NAME: Key

ENERGY AND WATER CYCLE NOTES

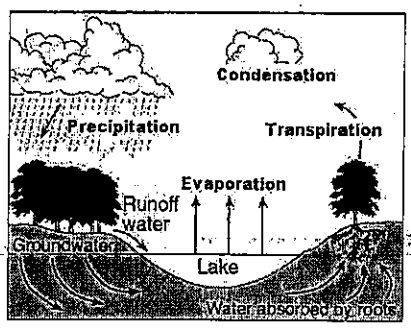
Log onto YouTube and search for **jocrisci** channel.

ENERGY (Videos 7.1 & 7.2 ESRT 1e, 14c)

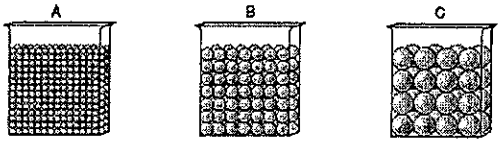
1. You must know the differences between the three ways energy is transferred:
    a. What is conduction?
        i. Give a real life example.
    b. What is convection?
        i. Give a real life example.
    c. What is radiation?
        i. Give a real life example.
2. Know the difference between the types of electromagnetic radiation.
3. Be able to read and interpret the electromagnetic spectrum diagram on page 14 ESRT.
    a. Which type of electromagnetic radiation has to longest wavelength? The shortest?
4. Which material absorbs the most energy? Reflects?
5. Why does water take a long time to heat up, but lead does not?

WATER CYCLE (Videos 7.3, 7.4, 7.5, 7.6, 7.7 ESRT 1c)

1. Be able to define and/or describe each of the **six** steps in the water cycle
    a. Which part of the water cycle adds water vapor into the atmosphere from plants?
2. On the diagram to the right label the:
    a. Zone of aeration
    b. Zone of saturation
    c. Water table



3. You must know the difference between permeability, porosity, and capillarity.
    a. Which container has the greatest permeability? How can you tell?
    b. Which container has the greatest porosity? How can you tell?
    c. Which container has the greatest capillarity? How can you tell?



EARTH'S ATMOSPHERE (Video ESRT 14a)

1. What is the altitude of the tropopause in kilometers? In miles?
2. What is the temperature in degrees C at the tropospause?
3. As altitude increases, what happens to air pressure?
4. As altitude increases, what happens to the amount of water vapor?
5. In which layer of the atmopshere is there the most water vapor?
6. What is the temperature at the mesopause?
7. As altitude increases from sea level to the mesopause, what happens to the air temperature?
8. Which layer of the atmosphere ranges from 50 km to 80 km?
9. At 50 km above sea level. What is the air pressure?

Energy and Water Cycle Facts

Video 7.1 ESRT 14c

1. Conduction is the / transfer of energy in solids through contact
2. Convection is the / transfer of energy in liquids and gases due to differences in density
3. Radiation is the / transfer of energy in waves; needs no medium (space) sun to earth or light bulb
4. Energy moves from the / source (highest temp.) to the sink (lowest temp.)
5. The difference between the forms of electromagnetic radiation is / wavelength
6. Dark and rough objects / absorb light ex. dark dirt or a forest
7. Light and smooth objects / reflect light ex. ice and snow
8. Good absorbers of light are / good radiators (black heats up and cools down quickly)

Vid 7.2 ESRT 1e

9. Specific heat is the / resistance to heating
10. Water has a high specific heat because / it heats up and cools down slowly
11. Lead has a low specific heat because / it changes temperature very easily

Videos 7.3 & 7.4 ESRT 1c

12. Water that lands on soil can / infiltrate (sink in) or run off (move over the surface)
13. Evaporation is greatest when it is / hot, dry, and windy -- also increase surface area
14. Condensation is when / water vapor turns into liquid water
15. Transpiration is when / water vapor enters the atmosphere through plants
16. Zone of Aeration is the / air between soil
17. Zone of Saturation is the / water between soil (think saturated sponge)
18. The water table is the / boundary line that separates the two zones

Videos 7.5 – 7.7

19. Infiltration occurs when the land is / permeable, unsaturated, low slope, not frozen.
20. Runoff occurs when the land is / impermeable, saturated, steep slope, frozen ground.
21. Permeability / how fast water flows through soil
22. As particle size increases, permeability / increases
23. Porosity is the / percent of empty space in soil
24. Porosity does NOT depend on / particle size
25. Capillarity is the / upward movement of water into small spaces
26. As particle size increases, capillary action / decreases (inversely related)

Key Concepts & Questions

Energy Transfer

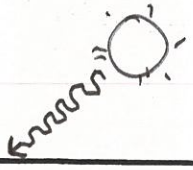
Fact(s) to memorize: 1-4

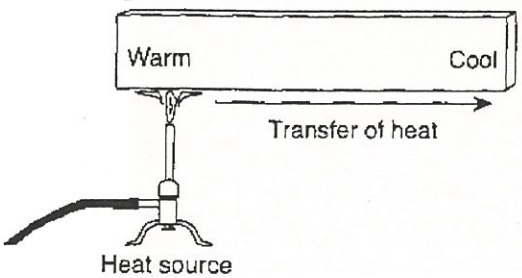
What is the difference between kinetic and potential energy? Give a real-life example of each

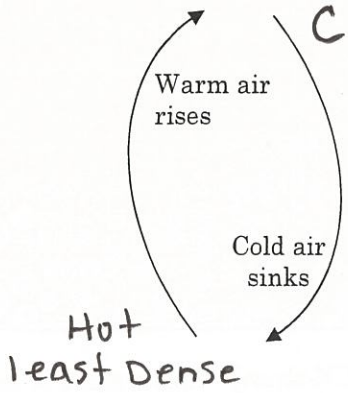
Potential Energy = Stored energy

Kinetic Energy = Energy in Motion.

What are the three ways that energy can be transferred between objects? Give one real-life example of each.

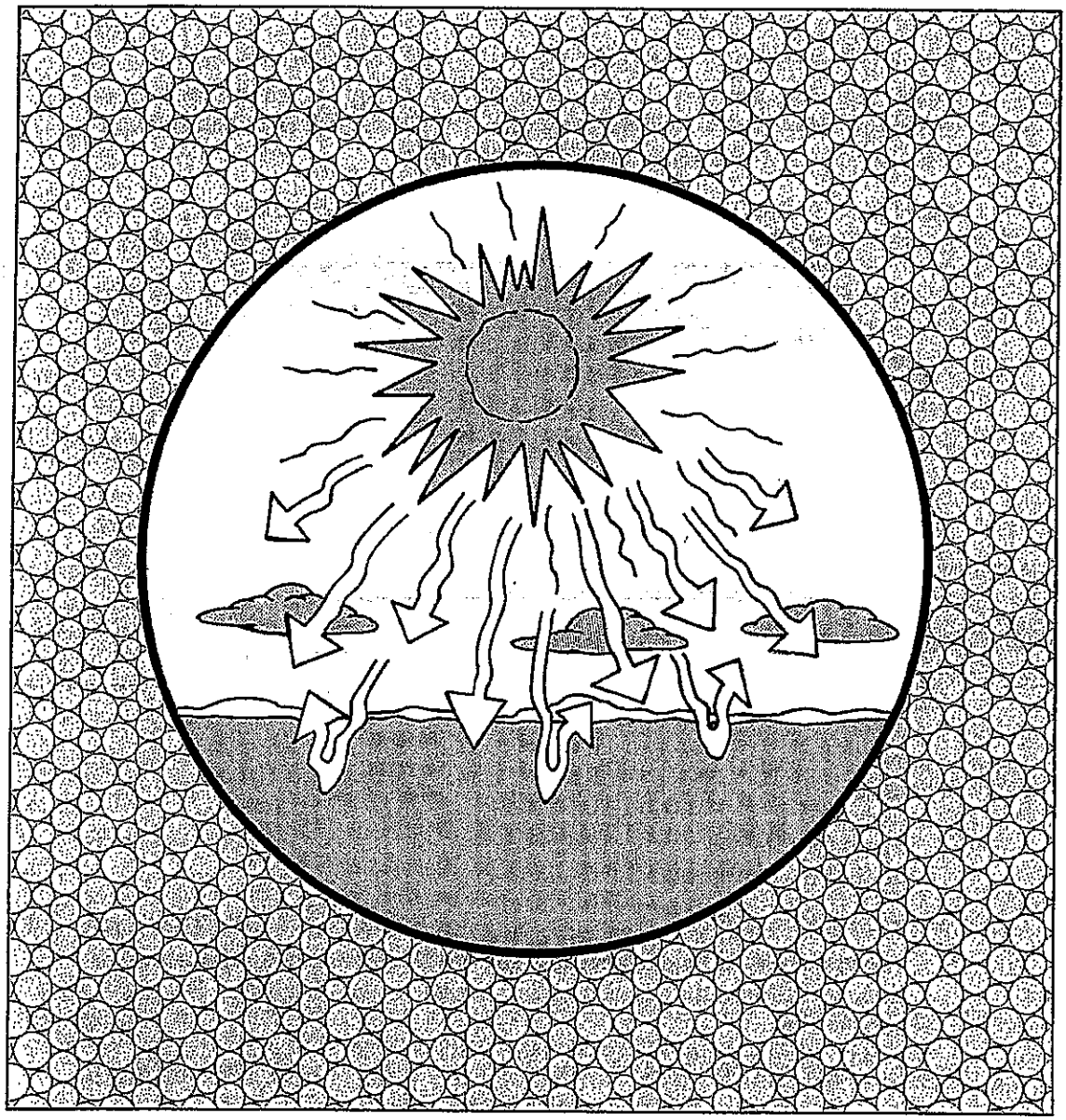
Conduction	Convection	Radiation
Transfer of energy due to Collision of molecules in solids	Transfer of energy by difference in Temperature. * In liquids + gases.	Transfer of energy by electromagnetic Waves. * In solids/liq/gases & empty space
Example	**Example**	**Example**
Handle of a pot gets hot.	Convection currents in the mantle. 	Energy from the sun. 





How does the sun heat the atmosphere?

12



conduction [kon-DUCK-shun]: movement of heat through a solid
convection [kon-VEK-shun]: movement of heat through a liquid or a gas
radiation [ray-dee-AY-shun]: movement of energy through empty space

LESSON 12 | How does the sun heat the atmosphere?

Without the sun, there would be no life on earth. Plants need the sun to help them grow. Without plants we would have no food to eat and no oxygen to breathe. The sun also gives us warmth. The sun heats the atmosphere and all the lands and waters.

When the sun's light is absorbed by the earth's surface, it is changed to heat. Heat does not stay in one place. It moves from place to place. Heat moves in three ways—**conduction** [kon-DUCK-shun], **convection** [kon-VEK-shun], and **radiation** [ray-dee-AY-shun].

Metal spoon

CONDUCTION Heat moves through solids by conduction. In conduction, vibrating molecules pass on heat from molecule to molecule.

CONVECTION Heat moves through gases and liquids by convection. In convection, heated molecules move away from the heat. Cooler molecules take their place. Then they become heated, too.

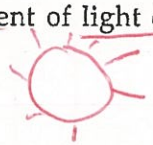
Hot air balloon

When air is heated, it expands. As warm air expands, it becomes lighter. Warm air is lighter than cool air. Warm air rises. Cooler, heavier air sinks.

Boiling Water

RADIATION Conduction and convection need molecules to work. Radiation does not. Radiation is the movement of light or heat energy through empty space.

Sun



Now let us trace the sun's energy.

- The sun is about 150 million kilometers from Earth. Most of this distance is empty space where there are almost no atoms or molecules. Such an empty space is called a vacuum. Energy from the sun moves through this vacuum by radiation.
- The sun's energy then hits the atmosphere. The air molecules become heated by convection.
- The sun's energy reaches the land and water on earth. The water becomes heated by convection. The land becomes heated by conduction. Air that touches the warm surface also becomes heated by conduction.

Some of the heat from the land and water reflects back into the atmosphere. This warms the atmosphere even more.

CONDUCTION, CONVECTION, AND RADIATION

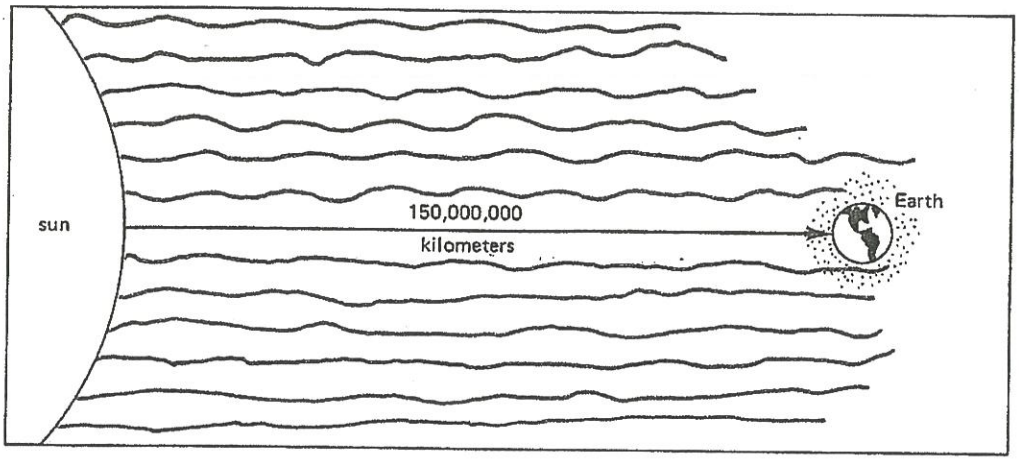


Figure A

1. Most of the distance between the sun and the earth is _____ .
   air, empty space

2. The sun's energy moves through outer space by _____ .
   conduction, convection, radiation

3. Radiation _____ need atoms and molecules to work.
   does, does not

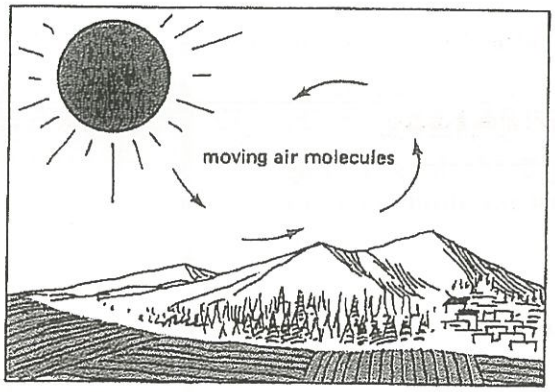


Figure B

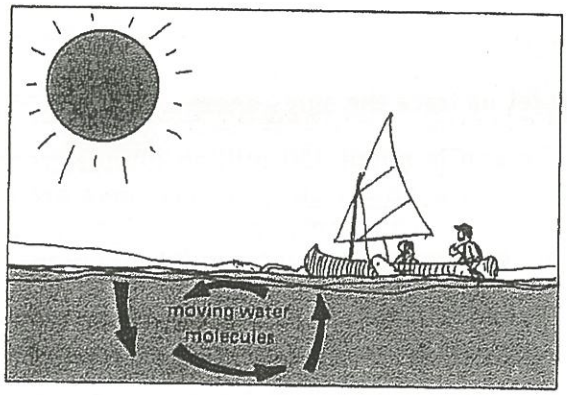


Figure C

4. Heat moves through gases and liquids by _____ .
   conduction, convection, radiation

5. Convection _____ need atoms and molecules to work.
   does, does not

6. What are liquids and gases made of? atoms

7. After atoms and molecules of gases and liquids are heated, they _____ . (rise, sink)

8. Warm air is _____ than cool air. (lighter, heavier)

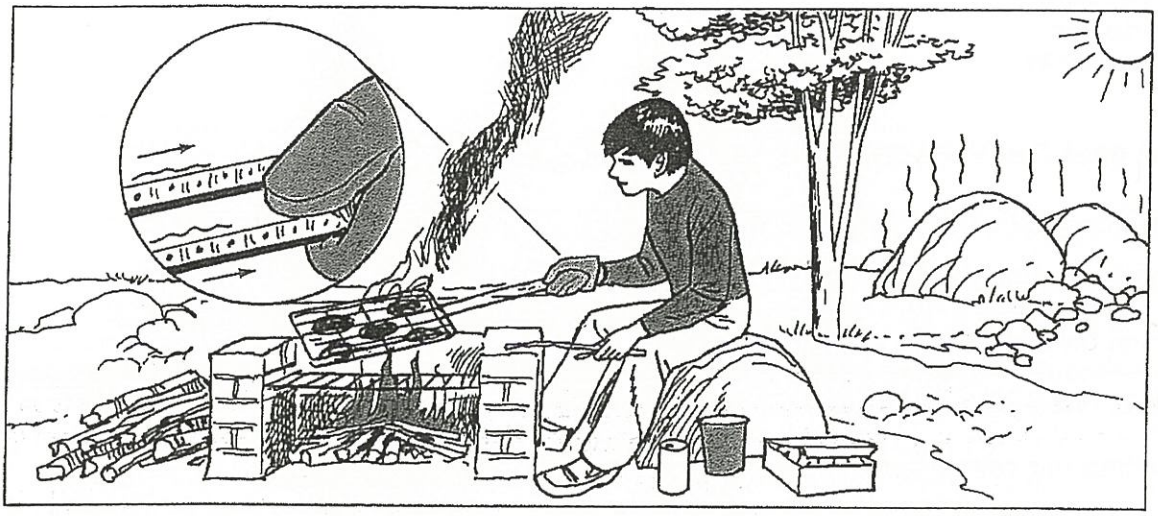


Figure D

9. Heat moves through solids by _____ . (conduction, convection, radiation)

10. Conduction _____ need atoms and molecules to work. (does, does not)

11. What are solids made of? molecules

12. Explain how heat moves through solids. molecules pass heat through contact with each other

13. How is some of the atmosphere heated by conduction? _____

FILL IN THE BLANK

Complete each statement using a term or terms from the list below. Write your answers in the spaces provided. Some words may be used more than once.

expands	atoms and molecules
atmosphere	conduction
radiation	rises
convection	

1. The three ways that heat moves from place to place are _____, _____, and _____.
2. Heat moves through solids by _____.
3. Heat moves through liquids and gases by _____.
4. Heat moves through empty space by _____.
5. In conduction and convection, heat is carried by _____.
6. When air is heated, it _____.
7. As warm air expands, it _____.
8. Heat moves through the atmosphere by _____.
9. Rocks and soil are heated by _____.
10. Some of the heat from the land and water bounce back into the _____.

MATCHING

Match each term in Column A with its description in Column B. Write the correct letter in the space provided.

	Column A	Column B
_____	1. sun	a) the way heat moves through empty space
_____	2. conduction	b) mixture of gases
_____	3. convection	c) warms our entire planet
_____	4. radiation	d) the way heat moves through gases and liquids
_____	5. atmosphere	e) the way heat moves through solids

TRUE OR FALSE

In the space provided, write "true" if the sentence is true. Write "false" if the sentence is false.

_____ 1. Heat stays in one place.

_____ 2. Heat moves only where there are atoms and molecules.

_____ 3. Heat moves in three different ways.

_____ 4. In solids, heat moves by convection.

_____ 5. In gases and liquids, heat moves by convection.

_____ 6. Conduction and convection need atoms and molecules.

_____ 7. In empty space heat moves by radiation.

_____ 8. There are many atoms and molecules in outer space.

_____ 9. The earth gets its heat from the sun.

_____ 10. Heat can be reflected.

REACHING OUT

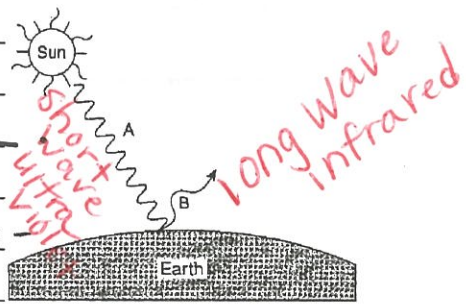
In what simple way can you show that the earth bounces some heat back into the atmosphere? (You need no instruments to do this—only your hand.)

Fact(s) to memorize: 1-4

How energy reaches Earth

Radiation Electromagnetic Energy

- How we get energy from the Sun
- Difference between forms of electromagnetic energy is due to size of Wavelengths.
- Shorter wavelength = more powerful



Electromagnetic spectrum See ↘

Earth Science Reference Tables, page 14

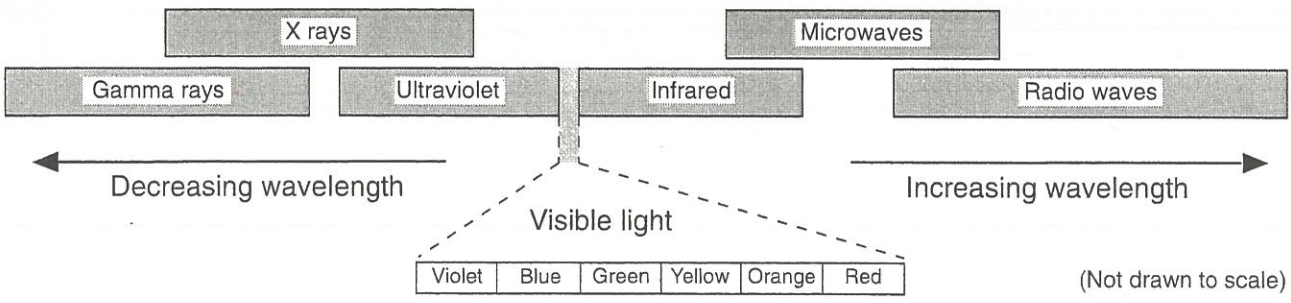
1. Heat waves _____
2. Lead protects you from these at the dentist _____
3. Skin cancer is a result of too much exposure to _____
4. Music is sent along these waves _____
5. Nuclear bombs deadly rays _____
6. Most of the waves sent by the sun are in the _____ range.

p14

1. Which form of electromagnetic radiation has a wavelength greatest wavelength?
   (1) ultraviolet (2) radio waves (3) infrared (4) microwaves

2. Scientists are concerned about the decrease in ozone in the upper atmosphere primarily because ozone protects life on Earth by absorbing certain wavelengths of
   (1) x-ray radiation (3) ultraviolet radiation
   (2) infrared radiation (4) microwave radiation

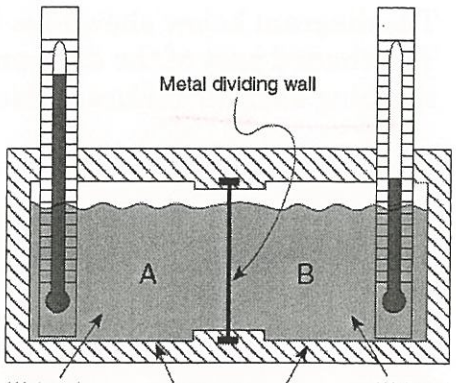
Electromagnetic Spectrum



(Not drawn to scale)

Fact(s) to memorize: 1- 3

1. The cross section to the right shows two compartments of water of equal volume insulated by Styrofoam and separated by a metal dividing wall, forming a closed energy system. When the temperature of the water in compartment *A* decreases by 10 C°, the temperature of the water in compartment *B* will
   (1) remain unchanged
   (2) decrease by only 5 C°
   (3) decrease by approximately 10 C°
   (4) increase by approximately 10 C°

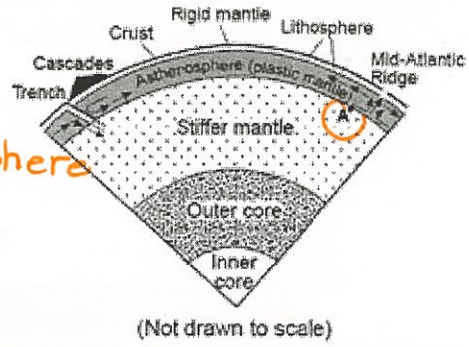


warmer − 10 colder + 10

2. During which process does heat transfer occur because of density differences?
   (1) conduction (2) radiation (3) convection (4) reflection

3. What is the primary method of heat transfer through solid rock during contact metamorphism?
   (1) advection (2) absorption (3) convection (4) conduction

4. The diagram to the right shows a portion of Earth's interior. Point *A* is a location on the interface between layers. The arrows shown in the asthenosphere represent the inferred slow circulation of the plastic mantle by a process called
   (1) insolation (3) conduction
   (2) convection (4) radiation



(Not drawn to scale)

Asthenosphere

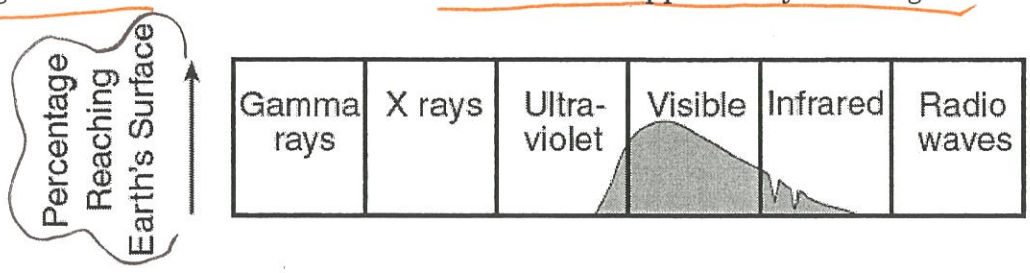
5. Which process transfers energy primarily by electromagnetic waves?
   (1) radiation (2) evaporation (3) conduction (4) convection
   (empty space) (Touch) liquid + Gases

6. Which method of energy transfer is primarily responsible for energy being lost from Earth into space?
   (1) conduction (2) convection (3) solidification (4) radiation

3. Which part of the Sun's electromagnetic spectrum has the longest wavelength? P14

(1) radio wave radiation
(2) visible light radiation
(3) infrared radiation
(4) x-ray radiation

4. The diagram below shows the types of electromagnetic energy given off by the Sun. The shaded part of the diagram shows the approximate amount of each type actually reaching Earth's surface. Which conclusion is best supported by the diagram?



(1) All types of electromagnetic energy reach Earth's surface.
(2) Gamma rays and x rays make up the greatest amount of electromagnetic energy reaching Earth's surface.
(3) Visible light makes up the greatest amount of electromagnetic energy reaching Earth's surface.
(4) Ultraviolet and infrared radiation make up the greatest amount of electromagnetic energy reaching Earth's surface.

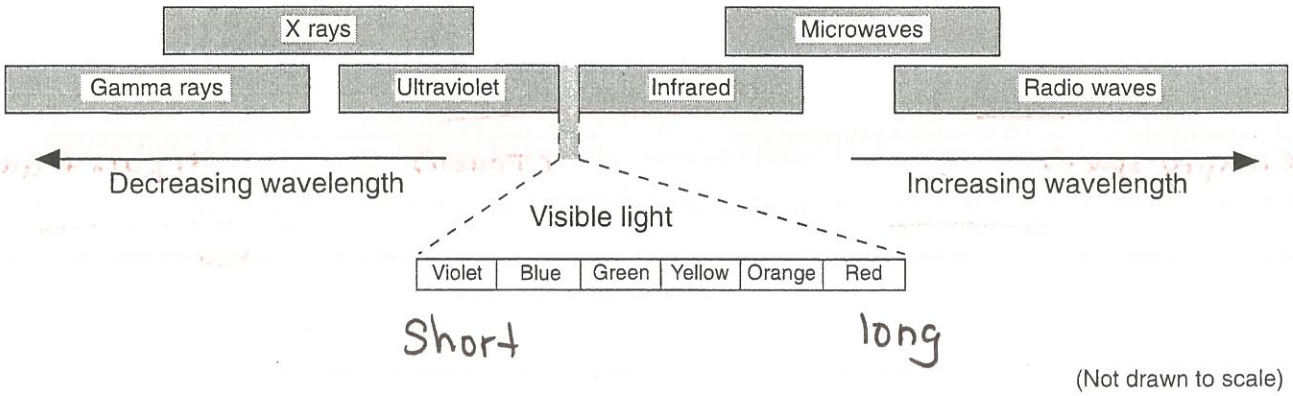
5. What is the basic difference between ultraviolet, visible, and infrared radiation? P14

(1) half-life (2) wavelength (3) temperature (4) wave velocity

6. Radiation with the shortest wavelength is visible as what color?

(1) violet (2) green (3) blue (4) yellow

Electromagnetic Spectrum



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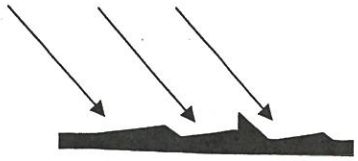
Fact(s) to memorize: 5 - 8

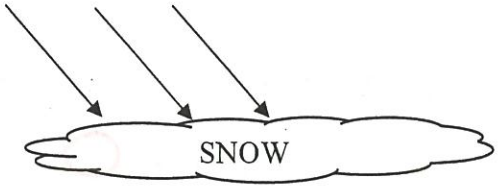
Reflection / Refraction / Absorption of insolation

Light vs. Dark



Dark surfaces

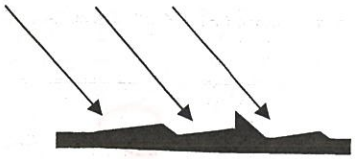
Absorbs radiation from the sun



Light surfaces

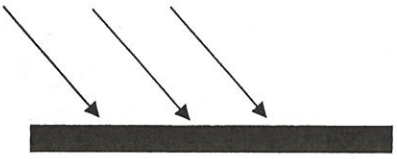
Reflect radiation from the sun

Rough vs. Smooth



Rough surfaces

Absorbs radiation from the sun



Smooth surfaces

reflects radiation from the sun.

Land vs. Water

Land is a better absorber + radiator of radiation from the sun.

** A good absorber of energy is also _____.

Heat Questions

1. Which type of land surface would most probably reflect the most incoming solar radiation?

   (1) light colored and smooth
   (2) light colored and rough
   (3) dark colored and smooth
   (4) dark colored and rough

2. Most insolation striking a smooth, light-colored, solid surface is

   (1) refracted (2) transmitted (3) reflected (4) absorbed

3. Which process requires water to gain heat energy from the environment? P1

   (1) evaporation (2) condensation (3) infiltration (4) precipitation

4. The air above a burning candle is heated and rises. Which table to the right correctly identifies the type of heat transfer within the rising air and the change in air density above the burning candle?

Type of Heat Transfer	Change in Air Density
conduction	density increases

(1)

Type of Heat Transfer	Change in Air Density
convection	density increases

(3)

Type of Heat Transfer	Change in Air Density
conduction	density decreases

(2)

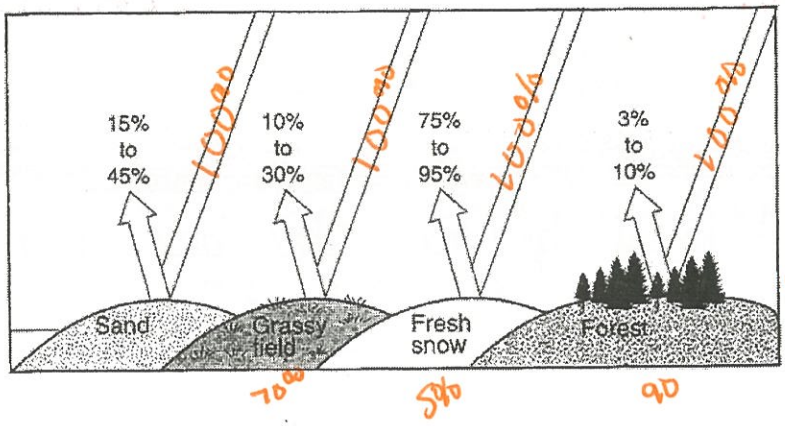
Type of Heat Transfer	Change in Air Density
convection	density decreases

(4)

The diagram to the right indicates the amount of solar radiation that is reflected by equal areas of various materials on Earth's surface.

5. Which material absorbs the most solar radiation?

   (1) grassy field
   (2) fresh snow
   (3) sand
   (4) forest



6. When Earth cools, most of the energy transferred from Earth's surface to space is transferred by the process of

   (1) conduction (2) reflection (3) refraction (4) radiation

7. Equal areas of which surface would most likely absorb the most insolation?

   (1) smooth, white surface
   (2) rough, white surface
   (3) smooth, black surface
   (4) rough, black surface

Specific Heat

Fact(s) to memorize: 9 - 11

Specific Heat: The resistance of a material to Heat up and Cool off.

ESRT page 1 Water has a high specific heat. It heats up slowly and cools off slowly.

(a) Which material on the specific heat chart heats up the fastest? lead (low specific heat)

(b) Which material on the specific heat chart heats up the slowest? liquid water (high specific heat)

(c) Which material needs the most amount of energy to raise its temperature? liquid water

(d) In each set below, circle the material that would heat up the fastest:

Water	Iron	Copper .38
Ice	Basalt	Granite .19
.13 Lead	Water	Iron

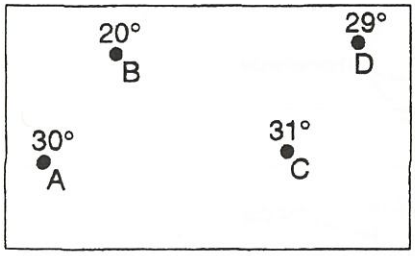
~~Dry air~~	Lead	Granite
Iron	Basalt	Water vapor
Ice	Copper	Dry air

(e) Compare the heating and cooling rate of land and water, using the term "specific heat" to explain your comparison. land heats up and cools off Quicker because it has a lower specific heat.

If you heated equal masses of basalt and lead, which one would record a faster increase in temperature? Explain how you know.

lead would heat up Quicker because it has a lower specific heat.

Energy moves from the Low **to the** High.



NAME: _____ PERIOD: _____ DATE: _____

LAB PARTNERS: _____ LAB #40

ABSORPTION AND RE-RADIATION OF ENERGY BY LAND AND WATER

INTRODUCTION
The earth's surface is approximately 75% water and 25% land. Because land and water heat and cool off at different rates, variations occur in temperature which affects local and world-wide weather patterns.

OBJECTIVES
You will be able to measure the rates at which water and soil surfaces heat and cool.

APPROXIMATE TIME
2 periods

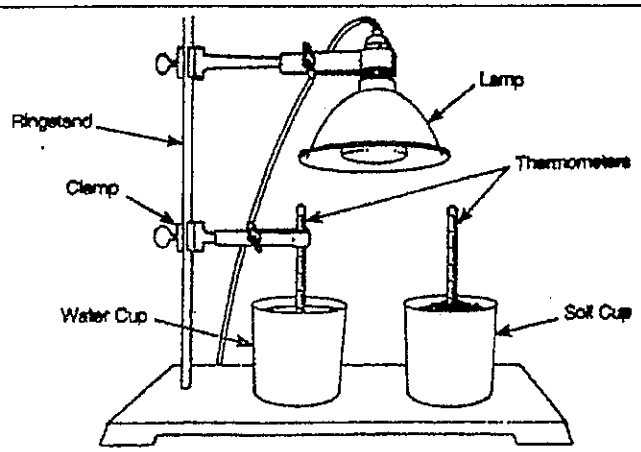
MATERIALS
2 cups	heat lamp	graph paper	
2 thermometers	soil and water	ring stand	2 clamps

PROCEDURE
1. Fill one cup with water at room temperature and the other with soil at room temperature.
2. Place a thermometer in each cup making sure the bulb is just below the surface of the water and soil.
3. Allow the thermometers to reach room temperature and enter that reading under time 0 in the data table.
4. Turn on the lamp and take readings at one minute intervals for 10 minutes, recording these readings in the data table.
5. At the end of 10 minutes, **turn off the lamp and move it away.** Continue reading and recording the temperature of both cups each minute for the next 10 minutes.
6. Graph the temperature for the soil and water using two curves on the same set of axes. Label each line.
7. Answer questions 1-8.

HYPOTHESIS: Think about the set up of this lab. Write a short hypothesis about what you think may happen to the temperature of the soil and water in this lab.

_____

_____



DATA TABLE

DAY

LIGHT ON		
TIME (Min)	SOIL TEMP °C	WATER TEMP °C
0	20	20
1	21	20
2	23	20
3	25	20
4	26	21
5	28	21
6	29	22
7	31	22
8	34	23
9	35	24
10	36	25

Night

LIGHT OFF		
TIME (Min)	SOIL TEMP °C	WATER TEMP °C
11	36	25
12	36	25
13	34	25
14	33	25
15	31	24
16	28	24
17	26	24
18	26	24
19	25	23
20	25	23

LABORATORY QUESTIONS

1. How did the heat energy **RECEIVED** by the cup of soil compare to the heat energy **RECEIVED** by the cup of water? _____

2. Which cup heated more rapidly? _____

3. Which cup cooled more rapidly? _____

4. Which was the better absorber of energy, soil or water? _____

5. Which material has the highest specific heat, soil or water? _____

6. By 4:00 PM on a clear summer day, would air be warmer over the land or over the nearby ocean?

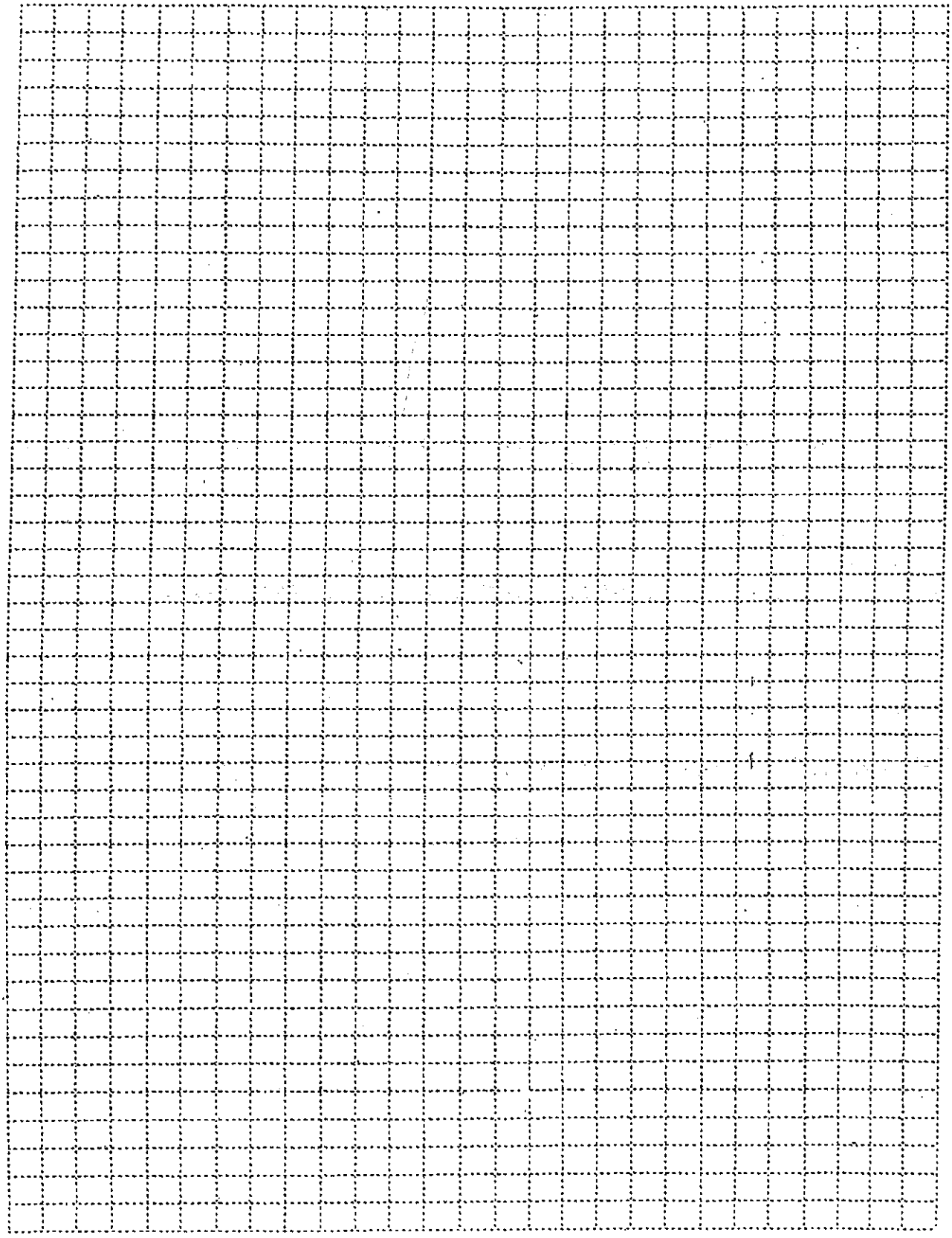
   _____ Why? _____

   _____

7. Does this experiment support your hypothesis? Explain. _____

   _____

8. ***CONCLUSION***: Using a short paragraph, write about what you learned in this lab.

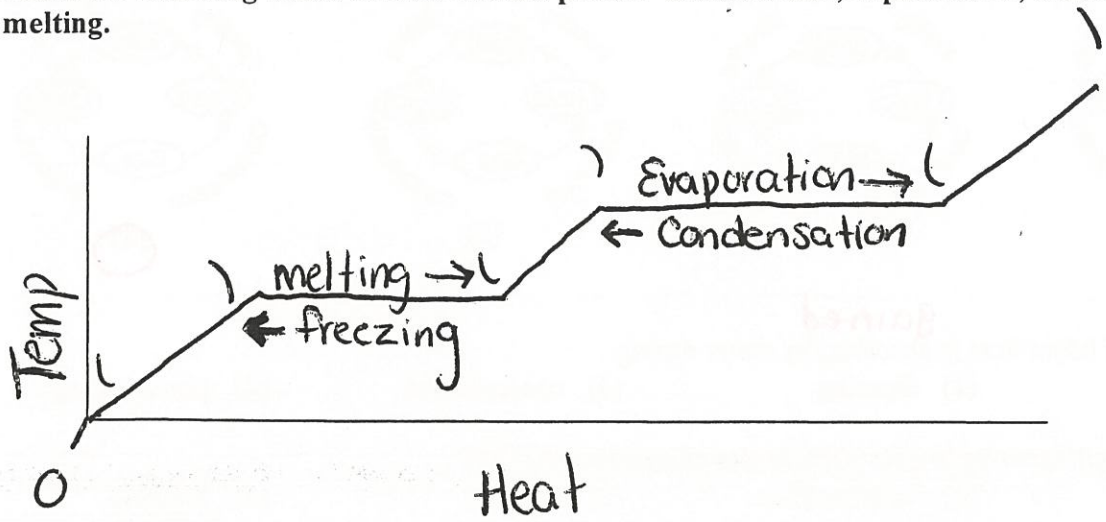


HEATING OF WATER

Fact(s) to memorize: 12 - 15

Draw the graph of water heating.

- **Label the following terms in their correct places: condensation, vaporization, solidification, melting.**



Check the box which describes whether energy is gained or lost for each process.

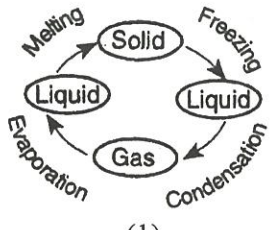
Process	Energy Gained	Energy Lost
Condensation		✓
Evaporation	✓	
Melting	✓	
Solidification		✓

How many calories are gained or lost by water for each of the following processes?

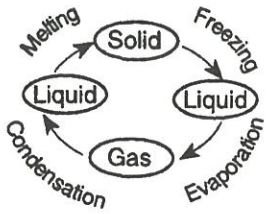
Process	Calories Gained	Calories Lost
Condensation		2260
Evaporation	2260	
Melting	334	
Solidification		334

1. During which phase change of water is the most energy released into the environment? P1
   (1) water freezing
   (2) ice melting
   (3) water evaporating
   (4) water vapor condensing 2260

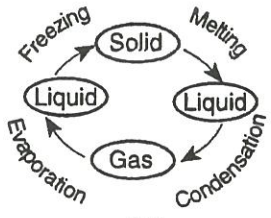
2. Which diagram correctly shows the processes that change the states of matter?



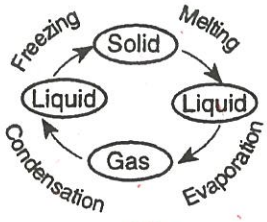
(1)



(2)



(3)



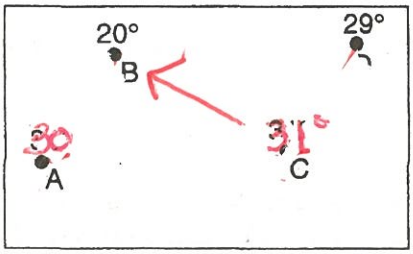
(4)

gained

3. A large amount of latent heat is absorbed by water during
   (1) evaporation (2) freezing (3) condensation (4) precipitation

4. Which process requires water to gain 2260 Joules of energy per gram?
   (1) vaporization (2) condensation (3) melting (4) freezing

5. The map below shows four locations in a temperature field. The temperature of each location is given in degrees Celsius.



Heat energy will normally flow from Hot → Cold
   (1) C to B (2) A to C (3) B to D (4) D to C

6. When 1 gram of liquid water at 0° Celsius freezes to form ice, how many total Joules of heat are lost by the water?
   (1) 1 (2) 0.5 (3) 334 (4) 2260

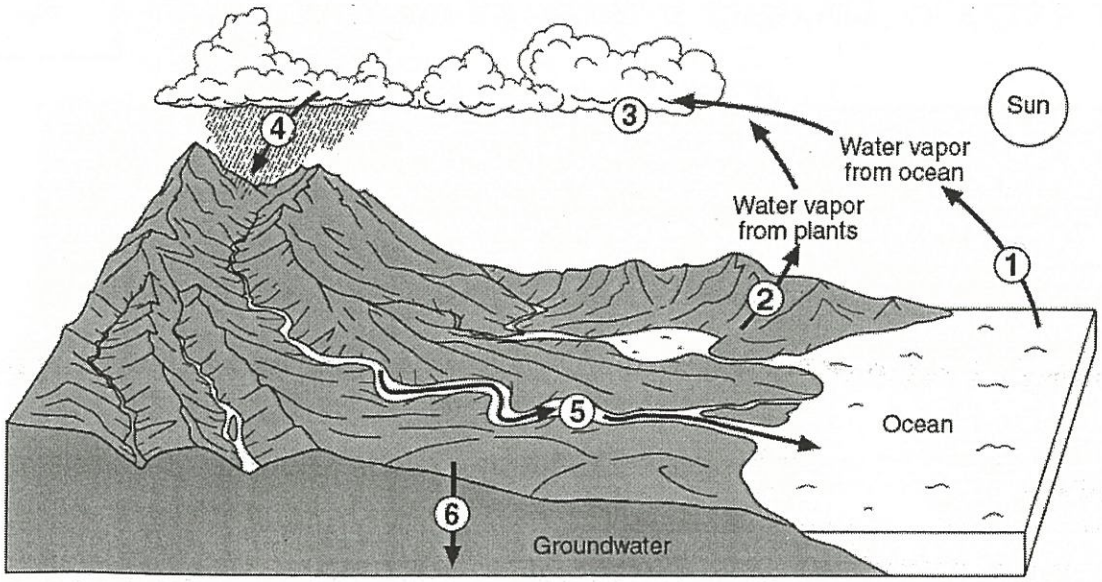
7. Which phase change requires water to gain 334 Joules per gram?
   (1) solid ice melting
   (2) liquid water freezing
   (3) liquid water vaporizing
   (4) water vapor condensing

8. Land surfaces of Earth heat more rapidly than water surfaces because
   (1) more energy from the Sun falls on land than on water
   (2) land has a lower specific heat than water
   (3) sunlight penetrates to greater depths in land than in water
   (4) less of Earth's surface is covered by land than by water

Fact(s) to memorize: 12 - 15

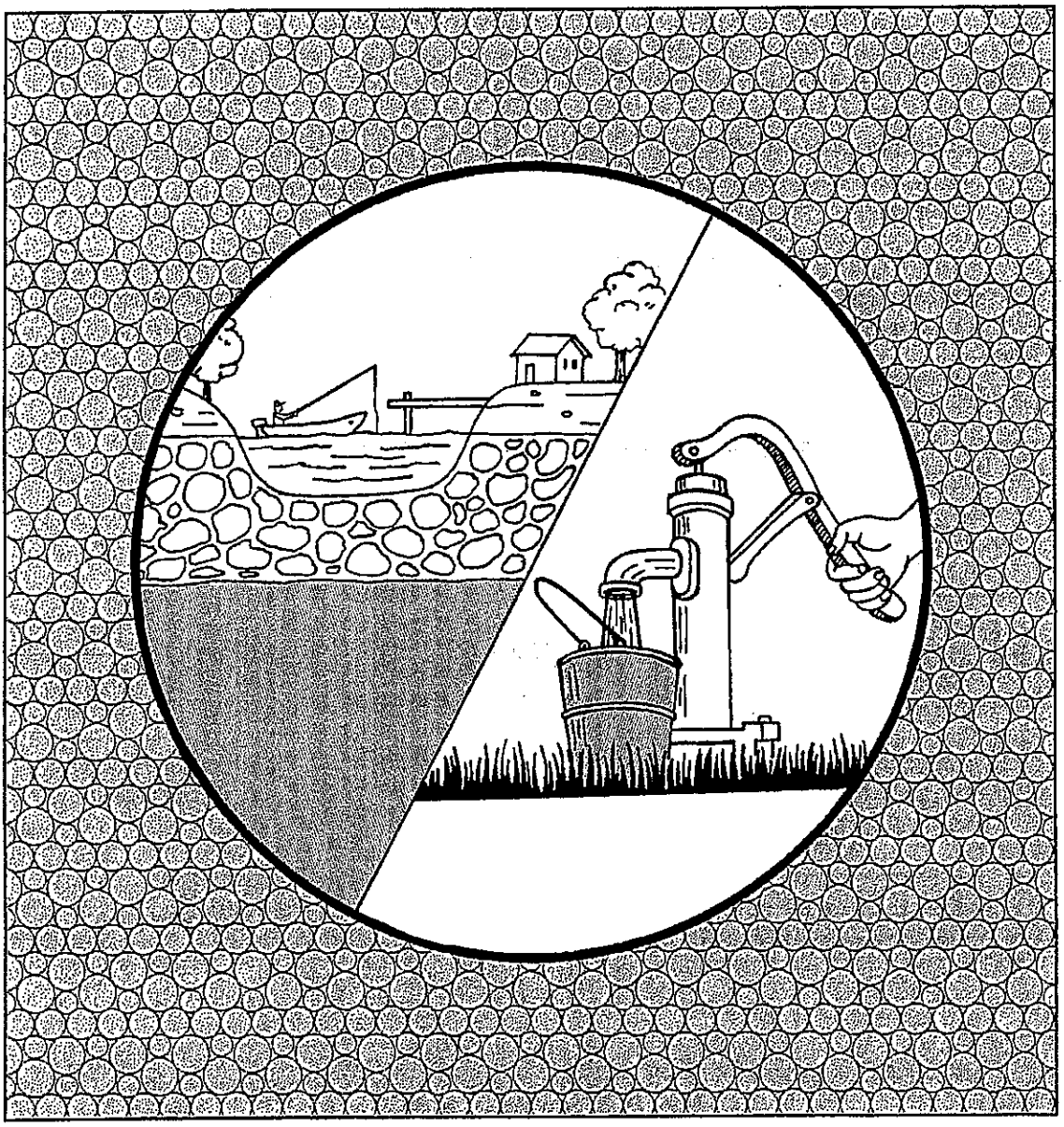
Hydrologic Cycle / Water Cycle

The diagram below shows a model of the water cycle. The arrows show the movement of water molecules through the water cycle. The circled numbers represent the processes that occur as the water molecules reach the different stages of the water cycle. Complete the table *below* by identifying the name of the water cycle process occurring at *each* number. Describe or give examples of each of the process.



No.	Water Cycle Process	Description or Example
1	Evaporation	The change from liquid water to water vapor
2	Transpiration	Water vapor that enters the air from plants, trees.
3	Condensation	Water droplets condense on dust = clouds
4	Precipitation	Some form of water falling from the clouds.
5	run-off	Water that flows over the land into a large body of water
6	ground Water	Water that soaks into the ground.

Where does rainwater go? 2



ground water: water that collects in pores in the soil

LESSON 2 | Where does rainwater go?

It rains on almost all places of our Earth. You have probably seen both heavy rains and light rains. Did you ever think about where the rain water goes?

You probably know part of the answer to this question. Rain falls into oceans, lakes, rivers, and steams. It becomes part of our surface water. Surface water can be seen on the surface of the earth.

However, some rainwater also seeps into the ground. It is **ground water.** Ground water is under the surface of the earth. The ground water is just below the surface of the ground. In other places it is very far below the surface—hundreds of meters (thousands of feet).

The ground water seeps into the ground until it rests on solid rock. Then it cannot seep farther. The water builds up similar to water filling a bathtub. It gets higher and higher. The level of the top of ground water is called the water table.

The water table keeps changing. It is higher when there is lots of rain. It is lower when there is no rain—or little rain.

We do not often see ground water, but it is important. People dig wells and get drinking water from ground water. Plants get water through their roots from ground water.

Lakes may be formed from ground water. Where the land dips below the water table, a lake forms. If the land dips only slightly below the water table, a swamp forms.

THE WATER TABLE

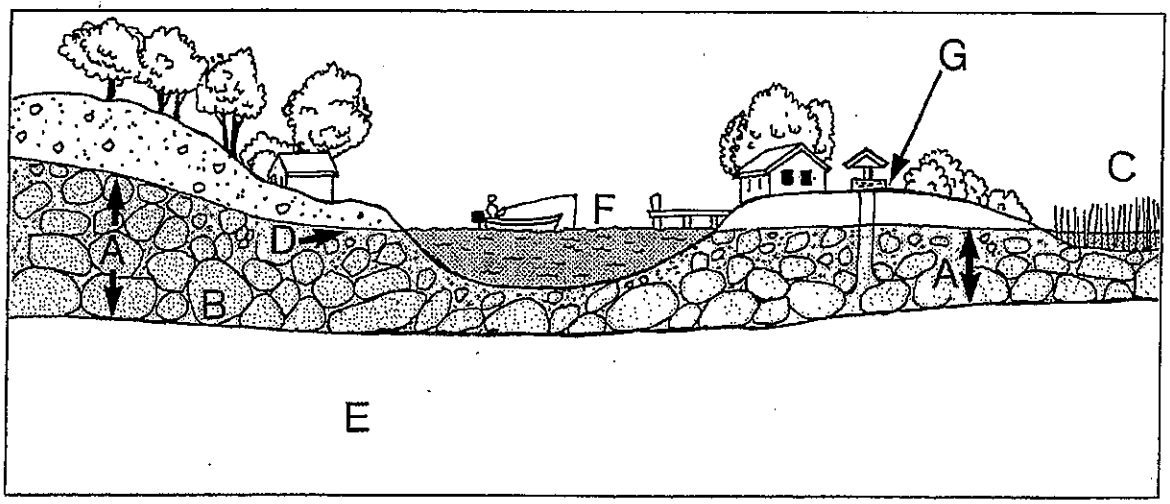


Figure A

1. Identify the following by letter.

   a) water table _____

   b) swamp _____

   c) lake _____

   d) well _____

   e) solid rock _____

   f) solid-rock line _____

   g) crust below the surface that is soaked with water _____

2. Trace the water table (line) with a red pencil.

3. The water table _____ a straight line.
   is, is not

4. A water table _____ change.
   does, does not

5. When there is little rain . . .

   a) the water table _____ .
      rises, lowers

   b) the lake level _____ .
      rises, lowers

   c) the swamp water _____ .
      rises, may dry out

   d) the well water _____ .
      rises, may dry out

6. When there is a lot of rain . . .

   a) the water table _____ .
      rises, lowers

   b) the lake level _____ .
      rises, lowers

   c) the swamp water _____ .
      rises, may dry out

   d) the well water level _____ .
      rises, may dry out

The kind of soil a place has also affects the water table. Some places have tightly packed soil, or soil that has a lot of clay in it. Clay and tight soil hold back water. It cannot seep into the ground. Usually, these places have low water tables. Soil that is good for crops and holding water has many holes in it and very little clay.

FILL IN THE BLANK

Complete each statement using a term or terms from the list below. Write your answers in the spaces provided.

far below	surface water	high
lakes	swamps	water table
ground water	low	amount of rainfall
always changing	near	drinking water
water to plants		

1. Water on the ground is called _____.
2. Water that is below the earth's surface is called _____.
3. The upper level of ground water is called the _____ .
4. In some places the water table is _____ . In other places it is _____ .
5. _____ and _____ form in places where the land dips below the water table.
6. The water table is _____.
7. The water table is affected by the _____.
8. In dry climates, the water table is _____ the surface.
9. In wet climates, the water table is usually _____ the surface.
10. Ground water is important because it gives _____ and _____ .

MATCHING

Match each term in Column A with its description in Column B. Write the correct letter in the space provided.

	Column A	Column B
_____	1. water table	a) has high water table
_____	2. swamp area	b) lowers the water table
_____	3. heavy rainfall	c) lakes and streams
_____	4. dry period	d) upper level of ground water
_____	5. surface water	e) raises the water table

TRUE OR FALSE

In the space provided, write "true" if the sentence is true. Write "false" if the sentence is false.

_____ 1. The water table is mostly underground.

_____ 2. The water table is the same everywhere.

_____ 3. The water table changes.

_____ 4. During dry weather, the water table rises.

_____ 5. During wet weather, the water table rises.

_____ 6. Swamps are found in places that have a high water table.

_____ 7. A lake can dry up.

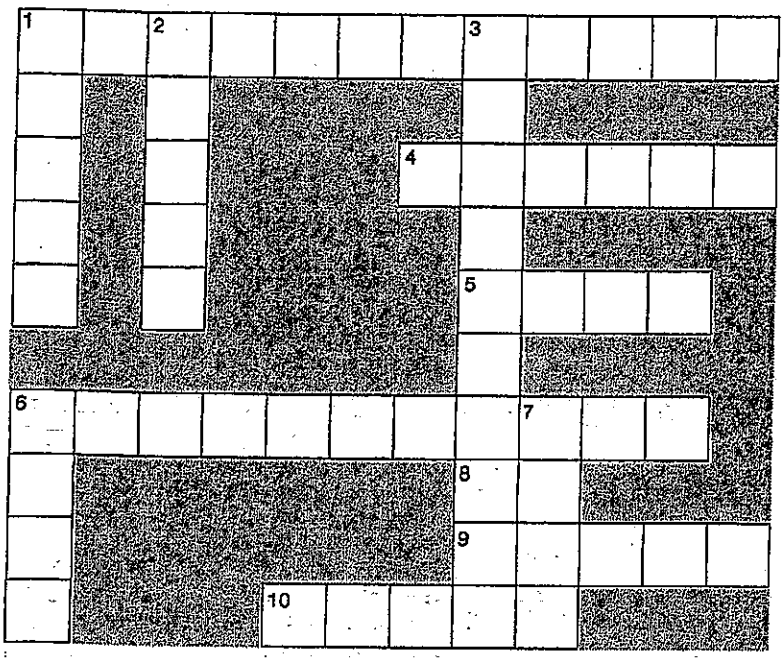
_____ 8. Much rain always means a high water table.

_____ 9. Good soil has a lot of clay.

_____ 10. Ground water is important only to plants.

CROSSWORD PUZZLE

Use the clues to complete the crossword puzzle.



CLUES

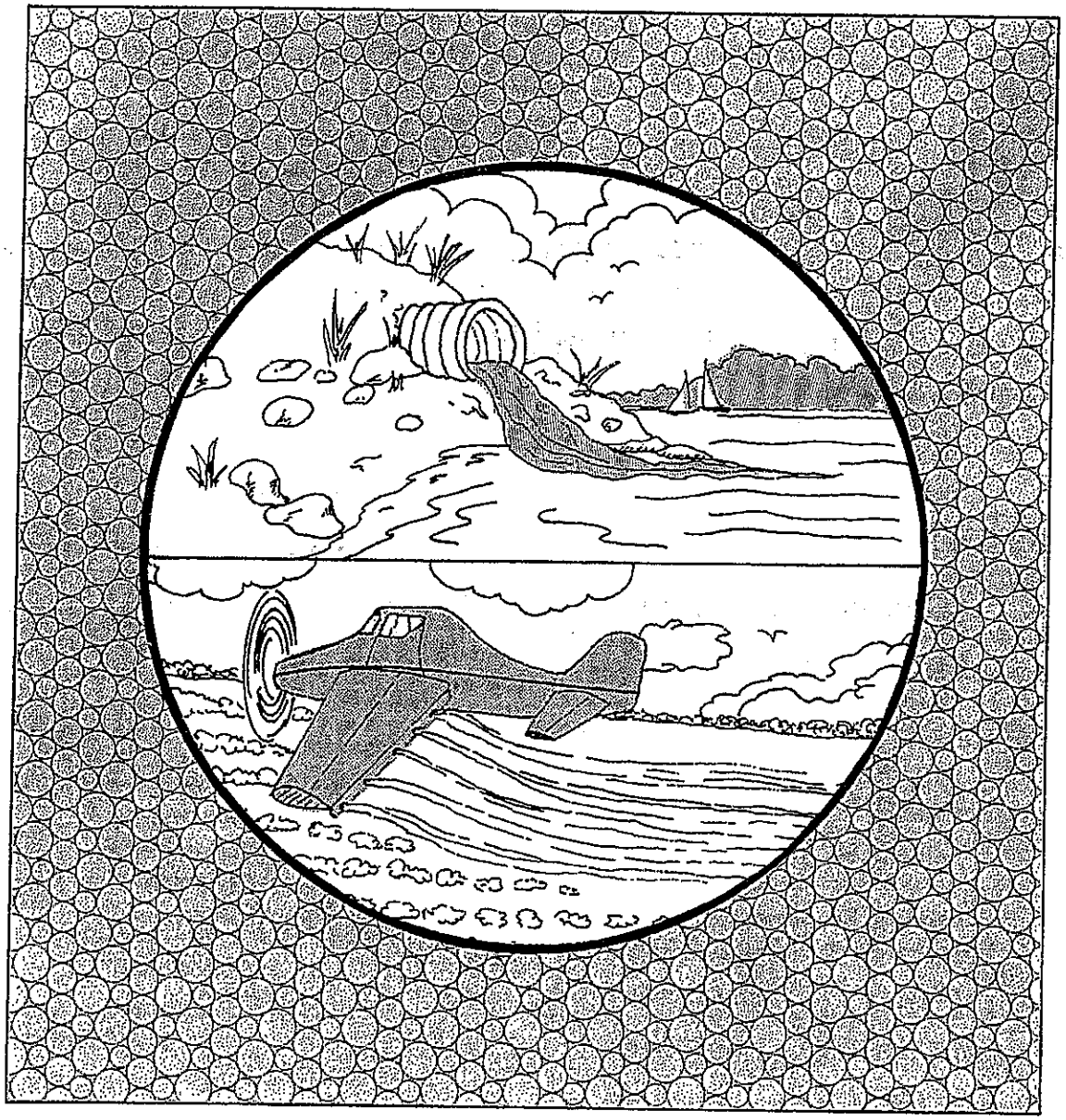
Across

1. Water you can see on the surface of the earth.
4. River.
5. It falls into streams.
6. Water that is under the surface of the earth.
8. Where land dips below the water table there may _____ a lake.
9. Bodies of water surrounded by land.
10. When there is little rain, the water table is _____ .

Down

1. If the land dips a little below the water table, there is a _____ .
2. Very wide stream.
3. The level of the top of ground water.
6. Ground water is _____ for plants.
7. "Raindrop" from your eye.

What is water pollution? 7



LESSON 7 | What is water pollution?

You have learned about some of the "gifts" from the ocean. But, what have people given to the oceans in return? . . . Oil spills, garbage, wastes from factories and ships — many kinds of harmful substances, or pollutants [puh-LOOT-ents].

Pollution is a major problem. Pollution is anything that harms the environment. Water pollution occurs when harmful substances enter the hydrosphere. Today, many lakes and rivers are polluted. They cannot be used for drinking or swimming. Some are so polluted that fish cannot live in them.

Now let us find out where water pollution comes from.

Sewage is a major source of water pollution. Germs live in sewage. Many fish and shellfish cannot be eaten because they contain germs that live in sewage.

Chemicals Many chemicals pollute the water. Some chemicals are used on farmlands to help plants grow. Others are used to kill insect pests. These chemicals seep into the ground water. The ground water is carried to lakes and rivers.

Some harmful chemicals come from industry too. Some factories dump wastes directly into rivers. Other industries bury wastes in drums in the ground. But what happens if the drums rust and break apart? The wastes leak into the ground water. Where do they end up?

WHAT DO THE PICTURES SHOW?

The pictures below show different causes of water pollution. Match each cause with its picture. Choose from the following causes:

Sewage — Industrial wastes

Oil spill — Farm chemicals

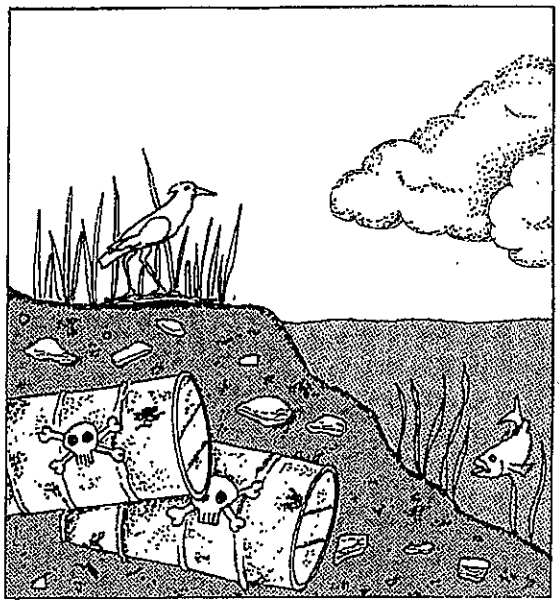


Figure A

1. Cause? _____

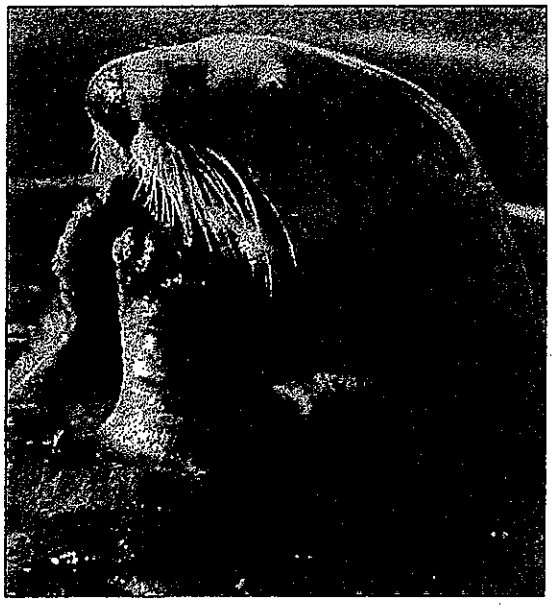


Figure B

2. Cause? _____

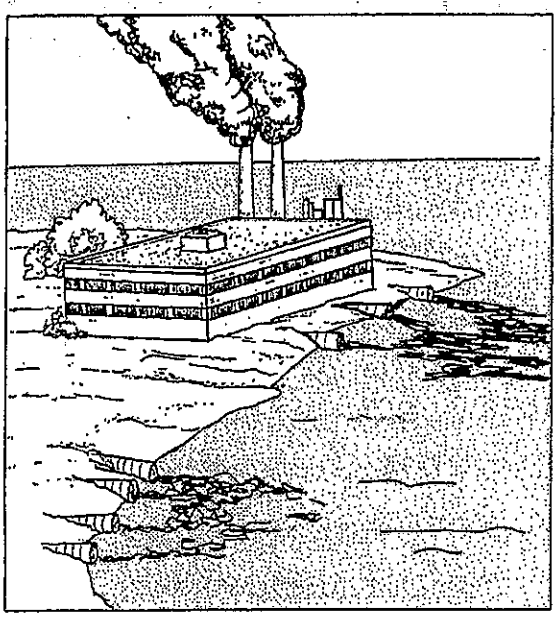


Figure C

3. Cause? _____

Figure D

4. Cause? _____

MORE ABOUT WATER POLLUTION

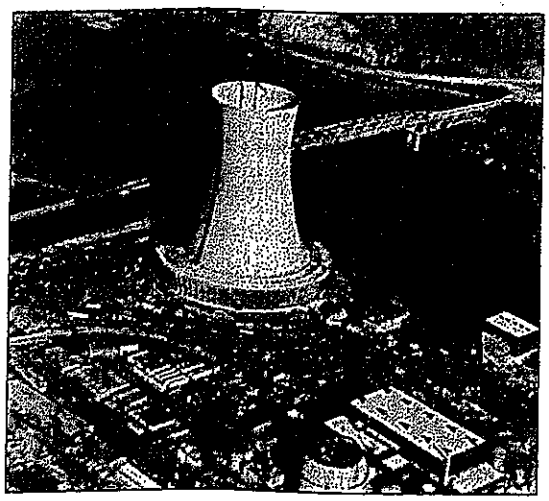


Figure E

Some industries take cold water from a lake or stream. They use the water for cooling. Then they release the water back into its river or lake. Is the water the same? No! When the water is used for cooling, the water itself becomes heated. So when the water is put back into its source, it kills plants and animals that normally live in cooler water.

This kind of pollution is called thermal [THUR-mul] pollution. Nuclear power plants are the main cause of thermal pollution.

TRUE OR FALSE

In the space provided, write "true" if the sentence is true. Write "false" if the sentence is false.

_____ 1. Pollution is not a major problem.

_____ 2. Some factories dump wastes directly into rivers.

_____ 3. Water pollution occurs when harmful substances enter the atmosphere.

_____ 4. Thermal pollution occurs when water is cooled.

_____ 5. Chemicals from farmland seep into ground water.

_____ 6. Germs live in sewage.

_____ 7. Pollutants of ground water are carried to lakes and rivers.

_____ 8. Farms are the major cause of thermal pollution.

_____ 9. Wastes buried in drums are not harmful to the environment.

_____ 10. Oil spills are harmful to ocean wildlife.

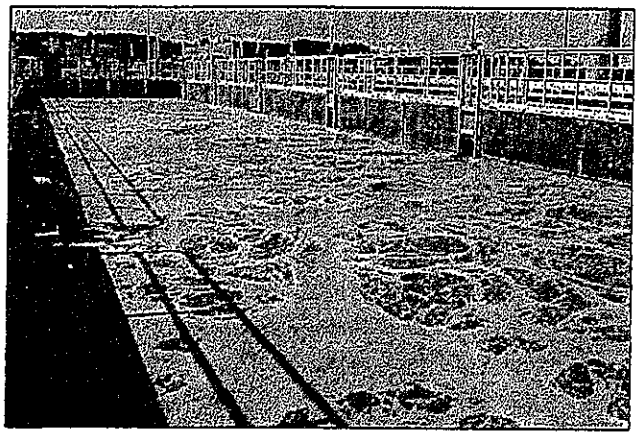


Figure F

Sewage-treatment plants have been built in many cities and towns. These plants change sewage into less harmful substances.

Figure G

Laws also help protect our water supply. Many farmland chemicals have been banned. They can no longer be used.

Laws require industries to clean their wastes before dumping them into lakes and rivers. Laws also call for the clean-up of wastes buried in drums in the ground.

1. Why is water pollution a major problem? _____

_____

2. a) How do laws help fight water pollution? _____

_____

b) What do you think should happen to people who break the law and illegally dump wastes into the water? _____

_____

3. How can you help stop water pollution? _____

_____

WORD SEARCH

The list on the left contains words that you have used in this Lesson. Find and circle each word where it appears in the box. The spellings may go in any direction: up, down, left, right, or diagonally.

pollution
water
sewage
germs
thermal
oil
fish
drums
harmful
wastes

P	A	J	R	L	G	S	H	P	S
W	O	K	L	E	J	H	M	L	E
A	I	L	R	P	I	S	N	U	W
S	L	M	L	O	C	I	A	F	A
T	S	G	B	U	O	F	Z	M	G
E	Y	F	X	R	T	B	E	R	E
S	N	I	E	F	D	I	R	A	D
M	U	T	Q	K	V	C	O	H	L
H	A	G	D	R	U	M	S	N	E
W	T	L	A	M	R	E	H	T	W

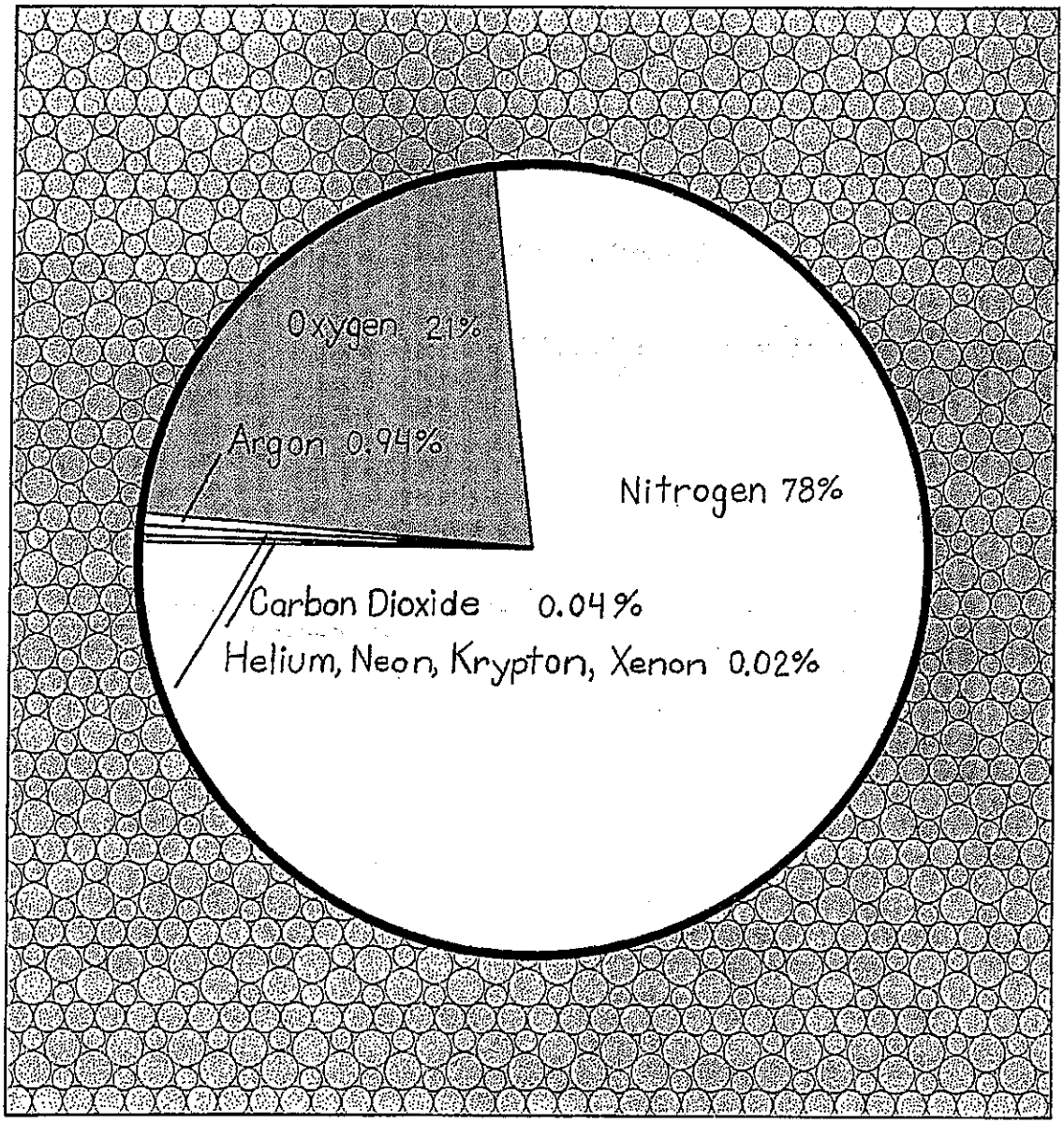
REACHING OUT

In the space below, draw a diagram that shows how a chemical used on a farm to kill insects, could end up in a person's body.

ATMOSPHERE

What is air made of?

8



atmosphere [AT-mus-feer]: envelope of gases that surrounds the earth
respiration [res-puh-RAY-shun]: process by which living things combine food and oxygen to get energy

LESSON 8 | What is air made of?

Several Americans have walked on the moon. Some of them even rode among the craters in lunar "buggies." But the moon has no air of its own. So the astronauts had to take along their own—in tanks.

Take a deep breath. Go ahead—really do it! Do you need air tanks in order to breathe?

Our planet is not like the moon. Our planet has air. It is surrounded by an "ocean" of air. We call this ocean of air the **atmosphere** [AT-mus-feer].

The atmosphere, or air, is a mixture of gases. Nitrogen and oxygen make up most of this mixture. About 78% of the atmosphere is made up of nitrogen. Living things need nitrogen to survive. Oxygen makes up about 21% of the air. Living things also need oxygen. Do you know why? Living things need oxygen to carry on **respiration** [res-puh-RAY-shun]. Respiration is the process by which living things combine food and oxygen to get energy.

Small amounts of other gases make up the rest of the atmosphere. They are carbon dioxide, water vapor (water in gas form), and certain "rare" gases such as helium and neon.

The atmosphere also contains tiny pieces of solids like pollen, dust, and ash.

COMPLETE THE GRAPH

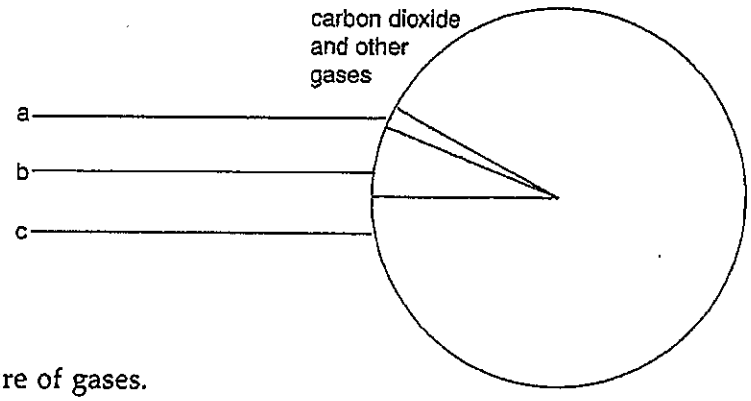


Figure A

The atmosphere is a mixture of gases.

This pie graph shows the percentages of the different gases.

1. About 78 percent of the atmosphere is nitrogen.

   Write "NITROGEN-78%" on the proper line of the graph.

2. About 21 percent of the atmosphere is oxygen.

   Write "OXYGEN-21%" on the proper line of the graph.

3. Figure this one out.

   If the atmosphere has 78 percent nitrogen and 21 percent oxygen . . .

   then

   what percent is left for carbon dioxide and the other gases? _____ percent

   Write this number on the proper line of the graph.

THE OXYGEN-CARBON DIOXIDE CYCLE

Oxygen and carbon dioxide constantly cycle through the environment. Animals breathe in oxygen for respiration. They gave off carbon dioxide as a waste product. Plants use the carbon dioxide to make their own food. Plants give off oxygen.

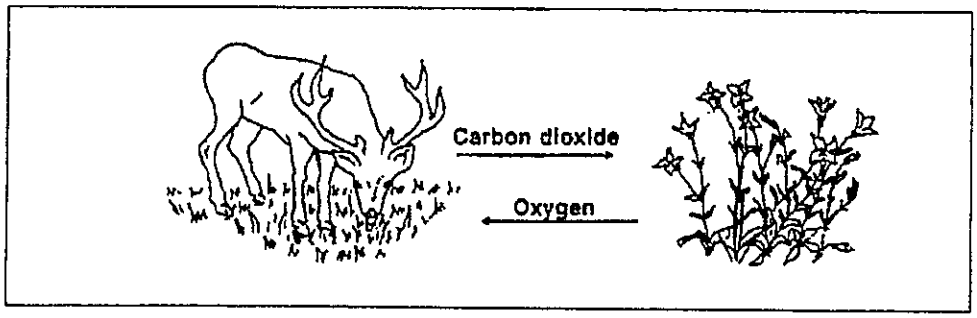


Figure B

THE NITROGEN CYCLE

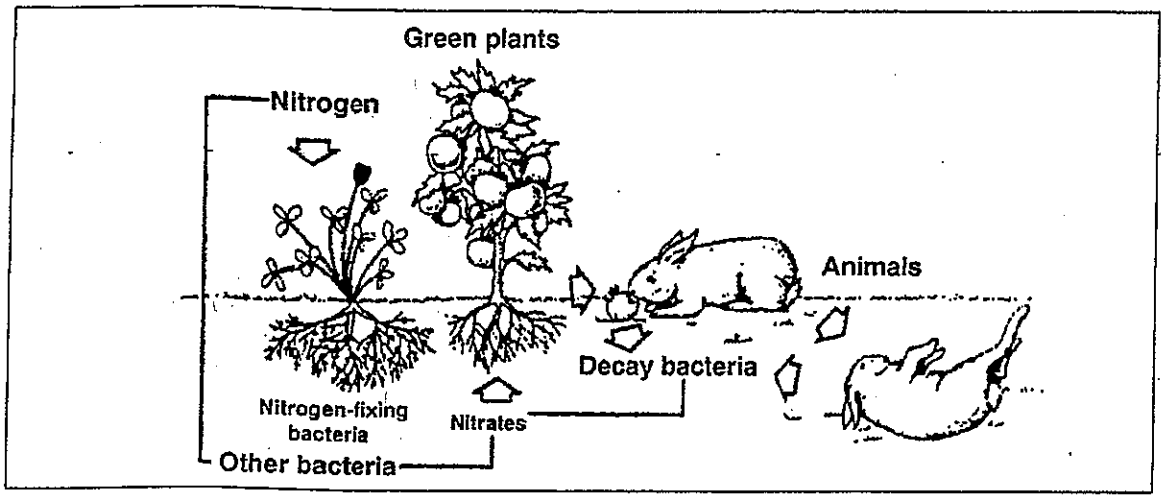


Figure C

Nitrogen makes up about 78% of the atmosphere. However, most living things cannot use nitrogen directly from the air. Bacteria (bak-TEER-ee-uh) are microscopic living things. Some bacteria in the soil change the nitrogen in the air into forms plants can use. Animals get the nitrogen they need by eating plants.

When plants and animals die, other kinds of bacteria break them down. The nitrogen is released back into the atmosphere.

Study Figures B and C to answer the following questions.

1. Animals take in _____ for respiration.
   oxygen, carbon dioxide

2. Plants give off _____ when they make their own food.
   oxygen, carbon dioxide

3. Nitrogen in the air is changed into forms most living things can use by _____.
   soil bacteria, plants

4. Animals get the nitrogen they need by eating _____.
   soil bacteria, plants

5. When plants and animals die and are broken down, nitrogen is released back into the _____.
   soil, atmosphere

WHERE DOES NATURAL DUST COME FROM?

Natural dust is formed in several ways:

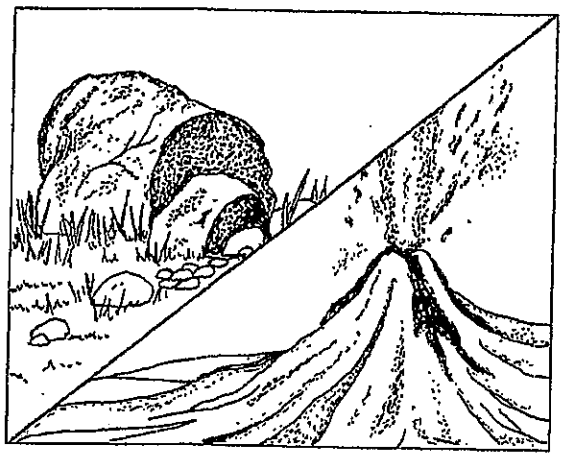


Figure D *Dust comes from broken-up rocks.*

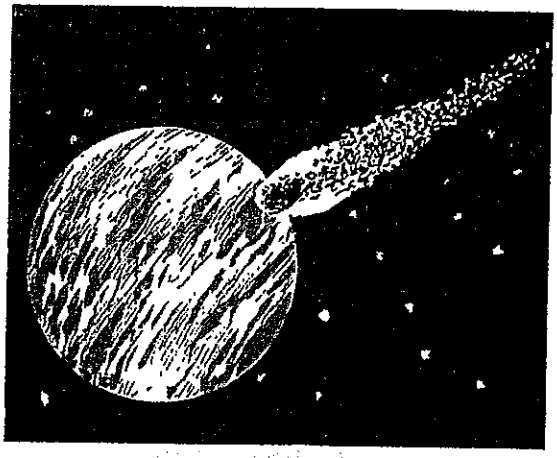


Figure E *Dust also comes from space.*

Rocks break into smaller pieces. Finally, they become the size of dust (Figure D).

Some dust comes from meteors that burn up in the atmosphere. Much more dust comes from deep outer space (Figure E).

Space dust adds about two million metric tons a year to the earth's weight. That's about 4 1/2 billion pounds!

And here's a surprise. Some household dust is made up of flaked off skin cells!

FILL IN THE BLANK

Complete each statement using a term or terms from the list below. Write your answers in the spaces provided.

78%	nitrogen	rare
21%	atmosphere	mixture of gases
water vapor		

1. The "ocean" of air that surrounds the earth is called the _____.
2. The atmosphere is made up of a _____.
3. Water in gas form is called _____.
4. Most of the atmosphere is made up of the gas _____.
5. Nitrogen makes up about _____ of the atmosphere.
6. Oxygen makes up about _____ of the atmosphere.
7. Helium and neon are _____ gases.

MATCHING

Match each term in Column A with its description in Column B. Write the correct letter in the space provided.

	Column A	Column B
_____	1. atmosphere	a) needed by all living things
_____	2. water vapor	b) tiny solids in the atmosphere
_____	3. oxygen	c) mixture of gases that surrounds the earth
_____	4. dust, pollen, and smoke particles	d) energy-producing process
_____	5. respiration	e) water in the gas form

TRUE OR FALSE

In the space provided, write "true" if the sentence is true. Write "false" if the sentence is false.

_____ 1. Carbon dioxide is a "rare" gas.

_____ 2. The moon has no air of its own.

_____ 3. Soil bacteria change nitrogen gas into forms plants can use.

_____ 4. The atmosphere is a mixture of gases.

_____ 5. Most of the atmosphere is oxygen.

_____ 6. Oxygen makes up about 21 percent of the atmosphere.

_____ 7. Only animals need oxygen.

_____ 8. Water vapor is a gas.

_____ 9. Some dust is a natural part of the atmosphere.

_____ 10. Animals take in oxygen for respiration.

Fact(s) to memorize: 12 - 15

Four things that can happen to precipitation:

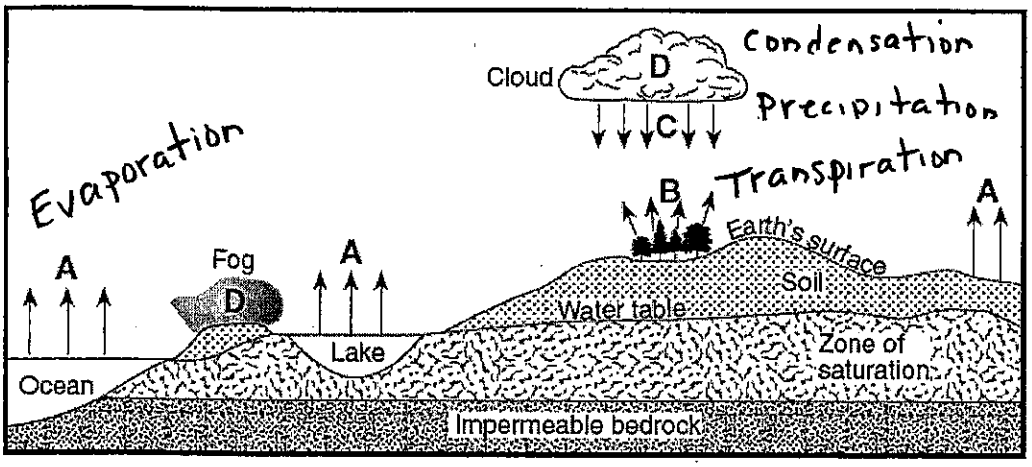
(1) Evaporate back into water vapor
(2) Infiltrate into the ground
(3) Be stored in glaciers as ice
(4) Roll across the surface as runoff

Conditions that increase the rate of evaporation:

(1) Dry air
(2) Wind
(3) Higher Temperatures
(4) Greater Surface Area

Questions:

Base your answers to questions 1 and 2 on the cross section below, which represents part of Earth's water cycle. Letters *A*, *B*, *C*, and *D* represent processes that occur during the cycle. The level of the water table and the extent of the zone of saturation are shown.



1. Which two letters represent processes in the water cycle that usually cause a lowering of the water table?
   (1) A and B (2) B and D (3) A and C (4) C and D

2. What are two water cycle processes *not* represented by arrows in this cross section?
   (1) transpiration and condensation
   (2) evaporation and melting
   (3) precipitation and freezing
   (4) runoff and infiltration

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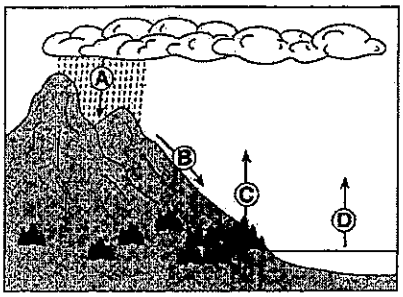
3. Most water vapor enters the atmosphere by the processes of
   (1) convection and radiation
   (2) evaporation and transpiration
   (3) condensation and precipitation
   (4) erosion and conduction

Water Cycle Questions

The arrows in the diagram to the right represent the movement of water in the water cycle.



1. Which arrow repersents the process of transpiration? Trees

   (1) A (2) B (3) C (4) D

The letters A through D on the cross section to the right represent four of the processes that are part of the water cycle.

2. Which table below correctly matches each letter with the process that it represents?

Letter	Process
A	condensation
B	precipitation
C	transpiration
D	evaporation

(1)

Letter	Process
A	transpiration
B	precipitation
C	evaporation
D	condensation

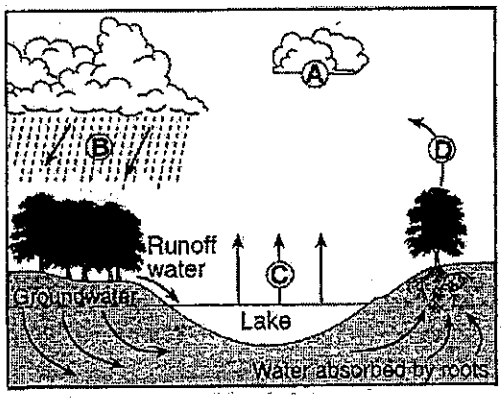
(3)

Letter	Process
A	evaporation
B	condensation
C	precipitation
D	transpiration

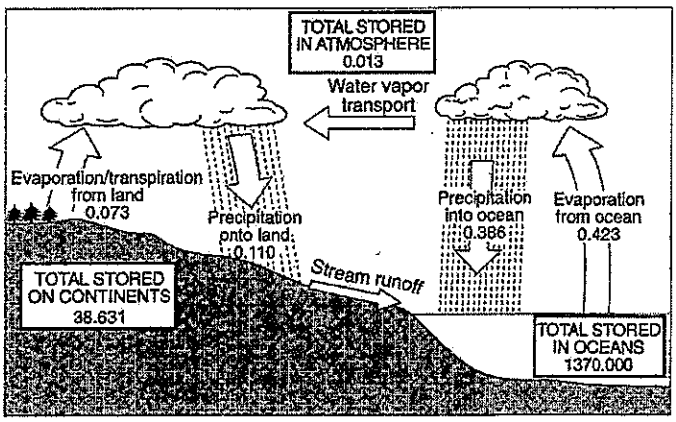
(2)

Letter	Process
A	condensation
B	precipitation
C	evaporation
D	transpiration

(4)



3. Calculate the total amount of water stored in the atmosphere, the oceans, and on the continents at any one time.



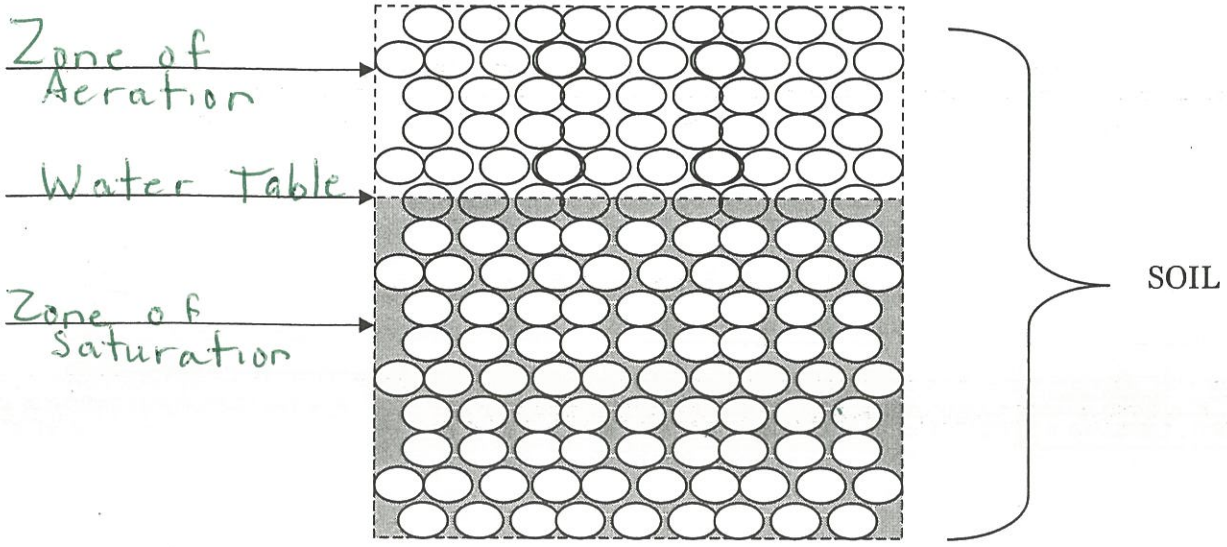
4. Explain why the yearly total precipitation over the oceans is greater than the yearly total precipitation over the continents.

Water vapor over the Ocean rises, condenses, and falls

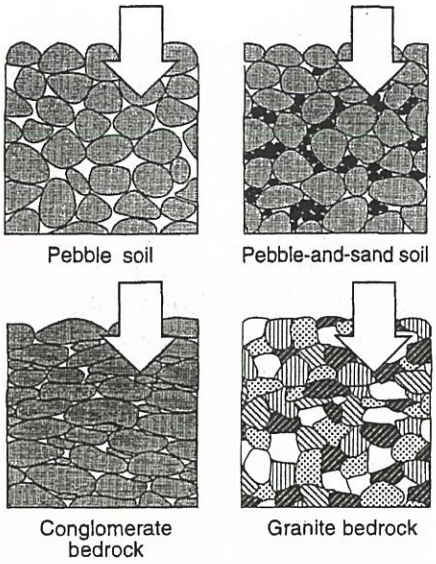
Fact(s) to memorize: 16 - 18

Underground Water Terms

1. Zone of Aeration — area that is filled with open space.
2. Zone of Saturation — area that is filled with water.
3. Water Table — Boundary between the two zones.



1. The diagram to the right represents samples of soil and bedrock at Earth's surface. The arrows represent possible infiltration of rainwater.



Which soil will allow the least amount of rainwater to infiltrate? (Soak in)

(1) Pebble soil
(2) Pebble and sand soil
(3) Conglomerate bedrock
(4) Granite bedrock

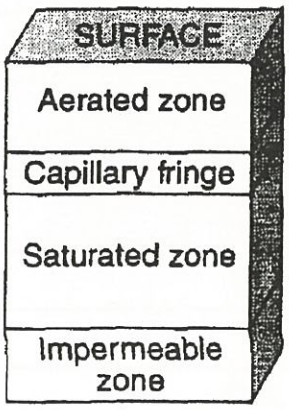
No open space

2. Which type of soil would water infiltrate most slowly? (Smallest) Pg 6
(1) silt (2) pebbles (3) fine sand (4) fine clay

3. As the temperature of the soil decreases from 10°C to -5°C, the infiltration rate of ground water through the soil will most likely — Freezing
(1) increase (2) decrease (3) remain the same

4. Flash flooding often occurs in city areas because
(1) runoff decreases during precipitation
(2) groundwater storage is usually very large
(3) roads, pavements, and buildings reduce the infiltration of water into the ground No infiltrat
(4) the hear generated by city areas decreases actual evapotranspiration

5. The diagram to the right represents zones within soil and rock. The zones are determined by the kinds of movement or lack of movement of water occulting within them.



What is the deepest zone into which water can be pulled by gravity?

(1) Aerated zone
(2) Capillary fringe
(3) Saturated zone
(4) Impermeable zone

6. A container of water is placed in an open outdoor area so that the evaporation rate can be observed. The water will most likely evaporate fastest when the weather is
(1) cool, humid, and windy
(2) warm, humid, and calm
(3) cool, dry, and calm
(4) warm, dry, and windy

7. During a dry summer, the flow of most large New York State streams generally
(1) continues because some groundwater seeps into the streams
(2) increases due to greater surface runoff
(3) remains unchanged due to transpiration from grasses, shrubs, and trees
(4) stops completely because no water runs off into the streams

Fact(s) to memorize: 19 -26

Ground water & Infiltration & Factors

1. Permeability — The ability for water to flow into the soil.

2. Permeability rate — How fast the water flows through the material.

3. Impermeable — Water can not go through or soak into the ground.
Ex: Concrete

Not

3. Porosity — The amount of open space in the soil.

4. Capillarity — The upwards movement of water through very tiny spaces.

Defies Gravity

Fact(s) to memorize: 19 -26

Factors that Effect Permeability Rate & Infiltration

	Factor that effect infiltration		Permeability rate (infiltration) is *greatest* when the following characteristics are true
(a)	shape	-	round Particles
(b)	size	-	large Particles
(c)	sorting	-	Sorted particles
(d)	packing	-	loosely packed particles

	Factors that cause runoff		Runoff increases (infiltration decreases) when the following conditions occur
(a)	saturated ground	-	no room for more water.
(b)	slope	-	steep slope
(c)	temperature	-	ground is 3. Frozen.
(d)	weather	-	rains faster then the soil can absorb.
(e)	location	-	pavement (concrete)

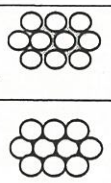
Factors that Effect Porosity

(a)

Shape < round particles allow more water to be ~~sorted~~ absorbed.

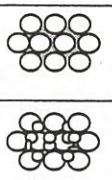
(b)

how tightly packed they are < loosely packed allows for more storage.



(c)

Sorting < Sorted particles allow for more room between them.



Fact(s) to memorize: 19 -26

Fact(s) to memorize: 19 -26

Size does NOT affect Porosity when the particles are sorted:

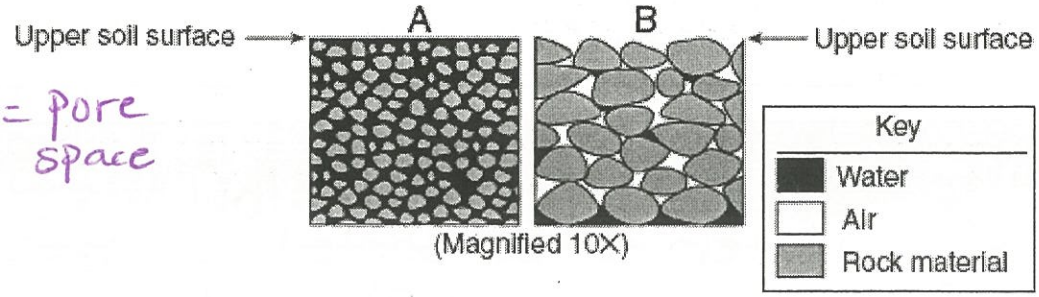
Large Particles	Small Particles
 Not as many holes, but larger holes.	 More holes, but smaller holes.

Factors that Effect Capillarity

The Smaller the pore space, the greater the capillarity.

Questions:

1. During a heavy rainstorm, soil samples *A* and *B* both became saturated with water. However, 10 minutes after the storm ended, the soils appeared as shown below.



Porosity = pore space

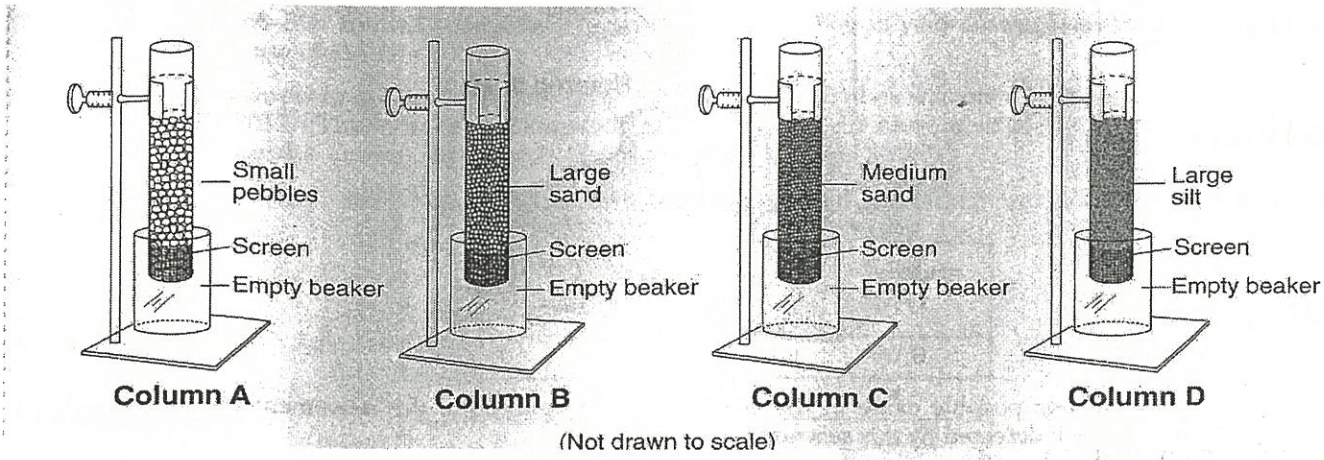
Which statement best explains the observed change in the water content of the soil samples?
(1) The permeability of *B* is greater than the permeability of *A*.
(2) The porosity of *B* is greater than the porosity of *A*.
(3) The capillarity of *B* is greater than the capillarity of *A*.
(4) The surface runoff at *B* is greater than the surface runoff at *A*.

2. During a rainfall, surface runoff will probably be greatest in an area that has a
(1) steep slope and a clay-covered surface
(2) steep slope and a gravel-covered surface
(3) gentle slope and a grass-covered surface
(4) gentle slope and a tree-covered surface

Permeability, Porosity and Capillarity Questions

1. A soil sample with a large amount of space between the particles will have a:

(1) low permeability rate
(2) low infiltration rate
(3) high porosity
(4) high capillarity - Small spaces

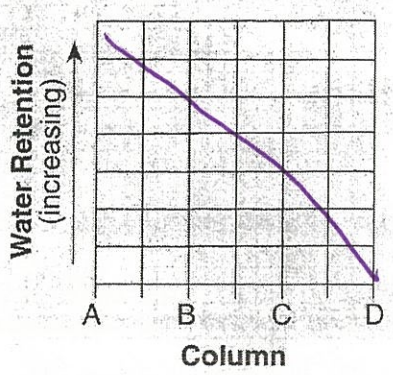


2. Which column above contains particles with a diameter of 0.4 cm? Pb Small pebbles (A)

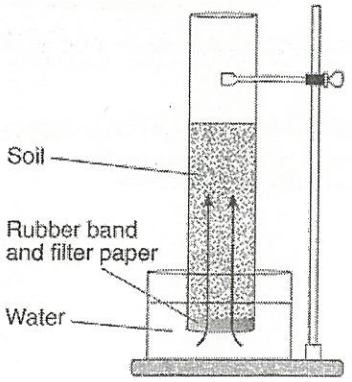
3. Describe the relationship between the sediment size and the permeability that will be observed when water is poured through the sediments in the columns above.

As Sediment size ↑ Permeability ↑

4. An equal amount of water is poured through each column above. On the grid to the right, draw a line to show the relative amount of water retained in the sediment after the water flows through each column.



The diagram to the right shows a laboratory setup. The rubber band holds the filter paper across the base of the open tube to hold the soil sample. The tube was placed in the water as shown. The upward movement of water is represented by arrows. The height of the water that moved upward within the soil was measured. Students repeated this procedure using soils with different particle sizes. Results of the experiment are shown in the data table.



5. Results of this experiment lead to the conclusion that:

(1) capillarity is greater in soils with larger particles
(2) capillarity is greater in soils with smaller particles
(3) permeability is greater in soils with smaller particles
(4) porosity is greater in soils with smaller particles

Data Table

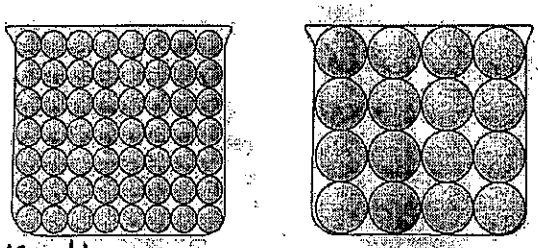
Average Soil Particle Diameter (cm)	Height of Water in Column (cm)
0.006	30.0
0.2	8.0
1.0	0.5

6. Refer to the diagram to the right to answer this question. Which characteristic is most likely the same for these particle-filled containers?

(1) infiltration rate (3) capillarity
(2) permeability (4) porosity

Pore Space

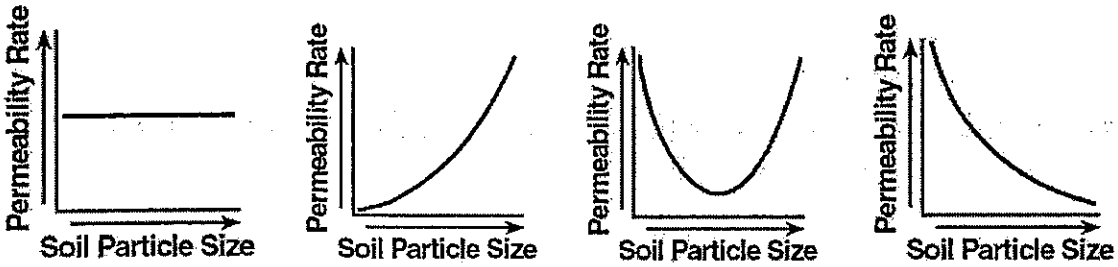
The diagram below shows two identical containers filled with uniform particles that were sorted by size.



As Particle Size ↑ Porosity stays the same

7. Which graph below best represents the relationship between soil particle size and the soil's permeability rate?

(1) (2) (3) (4)



As particle size ↑ Permeability ↑

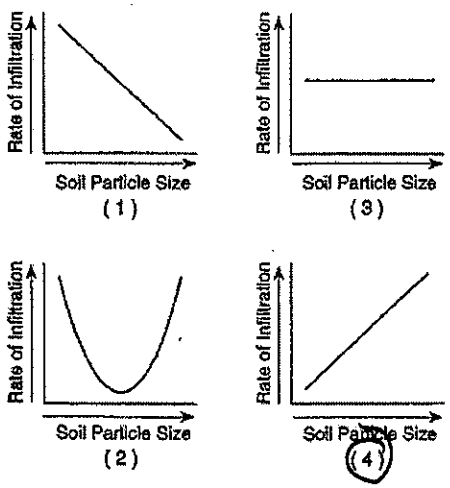
8. Which soil conditions normally result in the greatest amount of runoff?

(1) low permeability and gentle slope (3) high permeability and gentle slope
(2) low permeability and steep slope (4) high permeability and steep slope

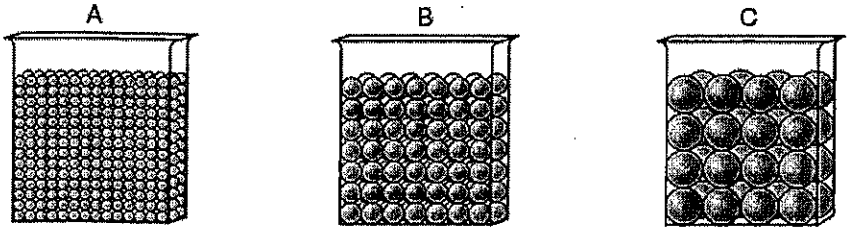
9. A soil sample with a large amount of space between the particles will have a

(1) low permeability rate (2) low infiltration rate (3) high porosity (4) high capillarity

10. Which graph to the right best represents the relationship between soil particle size and the rate at which water infiltrates permeable soil?



11. The diagrams below represent three containers, *A*, *B*, and *C*, which were filled with equal volumes of uniformly sorted plastic beads. Water was poured into each container to determine porosity and infiltration time.



(Not drawn to scale)

Which data table best represents the porosity and infiltration time of the beads in the three containers?

Same

Beaker	Porosity (%)	Infiltration Time (sec)
A	40	5.2
B	40	2.8
C	40	0.4

(1)

Beaker	Porosity (%)	Infiltration Time (sec)
A	20	5.2
B	30	2.8
C	40	0.4

(3)

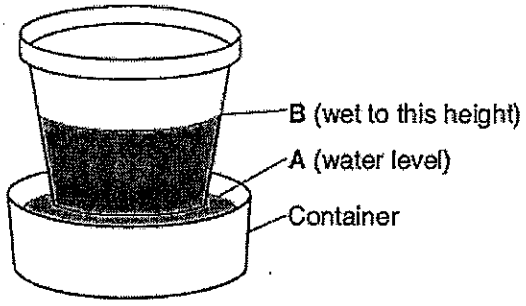
Beaker	Porosity (%)	Infiltration Time (sec)
A	40	0.4
B	40	2.8
C	40	5.2

(2)

Beaker	Porosity (%)	Infiltration Time (sec)
A	20	0.4
B	30	2.8
C	40	5.2

(4)

12. The diagram below shows the result of leaving an empty, dry clay flowerpot in a full container of water for a period of time. The water level in the container dropped to level *A*. The top of the wet area moved to level *B*.



Level *B* is higher than level *A* because water

(1) is less dense than the clay pot
(2) is more dense than the clay pot
(3) traveled upward in the clay pot by capillary action
(4) traveled downward in the clay pot by capillary action

Cut out the terms and paste them on the diagram in the appropriate spot.

Precipitation	Transpiration	Condensation	Evaporation
The Sun	Evaporation	Evapo-Transpiration	Water Table
Zone of Saturation	Precipitation	Unweathered Bedrock	Infiltration
Run-Off	Run-Off	Precipitation	Zone of Aeration
Lake/Pond	Condensation	The Water Cycle	Condensation

Fill in the Chart Below:

Environmental Process	Associated Phase Change
Evaporation	
Condensation	
Transpiration	Liquid to Gas

For the provided Environmental Scenarios state the Resultant Affect on Runoff and Infiltration Rates: (Increase or Decrease)

Environment	Rate of Runoff	Rate of Infiltration
Increased Gradient (Steep)		
Paved Roadways		
Flat Surface		
Vegetated Surface		
Saturated Ground		
Frozen Ground		

20: (Title of Diagram)

Name: