances in the density tower in order from least dense (1) to most dense (5).

| Substance | Rank |
|---|---|
| Water | |
| Oil | |
| Cork | |
| Woodchip | |
| Paper clips | |

2. Which substances are denser than water? Which substances are less dense than water?

_____

_____

_____

_____

3. Can a solid be less dense than a liquid? Use the particle theory to explain your answer.

_____

_____

_____

4. Does the volume of an object determine its density?

_____

_____

_____

DATE: NAME: CLASS:

UNIT 3

# Calculating Pressure

BLM 3-35

**Goal** • Use these questions to practise calculating pressure after you have read pages 350 and 351 of your textbook.

## What to Do

Complete the following pressure calculations.

| | |
|---|---|
| 1. A football player is tackled by another player and lands with the combined weight of both players on his knee. If the combined weight of the players is 2400 N and the player's knee measures 0.1 m by 0.1 m, how much pressure is exerted on the turf when the player lands on his knee? | 2. A forestry worker accidentally strikes a pipe with the end of a pickaxe while trying to dig a hole. If the pickaxe strikes with a force of 2000 N and the end of the pickaxe measures 0.02 m by 0.01 m, how much pressure is exerted on the pipe by the pickaxe? |
| 3. A poorly tied down blimp falls over in a field. If the blimp exerts a downward force of 4000 N over an area of 250 $m^2$, what pressure is put on the ground by the blimp? | 4. A skateboarder lands on all four wheels after riding a railing. If the skateboarder has a weight of 900 N and the area on the bottom of a single wheel is 0.0001 $m^2$, what pressure does the skateboard put on the ground? |
| 5. The tip of a hypodermic needle is pressed against someone's skin with a force of 2 N. If the tip of the needle has an area of 0.000 001 $m^2$, what is the pressure exerted on the skin by the needle? | 6. A brick delivery truck parks on a road-side scale that measures 4 m by 6 m. If the brick truck weighs 60 000 N, what pressure does the scale put on the spring below? |

| | |
|---|---|
| 7. A ballet dancer does a pirouette on the tip of his toe. If the dancer has a weight of 580 N and the tip of his ballet shoe measures 0.02 m by 0.01 m, what pressure does his toe exert on the stage? | 8. A custom motorbike designer displays her new creation on a rigid sheet of steel that measures 2.0 m by 1.5 m. If the combined weight of the motorbike and the steel is 7200 N, what pressure is exerted on the ground beneath the steel sheet? |
| 9. A charity fundraiser fits 12 students into a small car. If the combined weight of the car and students is 1600 kg and the combined area of the wheels touching the ground is 0.08 $m^2$, what is the pressure placed on the ground by the car and students? | 10. A swordfish jumps out of the water and the tip of its pointy upper jaw strikes a wooden wall of a fishing boat with 7500 N of force. If the tip of the pointy jaw has an area of 0.0004 $m^2$, what pressure is placed on the part of the wooden wall that is struck by the jaw? |

DATE: NAME: CLASS:

UNIT 3

# Pressure Problems

BLM 3-36

**Goal** • Use this page to solve problems related to pressure.

## Introduction

Recall the formula used in the chapter:

$$\text{pressure } (P) = \frac{\text{force } (F)}{\text{area } (A)}$$

## What to Do

Solve the following questions.

1. What is the volume of an aquarium with dimensions 3 m × 2 m × l m?

2. Draw a picture of the aquarium in a position that exerts the greatest pressure on a table.

3. Draw the same aquarium in a position that exerts the least pressure on a table.

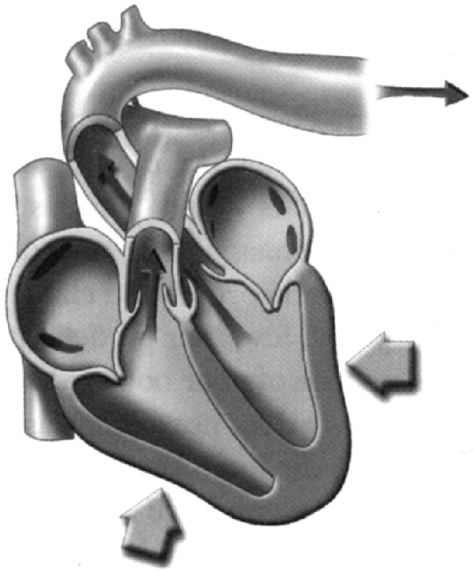
4. What is the pressure exerted on the table if the aquarium sits on its side with dimensions 3 m × 1 m? (Hint: The density of water is 1000 kg/m$^3$.)

DATE: NAME: CLASS:

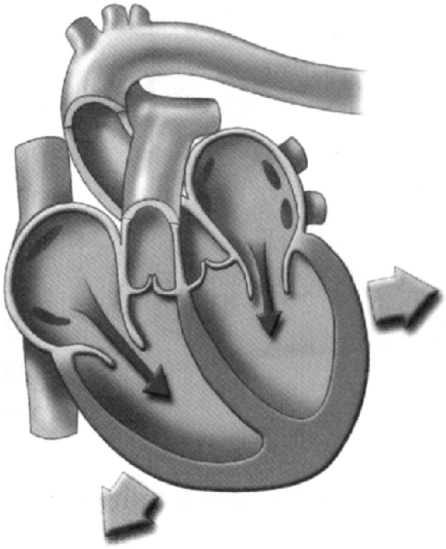
UNIT 3

# How the Heart Works

BLM 3-37



Heart during contraction



Relaxed heart, between contractions

DATE: NAME: CLASS:

UNIT 3

# Safety with Fluids

BLM 3-38

**Goal** • Use this page to learn about safety with fluids in your home.

## What to Do

Your home is filled with various containers of different types of fluids. Go on a fluid hunt. Fill in the chart with your discoveries.

| Product | Use | Warning Symbols | Storage |
|---|---|---|---|
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |

## Questions

1. What types of warning symbols did you find on containers for liquids?

_____

_____

2. What types of warning symbols did you find on containers for gases?

_____

_____

3. Why are special tips for storage printed on the labels?

_____

_____

4. Gases are compressible. Would it be advisable to reduce the size of the container that a gas comes in while maintaining the same amount of product? Why or why not?

_____

_____

DATE: NAME: CLASS:

UNIT 3

# The Sphygmomanometer

BLM 3-39

**Goal** • Read this page to learn about the sphygmomanometer.

## About the Sphygmomanometer

The sphygmomanometer, or blood pressure monitor, is a device used to measure the pressure exerted by the blood pushing on the walls of an artery. The sphygmomanometer is quite a complicated name for such a useful tool, but it might be easier to understand if the word is broken down into its parts. "Sphygmos" is the Greek word for pulse, "manos" means thin, and "metron" means measure. This may give you a better understanding of the term. Sometimes it is important to know what each part of a word means in order to understand the whole word.

Blood pressure monitors were previously used only by doctors, nurses, and other health care professionals, but now many monitors are sold to the general public. Each monitor consists of a cuff to put around the arm (or sometimes finger), an inflation bulb, and a gauge or electronic unit. A health care professional usually uses a gauge type along with a stethoscope. Units for home use usually have a digital display, which shows your blood pressure in units called "millimetres of mercury."

What happens when the cuff is inflated? The inflated cuff presses the artery against the bone, making it difficult for the blood to flow. Then inflation is stopped and the cuff is gradually deflated. The maximum (systolic) and minimum (diastolic) pressures are measured when the sound of the blood flow returns and then disappears respectively. This information can be helpful in the maintenance of good health. The next time you are at the doctor's, ask about the sphygmomanometer!

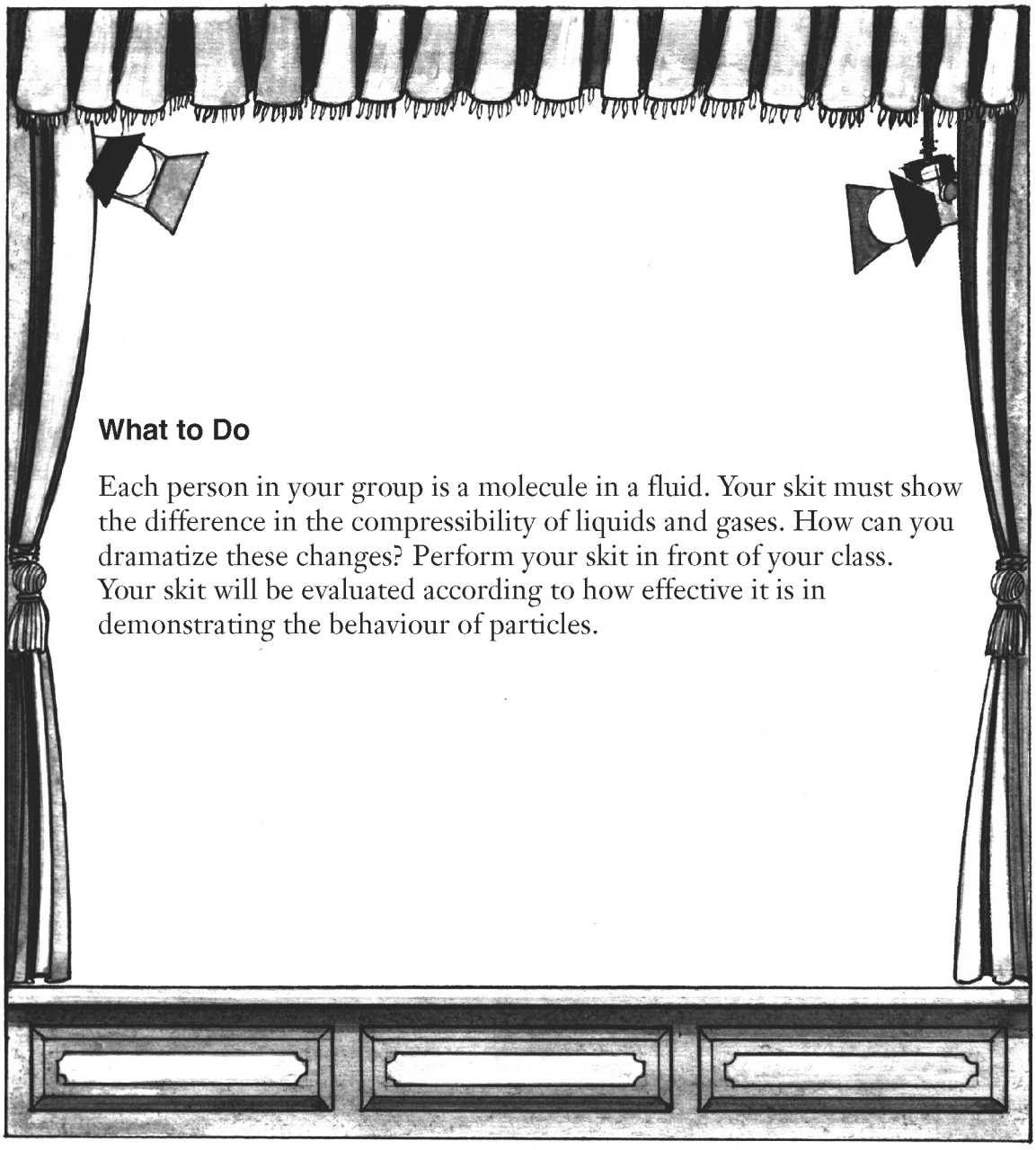
DATE: NAME: CLASS:

UNIT 3

# Particles in Motion Skit

BLM 3-40

**Goal** • Use this page to plan a skit that will demonstrate your group's understanding of the motion of particles in fluids.



## What to Do

Each person in your group is a molecule in a fluid. Your skit must show the difference in the compressibility of liquids and gases. How can you dramatize these changes? Perform your skit in front of your class. Your skit will be evaluated according to how effective it is in demonstrating the behaviour of particles.

DATE: NAME: CLASS:

UNIT 3

# Poetic Pressure

BLM 3-41

**Goal** • Use this page to demonstrate your understanding of pressure in fluids.

## Introduction

Have you ever heard the expression, "The people on the bus were packed like sardines in a can"? This type of expression is called a simile. A simile compares two things by using words such as "like" or "as." In this case it gives the reader an idea of how tightly the people were crowded together.

## What to Do

Think of five similes that describe pressure in fluids. What can you compare to the molecules in liquids or gases? Record your similes below.

### Similes About Pressure in Fluids

1. _____

_____

2. _____

_____

3. _____

_____

4. _____

_____

5. _____

_____

DATE: NAME: CLASS:

UNIT 3

# Wacky Straw Design

BLM 3-42

**Goal** • Use this page to design and construct a wacky straw.

## Introduction

Have you ever had a "wacky straw"? It seems to take forever for the liquid to wind its way up past all of the twists and turns before entering your mouth! Is it possible for the liquid in the straw to wind past a certain point? Would it be reasonable for the manufacturers to expect young children to use these straws?

## Safety Precaution

Do not drink from anyone else's straw, and do not allow others to drink from your straw.

## Things to Gather

– a plastic cup
– some drinking straws
– water

## What to Do

Use one straw as your starting point. Bend it in various directions and try to drink from the straw. What type of design will you make? You may want to attach several straws together before you start your design. Keep your hands clean if you want to drink using this straw! When you have come up with the most complicated design that still works, draw it below.

DATE: NAME: CLASS:

UNIT 3

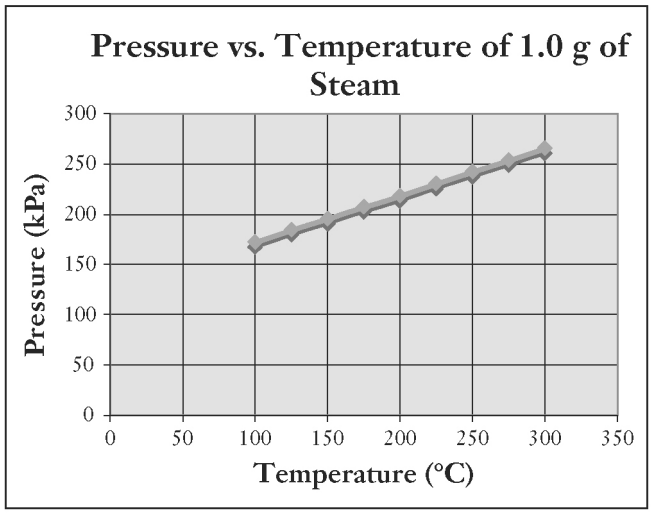
# The Pressure is Rising

BLM 3-43

**Goal** • Use this page to help you complete Think About It Activity 9-3C, The Pressure is Rising.

## What to Do

In an investigation, 1.0 g of water was boiled into steam in a sealed container that could not expand. The container was fitted with a thermometer and a pressure gauge that could measure the temperature and pressure of the gas inside the container. As the container was heated, the temperature and pressure were recorded. This graph shows the data.




## What Did You Find Out?

1. Write a statement that describes the relationship between the temperature and pressure of a gas when the volume is held constant. (**Hint**: What happens to the pressure when the temperature increases? Is the line straight or curved?)

_____

_____

_____

_____

_____

2. Use the particle theory to explain the relationship that you found between pressure and temperature of a gas when the volume is held constant.

_____

_____

_____

_____

DATE: NAME: CLASS:

UNIT 3

# Putting on the Pressure

BLM 3-44

**Goal** • Use this data table to record your data from Conduct an Investigation 9-3D, Putting on the Pressure.

## What to Do

Complete the data table.

| Fluid | Mass Applied (kg) | Force Applied (N) | Syringe Start Position (mL) | Syring Finish Position (mL) | Change in Volume (mL) |
|---|---|---|---|---|---|
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |

Create a line graph of your results by plotting change in volume vs. the force applied for each of the fluids.

## Analyze, Conclude and Apply

1. What were the independent, dependent, and controlled variables in your investigation?

_____

_____

_____

2. How did your experimental results compare with your hypothesis?

_____

_____

_____

3. Use your line graph to answer the following questions.
   (a) If you increased the amount of pressure, how would you expect the volume to change for each of the fluids? Explain.

_____

_____

_____

   (b) Could you reduce the volume of any of the substances to zero? Explain.

_____

_____

_____

DATE: NAME: CLASS:

UNIT 3

# Working Underwater Poster

BLM 3-45

**Goal** • Use this page to plan a poster to advertise a SCUBA-diving job.

## What to Do

Write down information you will need to produce a poster.

1. There are many jobs that require SCUBA-diving in lakes, oceans, or other bodies of water. Do some research to find at least five different jobs and list them here.

_____

_____

_____

_____

2. Pick one of the jobs that you listed above. Imagine that you work for an organization that needs to hire people for that job. What are the main points you should advertise on a poster? List them here.

_____

_____

_____

_____

3. Make a rough draft of your poster on this page. When your teacher approves your design, enlarge it onto a poster-sized piece of paper and colour it.

DATE: NAME: CLASS:

UNIT 3

# Chapter 9 Review

BLM 3-46

**Goal** • Check your understanding of Chapter 9.

## What to Do

Circle the letter of the best answer.

1. Which of the following is not an accurate description of air pressure at sea level?
   A. one atmosphere
   B. 101.3 Pa
   C. 101.3 kPa
   D. 101 300 Pa

2. What situation would cause a submarine to sink?
   A. The buoyant force is double the gravitational force.
   B. The buoyant force is equal to the gravitational force.
   C. The buoyant force is greater than the gravitational force.
   D. The buoyant force is less than the gravitational force.

3. Which of the following explains why a juice box sometimes caves in as you drink from it?
   A. Air pressure outside the box increases as you drink.
   B. The forces acting on the box become unbalanced.
   C. The liquid in the box is cool and condenses the air around it.
   D. When the straw is inserted it breaks the tight seal.

4. You dive 10 m below the surface of the ocean to view a beautiful coral reef. Which of the following statements regarding pressure at that depth is false?
   A. The pressure at that depth is exerted on all parts of your body equally.
   B. The pressure at that depth is greater than at the surface.
   C. The pressure at that depth would be equivalent to 101.3 kPa.
   D. The pressure you feel would be equivalent to two atmospheres.

5. Buoyant force contributes to which of the following?
   A. atmospheric pressure
   B. pollen floating in the air
   C. the mass of a boat
   D. the pressure inside a balloon

6. Which of the following systems make use of the pressure exerted on gas?
   A. dynamic system
   B. hydraulic system
   C. pneumatic system
   D. valve system

7. A fluid in motion has what kind of pressure?
   A. dynamic pressure
   B. hydraulic pressure
   C. pneumatic pressure
   D. static pressure

8. Which of the following statements regarding hydraulic systems is true?
   A. A hydraulic system creates pressure in a gas such as air.
   B. A hydraulic system creates pressure in a liquid such as oil.
   C. The pressure in a hydraulic system gets higher the farther away you are from the pump.
   D. The pressure in a hydraulic system gets lower the farther away you are from the pump.

9. Which of the following reduces the effectiveness of a hydraulic system?
   A. hydraulic multiplication
   B. pipes with many twists and turns
   C. pumps that work against gravity
   D. static pressure

**Match the Term on the left with the best Descriptor on the right.**
**Each Descriptor may be used only once.**

| Term | Descriptor |
|---|---|
| _____ 10. buoyancy | A. buoyant force |
| _____ 11. hydraulics | B. force acting on certain area of a surface |
| _____ 12. pneumatics | C. gas under pressure |
| _____ 13. pressure | D. gravity acting on an object |
| _____ 14. weight | E. liquid under pressure |
| | F. vertical movement of liquid |

## Short Answer Questions

15. Why does a hot air balloon rise when the air inside it is heated?

_____

16. Why is buoyancy called the "anti-gravity" force?

_____

17. Explain why high heels exert more pressure on the ground.

_____

DATE: NAME: CLASS:

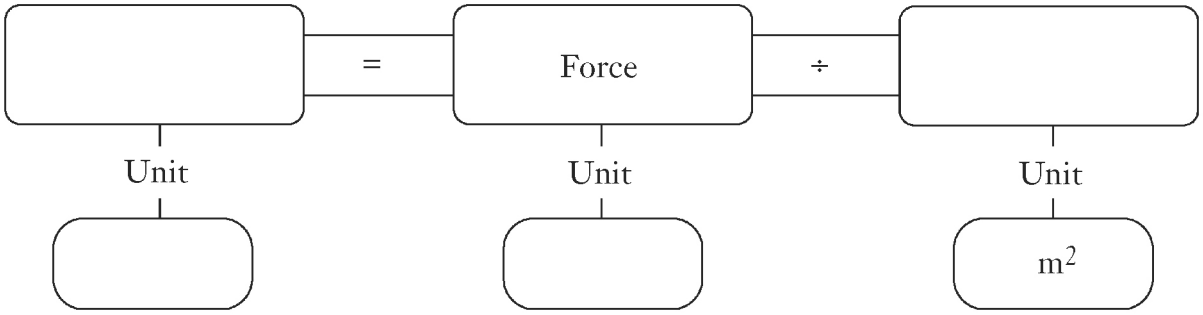
UNIT 3

# Unit 3 Concept Map

BLM 3-47

**Goal** • Use this page to help you review Unit 3.

Complete this concept map for the Unit 3 Review on page 380 of your textbook, question 1.



DATE: NAME: CLASS:

UNIT 3

# Unit 3 Review

BLM 3-48

**Goal** • Check your understanding of Unit 3.

## What to Do

Circle the letter of the best answer.

1. Which of the following statements regarding particle theory is false?
   A. All matter is made up of very small particles.
   B. All particles are attracted to one another with equal strength.
   C. Particles that make up matter are always moving.
   D. There are spaces in between particles.

2. What are you calculating if you divide the mass of a substance by its volume?
   A. buoyancy
   B. density
   C. pressure
   D. weight

3. Which of the following statements is true of Archimedes' principle?
   A. The buoyant force acting on an object equals the weight of the fluid displaced by the object.
   B. The buoyant force acting on an object is greater than the weight of the fluid displaced by the object.
   C. The buoyant force acting on an object is less than the weight of the fluid displaced by the object.
   D. The buoyant force acting on an object is not equal to the weight of the fluid displaced by the object.

4. On very cold winter days, water vapour in the air can turn directly into a solid and form frost on the inside of windows. Which of the following changes of state occurs when frost forms on a window?
   A. condensation
   B. deposition
   C. solidification
   D. sublimation

5. Why do objects float more easily in salt water than in fresh water?
   A. The density of fresh water is greater than that of salt water.
   B. The density of salt water is 1.00 g/mL.
   C. The density of salt water is greater than that of fresh water.
   D. The particles of fresh water are packed together more tightly than those in salt water.

6. Two different tennis balls (one filled with air, one with water) are struck with the same amount of force. The tennis ball filled with air can absorb much more force than the similar tennis ball filled with water. Which of the following statements is the reason for this result?
   A. Air is compressible, while water is not.
   B. Air is not compressible under ordinary circumstances.
   C. The force of gravity is greater on the water-filled tennis ball.
   D. The forces on the air-filled tennis ball are more out of balance.

7. A submarine sinks when which of the following occurs?
   A. Its weight is equal to the buoyant force.
   B. Its weight is greater than the buoyant force.
   C. Its weight is less than the buoyant force.
   D. Water is released from its ballast tank.

8. What causes your ears to pop when you gain or lose altitude quickly?
   A. a decrease in air pressure in the brain
   B. a difference in air pressure between the middle ear and the surrounding air
   C. liquid in the ear striking the eardrum
   D. Pascal's principle

9. Engineers must plan pipe systems carefully. Which of the following is not a major consideration?
   A. air pressure outside the pipe
   B. diameter of the pipe
   C. number of turns of the pipe
   D. smoothness inside the pipe

**Match the Term on the left with the best Descriptor on the right.**
**Each Descriptor may be used only once.**

| Term | Descriptor |
|---|---|
| _____ 10. compressibility | A. a device that transmits a force through a liquid |
| _____ 11. condensation | B. ability to be squeezed into a smaller space |
| _____ 12. hydraulic system | C. change from gas to liquid |
| _____ 13. low viscosity | D. change from liquid to solid |
| _____ 14. mass | E. change from solid to gas |
| _____ 15. pneumatic system | F. force divided by area |
| _____ 16. pressure | G. high flow rate |
| _____ 17. sublimation | H. low flow rate |
| | I. remains the same anywhere in universe |
| | J. vacuum cleaner |

## Short Answer Questions

18. Explain the differences among a solid, liquid, and gas in terms of shape and volume.

_____

_____

_____

19. List the main points of the particle theory of matter.

_____

_____

_____

20. Being stranded in cold water can be dangerous. The main problem is that as cold water touches your body, your body becomes cooler while the water becomes warmer. Explain what happens to the energy of the particles that make up your body and the surrounding water particles to account for the temperature changes.

_____

_____

_____

21. A boat travels along the water at a steady speed.

    (a) Are the forces on the boat balanced or unbalanced? Explain.

_____

_____

    (b) Draw a diagram of the boat and label all the forces acting on it.

22. A student performs an experiment with three balloons. One is filled with air, one with water, and one with cement that is allowed to harden. The student records the following observations:
    - When force is applied, the balloon filled with air reduces in volume.
    - When force is applied, the balloon filled with water can be deformed, but does not reduce in volume.
    - The balloon filled with cement cannot be deformed or reduced in volume with applied force.

    Explain why the student observed different results for the three balloons.

    _____

    _____

    _____

23. (a) How are pneumatic systems and hydraulic systems similar?

    _____

    _____

    (b) How are they different?

    _____

    _____

24. Solve the following problems:

    (a) A 40 $cm^3$ cube of pure nickel is measured by a student to have a mass of 356 g. What is the density of the nickel?

    _____

    (b) A 200 mL sample of alcohol has a mass of 158 g. What is the density of the alcohol?

    _____

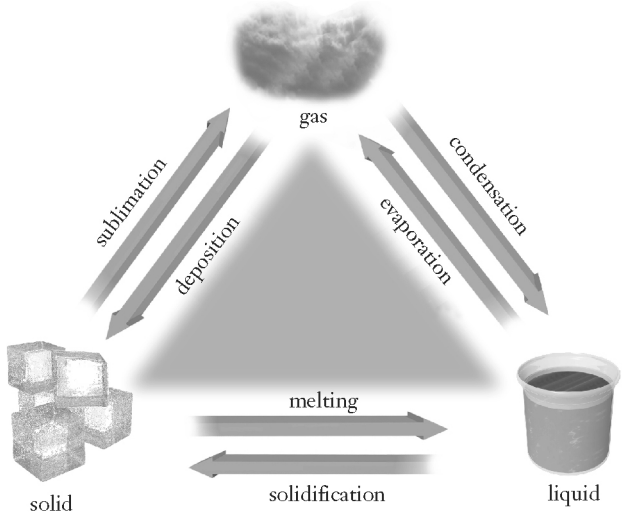
    (c) A football player with a weight of 125 kg stands on a 0.5 m by 0.5 m scale. What pressure does the platform of the scale exert on the spring below?

    _____

    (d) The bottom of a woman's shoe heel measures 0.02 m by 0.04 m. If the woman with a weight of 56 kg balances on a single heel, what pressure does she exert on the ground below?

    _____

BLM 3-3, Chapter 7 Key Terms




- Flow rate describes how easily a fluid flows, whereas viscosity describes a fluid's resistance to flow.
- The particle theory of matter helps us understand that as particles gain kinetic energy they move more quickly and take up more space.
- A substance changes from liquid to solid at its freezing point.
- A substance changes from solid to liquid at its melting point.
- A substance changes from liquid to gas at its boiling point.
- All moving objects have kinetic energy.
- When a gas changes to a liquid, the process is called condensation.
- When a gas becomes a solid without becoming a liquid first, the process is called deposition.

BLM 3-5, Chapter 9 Key Terms

weight
buoyancy
average density
pressure
pascal
compressibility
force
mass
pneumatic systems
hydraulics

BLM 3-6, Fluids or Non-fluids?

The fluids in the illustrations are hand lotion, pasta sauce, steam, nail polish, milk, glue, bleach, liquid make-up, perfume, molten lava, smoke, natural gas, rain, sweat, engine oil, condensation, shampoo, salad dressing, paint, tears, syrup, dew on grass, food colouring, ocean water, and blood. Non-fluids are sugar, laundry soap powder, pile of sand, pail of sand, flour, burning wood, drink crystals, cornstarch, cereal, and bubble bath crystals (although some of these do sometimes behave as fluids).
Answer to Question: Students' answers will vary based on the environment the students identify as their own. Check to make sure that they have identified substances that "flow."

BLM 3-7, The Particle Theory of Matter

1. Solids have a definite shape because the particles are so close together that they cannot move around freely; they can only vibrate.
2. Liquids and gases flow because their particles are farther apart than those of a solid and therefore can move more freely.
3. Ice cubes form in the freezer because the water particles lose energy and slow down when the temperature decreases.
4. Ice cream melts quickly on a hot day because the particles gain energy as the temperature increases.
5. Gases do not have a definite shape because their particles are far apart.

BLM 3-8, Identifying Changes of State

1. (e) melting
2. (d) deposition
3. (f) solidification
4. (c) evaporation
5. (a) sublimation
6. (b) condensation
7. (c) evaporation
8. (c) evaporation
9. (e) melting
10. (c) evaporation
11. (f) solidification
12. (b) condensation

BLM 3-12, Viscosity and the Real World

1. A straw that is served with a milkshake has a larger diameter than the one served with the soft drink. A milkshake is more viscous than a soft drink so a larger straw is needed in order to "suck up" an adequate amount to drink.
2. (a) The pipeline for the molasses would be larger than the one for the water because the molasses is more viscous.
(b) The pipe might also be heated in order to reduce the viscosity of the molasses so it will flow more easily. The cost to do this should be investigated before a decision is made.
3. (a) Several viscous liquids are available in squeeze bottles, including chocolate syrup, nacho cheese sauce, shampoos, ketchup, and mustard.
(b) This type of bottle makes it easier to use the product because consumers do not have to wait for the product to flow out of the bottle. They can give the product a "push" by compressing the bottle, which compresses the product and forces it out of the bottle more quickly.

BLM 3-13, Controlling Viscosity

| **Liquid** | **Methods** |
|---|---|
| Ketchup | To slow down ketchup, it could be chilled/refrigerated. To speed up ketchup, it could be heated or thinned with water. |
| Honey | To slow down honey, it could be chilled/refrigerated. To speed up honey, it could be heated or thinned with water. |
| Cooking oil | To slow down cooking oil, it could be chilled/refrigerated. To speed up cooking oil, it could be heated or thinned with water. |

Questions

1. Students' answers may vary, depending on whether they had to speed up or slow down the liquids. As well, they may have tried different things to slow down or speed up the flow rates.
2. A fluid becomes more viscous if it is cooled or concentrated by chilling.
3. A fluid becomes less viscous if it is heated up or thinned with water.
4. Ketchup would be the easiest to manipulate. Honey and oil would be more difficult to mix with water to reduce their viscosities.

BLM 3-18, Chapter 7 Review

1. C
2. C
3. D
4. D
5. C
6. D
7. D
8. A
9. B
10. F
11. C
12. D
13. A
14. E
15. G
16. A cold glass has particles that are moving very slowly. When heated by the hot water, the particles of glass move faster and slightly farther apart. This increased movement of particles results in thermal expansion of the glass. When this expansion occurs quickly and unevenly, it can cause the glass to crack.
17. (a) Students' answers will vary. Items that have a low viscosity include water, milk, juice, and water-based paint. (b) Students' answers will vary. Items that have a high viscosity include ketchup, mustard, milkshakes, yogurt, hand soap, and nacho cheese.
18. When temperature increases, particles in a liquid have more energy and slide past other particles more easily, increasing the liquid's ability to flow and decreasing its viscosity. When temperature decreases, liquid particles have less energy and the viscosity of the liquid increases. The effect of temperature on gases is opposite to the effect on liquids, because gas particles are already very far apart. When temperature increases, gas particles move faster and collide with each other more often, increasing internal friction and, therefore, viscosity.
19. When the concentration of a substance is increased, the viscosity is also increased.
20. Small particles can move past each other more easily than large particles can because they take up less space and have more room to move. Fluids made up of small particles, therefore, have a lower viscosity.

BLM 3-19, Chapter 7 Concept Map

Fluids are gases or liquids, but not solids.
Gases and liquids share the property of viscosity.
Viscosity is affected by temperature, shape of particles, and concentration.

BLM 3-21, Calculating Density Practice Problems

1. 1.61 $g/cm^3$
2. 0.87 g/mL
3. 2.75 $g/cm^3$
4. ethyl alcohol, machine oil, water, seawater, glycerol, mercury
5. 0.24 g/mL
6. 2.7 $g/cm^3$

7. 1.3 g/cm$^3$
8. 1.75 g/cm$^3$
9. 0.917 g/cm$^3$
10. 19.4 g/cm$^3$

BLM 3-22, Working with Density Measurements

1. cork
2. iron
3. glycerol
4. mercury
5. salt
6. Styrofoam™
7. lead
8. oak
9. seawater
10. ethyl alcohol

BLM 3-23, Densities Calculations

1. 0.715 g
2. 446 g
3. 0.1 cm$^3$
4. 769 230 mL
5. No. This result is not accurate. The students must have made a mistake with a decimal place. This combination of mass and volume would not result in the proper density.
6. This conclusion might be correct. The density of oak is 0.70 g/cm$^3$, which is very close to the students' results.

BLM 3-24, What is the Density of a Tennis Ball?

Answers will vary, although the whole class should have similar answers for the mass (approximately 57 g), volume (approximately 144 cm$^3$, and density (approximately 0.4 g/cm$^3$).

BLM 3-28, Chapter 8 Review

1. D
2. B
3. D
4. C
5. A
6. D
7. C
8. F
9. E
10. (a) 1.57 g/cm$^3$
    (b) 2.7 g/cm$^3$
    (c) 0.86 g/mL

BLM 3-31, Mass vs. Weight Calculations

Mass should be the same on every planet. It is constant. Weight will differ. On planets where the gravitational pull is stronger than on Earth, the weight will be greater than on Earth. On planets where the gravitational pull is weaker than on Earth, the weight will be less than on Earth.

BLM 3-32, Identifying Buoyancy

1. (a) sink
   (b) remain in place
   (c) rise
   (d) sink
   (e) rise
   (f) all
2. It would be correct to circle more than one answer since a person is able to adjust in order to do any of the three things.
3. Initially the wood may be less dense than the water, so it floats. Later, the wood may become waterlogged and sink.

BLM 3-33, Zebra Mussels

Look for a depth of reasoning in students' answers. Students should be able to see that this problem is complicated with no easy solution. The presence of the zebra mussels has upset the balance of the ecosystem.

BLM 3-35, Calculating Pressure

1. 240 000 Pa
2. 10 000 000 Pa
3. 16 Pa
4. 2 250 000 Pa
5. 2 000 000 Pa
6. 2500 Pa
7. 2 900 000 Pa
8. 2400 Pa
9. 20 000 Pa
10. 18 750 000 Pa

BLM 3-36, Pressure Problems

1. $V = 6\ m^3$
2. 2 m × 1 m side on table
3. 3 m × 2 m side on table
4. 333 Pa

BLM 3-38, Safety with Fluids

1. Liquids may have many warnings, such as flammable, corrosive, or poisonous.
2. Gases may have the above warnings as well as explosive.
3. The items pose a danger if stored incorrectly. For example, they may catch fire or explode.
4. The smaller the container, the more pressure it is under. It may not be advisable to go over a certain pressure level due to the risk of explosion.

BLM 3-46, Chapter 9 Review

1. B
2. D
3. B
4. C
5. B
6. C
7. A
8. B

9. B
10. A
11. E
12. C
13. B
14. D
15. Heating hot air causes the particles to move faster and farther apart, decreasing the density of the air inside the balloon. The more dense air outside is now pulled down to Earth by gravity, displacing the balloon and causing it to rise.
16. Buoyancy is called the "anti-gravity" force because it works against gravity. The force of gravity pulls objects toward the centre of Earth. Buoyancy is the upward force on objects submerged in or floating on fluids. Buoyancy pushes objects away from the centre of Earth.
17. High heels exert more pressure on the ground because the force is concentrated into smaller surface areas.

BLM 3-47, Unit 3 Concept Map

Pressure (Pa) = Force (N) ÷ Area ($m^2$)

BLM 3-48, Unit 3 Review

1. B
2. B
3. A
4. B
5. C
6. A
7. B
8. B
9. A
10. B
11. C
12. A
13. G
14. I
15. J
16. F
17. E
18. A solid has a definite shape and volume. A liquid has a definite volume but its shape is determined by its surroundings. The volume and shape of a gas are determined by its surroundings.
19. • All matter is made of very small particles.
• There is empty space between particles.
• Particles are constantly moving. The particles are colliding with each other and the walls of their container. Particles of a solid cannot move freely; particles of a liquid can slide past one another; particles of a gas can move freely and quickly.
• Energy makes particles move. The more energy that particles have, the faster they move and the farther apart they can get.
20. The particles of the cold water gain energy from the particles in your body as heat is transferred from your body to the water. At the same time, the particles in your body are losing energy.
21. (a) The boat's motion is not changing, so the forces on the boat must be in balance.
(b) The diagram could show as many as four forces. Equally sized arrows should indicate the forces of buoyancy (upward) and gravity (downward). Equally sized arrows could also indicate friction (against the boat) and engine propulsion (in the direction of the boat).

22. Air is a gas, and is compressible. These properties are the reason why the air-filled balloon could be reduced in volume. Liquids and solids are not compressible. These properties are why the water and cement-filled balloons could not be compressed. A water-filled balloon can be deformed because water particles can slide past each other to assume different positions. The particles of a solid cannot change position, so the cement-filled balloon could not be deformed.
23. (a) Both systems use applied force to create pressure. Both systems are capable of transmitting force to perform tasks.
(b) Hydraulic systems use an incompressible liquid such as oil. Pneumatic systems use compressible air.
24. (a) 8.9 $g/cm^3$
(b) 0.79 g/mL
(c) 500 Pa
(d) 70 000 Pa