

NAME: _____

ENERGY AND WATER CYCLE NOTES

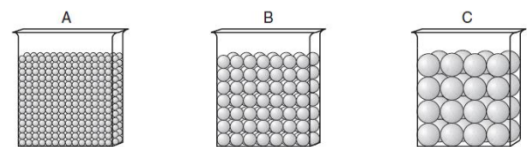
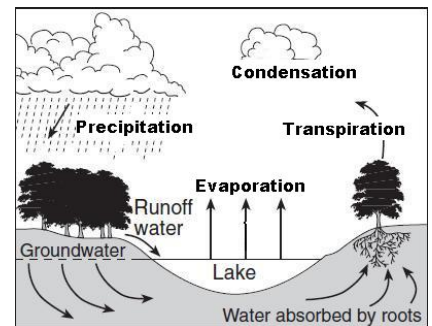
Log onto YouTube and search for jocrisci channel.

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

- You must know the differences between the three ways energy is transferred:
 - What is conduction?
 - Give a real life example.
 - What is convection?
 - Give a real life example.
 - What is radiation?
 - Give a real life example.
- Know the difference between the types of electromagnetic radiation.
- Be able to read and interpret the electromagnetic spectrum diagram on page 14 ESRT.
 - Which type of electromagnetic radiation has to longest wavelength? The shortest?
- Which material absorbs the most energy? Reflects?
- 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)

- Be able to define and/or describe each of the **six** steps in the water cycle
 - Which part of the water cycle adds water vapor into the atmosphere from plants?
- On the diagram to the right label the:
 - Zone of aeration
 - Zone of saturation
 - Water table
- You must know the difference between permeability, porosity, and capillarity.
 - Which container has the greatest permeability? How can you tell?
 - Which container has the greatest porosity? How can you tell?
 - Which container has the greatest capillarity? How can you tell?



EARTH'S ATMOSPHERE (Video ESRT 14a)

- What is the altitude of the tropopause in kilometers? In miles?
- What is the temperature in degrees C at the tropopause?
- As altitude increases, what happens to air pressure?
- As altitude increases, what happens to the amount of water vapor?
- In which layer of the atmosphere is there the most water vapor?
- What is the temperature at the mesopause?
- As altitude increases from sea level to the mesopause, what happens to the air temperature?
- Which layer of the atmosphere ranges from 50 km to 80 km?
- 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



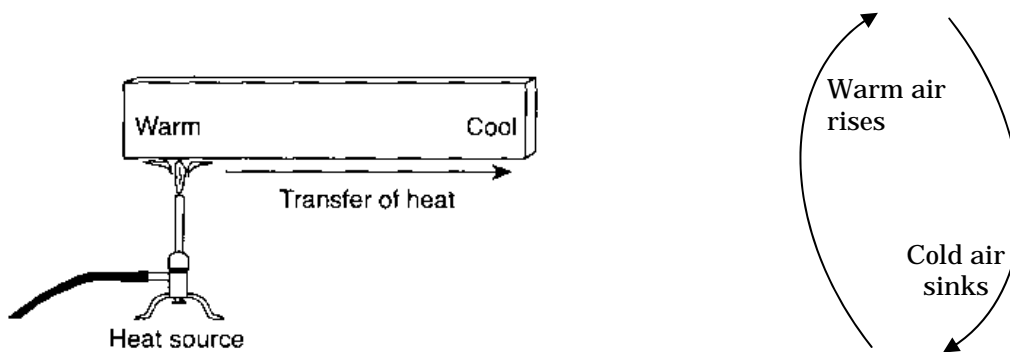
Energy Transfer

Fact(s) to memorize: 1- 4

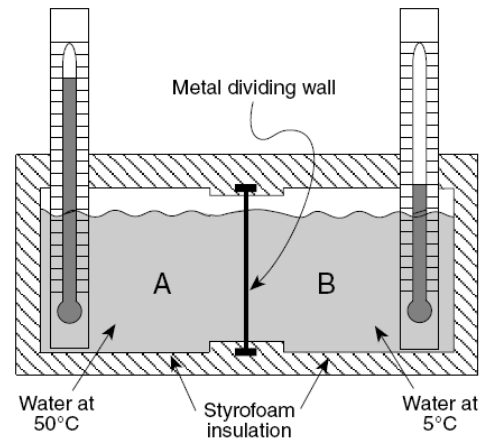
What is the difference between kinetic and potential energy? Give a real-life example of each

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

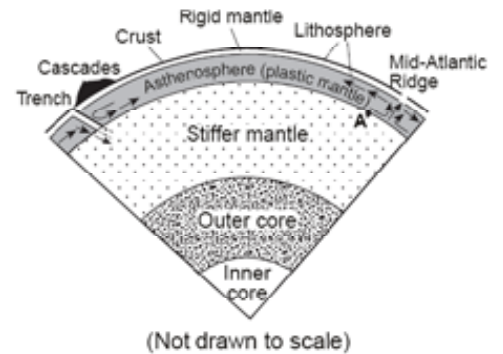
Example	Example	Example



- 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
 - remain unchanged
 - decrease by only 5 C°
 - decrease by approximately 10 C°
 - increase by approximately 10 C°



- During which process does heat transfer occur because of density differences?
 - conduction
 - radiation
 - convection
 - reflection
- What is the primary method of heat transfer through solid rock during contact metamorphism?
 - advection
 - absorption
 - convection
 - conduction
- 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
 - insolation
 - convection
 - conduction
 - radiation

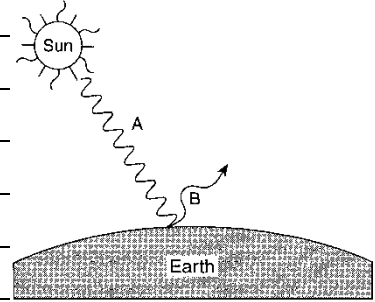


- Which process transfers energy primarily by electromagnetic waves?
 - radiation
 - evaporation
 - conduction
 - convection
- Which method of energy transfer is primarily responsible for energy being lost from Earth into space?
 - conduction
 - convection
 - solidification
 - radiation

Fact(s) to memorize: 1- 4

How energy reaches Earth

Radiation _____



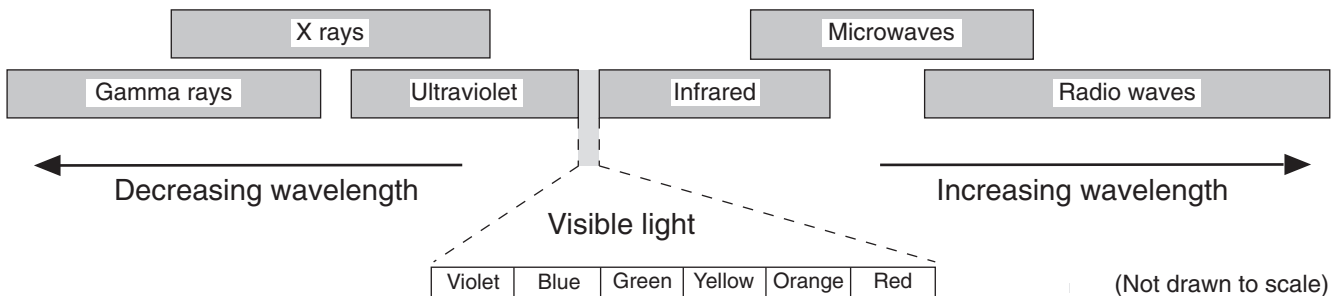
Electromagnetic spectrum _____

Earth Science Reference Tables, page _____

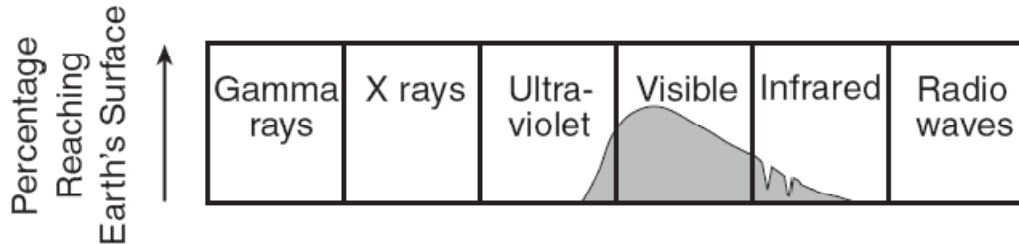
1. Heat waves _____
2. Lead protects you from these at the dentist _____
3. Skin cancer is a result of too much exposure to _____
4. Music is sent along these waves _____
5. Nuclear bombs deadly rays _____
6. Most of the waves sent by the sun are in the _____ range.

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

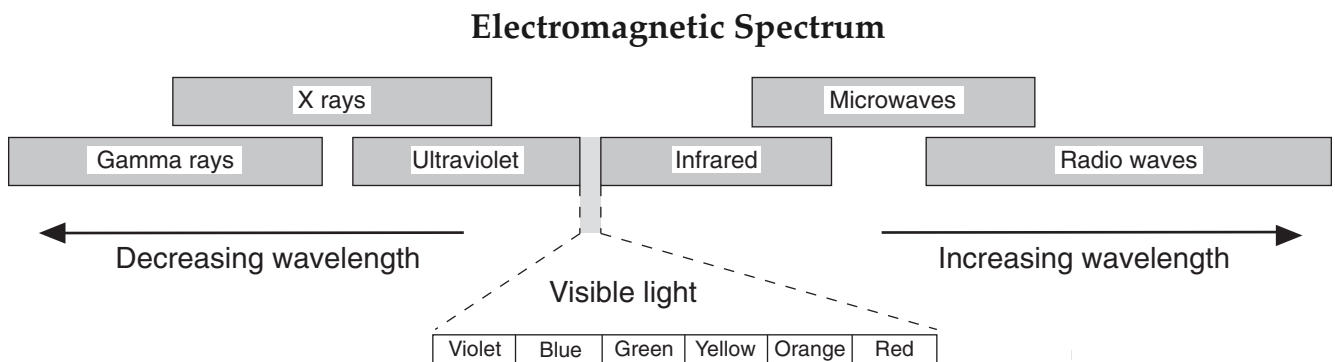
Electromagnetic Spectrum



3. Which part of the Sun's electromagnetic spectrum has the longest wavelength?
 (1) radio wave radiation (3) infrared radiation
 (2) visible light 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?
 (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

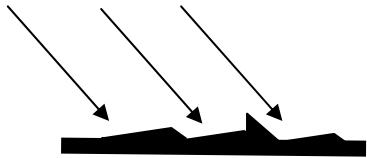


(Not drawn to scale)

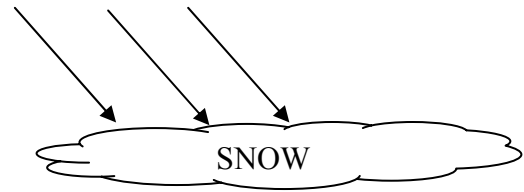


Reflection / Refraction / Absorption of insolation

Light vs. Dark

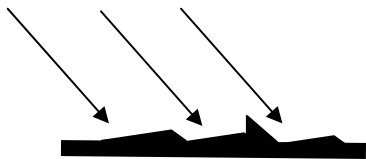


Dark surfaces

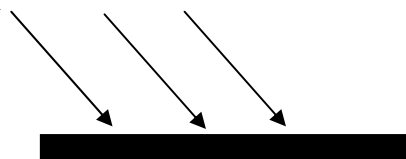


Light surfaces

Rough vs. Smooth



Rough surfaces



Smooth surfaces

Land vs. Water

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?

- (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)

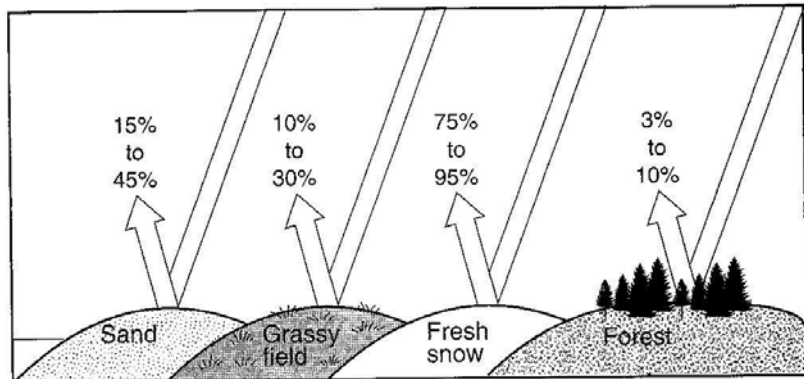
Type of Heat Transfer	Change in Air Density
convection	density decreases

(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: _____

ESRT page _____

- (a) Which material on the specific heat chart heats up the fastest? _____
- (b) Which material on the specific heat chart heats up the slowest? _____
- (c) Which material needs the most amount of energy to raise its temperature? _____
- (d) In each set below, circle the material that would heat up the fastest:

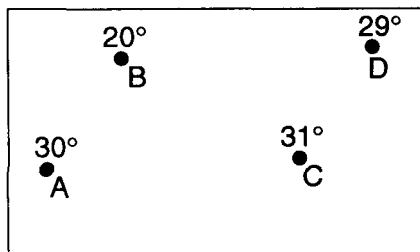
Water	Iron	Copper
Ice	Basalt	Granite
Lead	Water	Iron

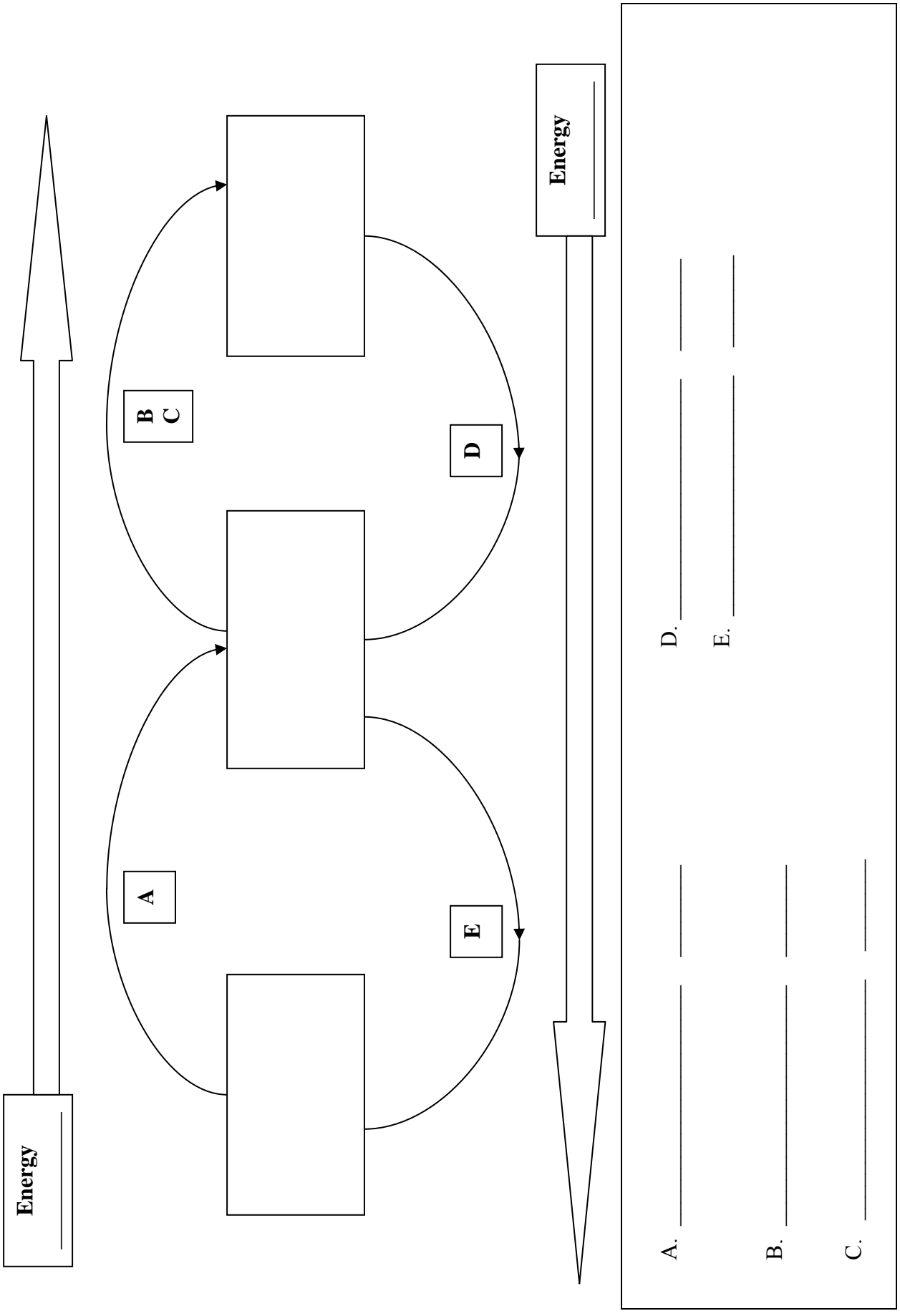
Dry air	Lead	Granite
Iron	Basalt	Water vapor
Ice	Copper	Dry air

- (e) Compare the heating and cooling rate of land and water, using the term “specific heat” to explain your comparison. _____

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

Energy moves from the _____ to the _____.



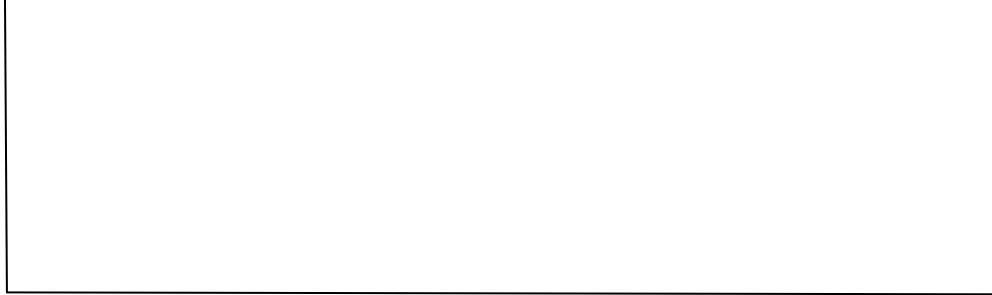


HEATING OF WATER

Fact(s) to memorize: 12 - 15

Draw the graph of water heating.

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



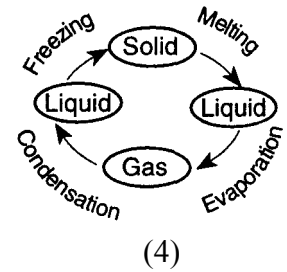
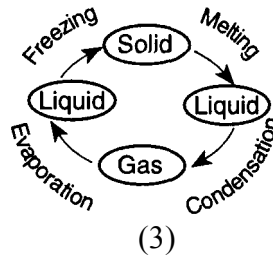
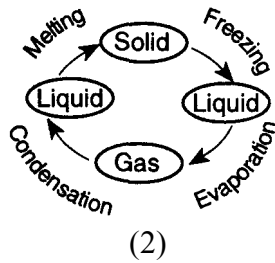
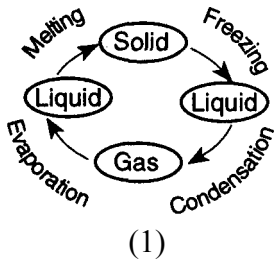
Check the box which describes whether energy is gained or lost for each process.

Process	Energy Gained	Energy Lost
Condensation		
Evaporation		
Melting		
Solidification		

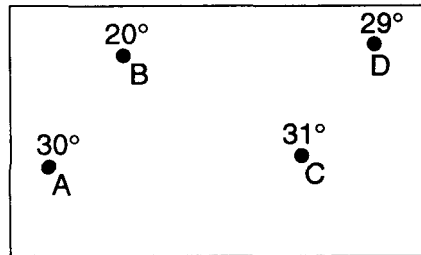
How many calories are gained or lost by water for each of the following processes?

Process	Calories Gained	Calories Lost
Condensation		
Evaporation		
Melting		
Solidification		

- During which phase change of water is the most energy released into the environment?
 - water freezing
 - ice melting
 - water evaporating
 - water vapor condensing
- Which diagram correctly shows the processes that change the states of matter?



- A large amount of latent heat is absorbed by water during
 - evaporation
 - freezing
 - condensation
 - precipitation
- Which process requires water to gain 2260 Joules of energy per gram?
 - vaporization
 - condensation
 - melting
 - freezing
- The map below shows four locations in a temperature field. The temperature of each location is given in degrees Celsius.

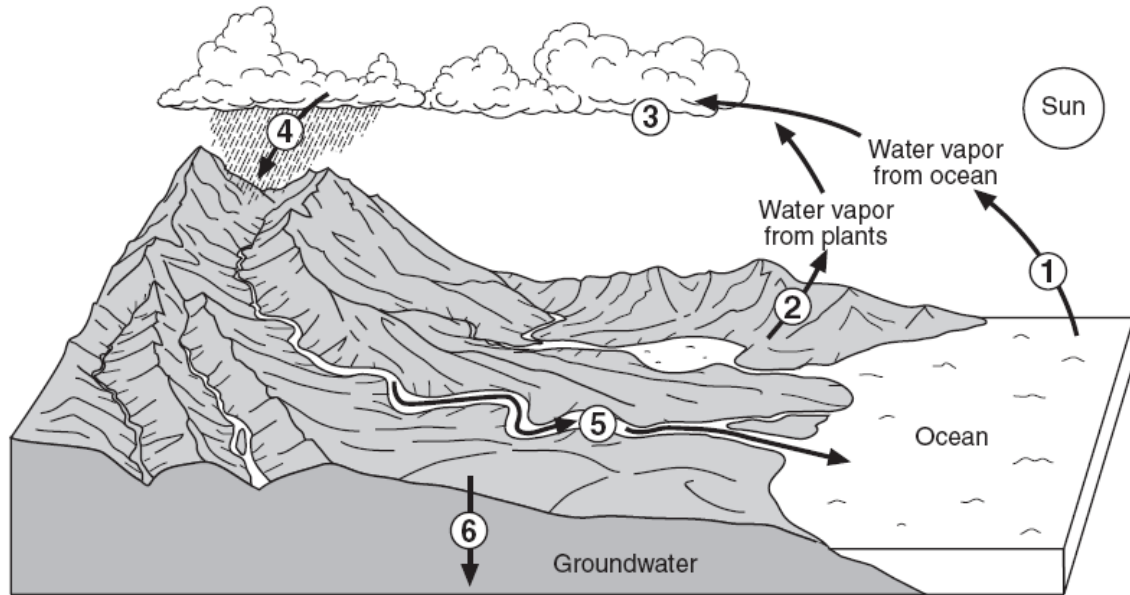


Heat energy will normally flow from

- C to B
 - A to C
 - B to D
 - D to C
- 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
 - 0.5
 - 334
 - 2260
 - Which phase change requires water to gain 334 Joules per gram?
 - solid ice melting
 - liquid water freezing
 - liquid water vaporizing
 - water vapor condensing
 - Land surfaces of Earth heat more rapidly than water surfaces because
 - more energy from the Sun falls on land than on water
 - land has a lower specific heat than water
 - sunlight penetrates to greater depths in land than in water
 - less of Earth's surface is covered by land than by water

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	-	_____
2	-	_____
3	-	_____
4	-	_____
5	-	_____
6	-	_____

Four things that can happen to precipitation:

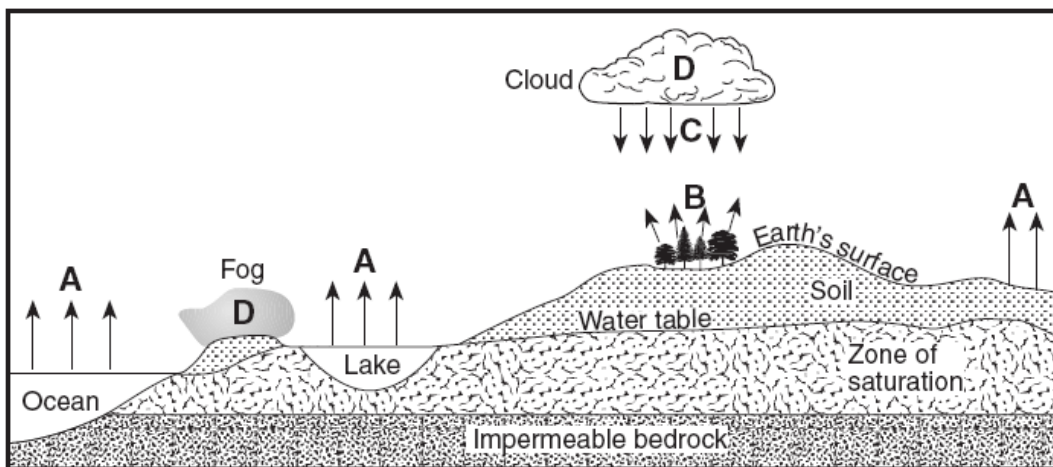
- (1) _____
- (2) _____
- (3) _____
- (4) _____

Conditions that increase the rate of evaporation:

- (1) _____
- (2) _____
- (3) _____
- (4) _____

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 (3) precipitation and freezing
 (2) evaporation and melting (4) runoff and infiltration

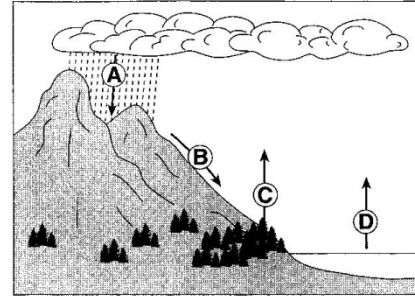
3. Most water vapor enters the atmosphere by the processes of
 (1) convection and radiation (3) condensation and precipitation
 (2) evaporation and transpiration (4) erosion and conduction

Water Cycle Questions

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

1. Which arrow represents the process of transpiration?

- (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

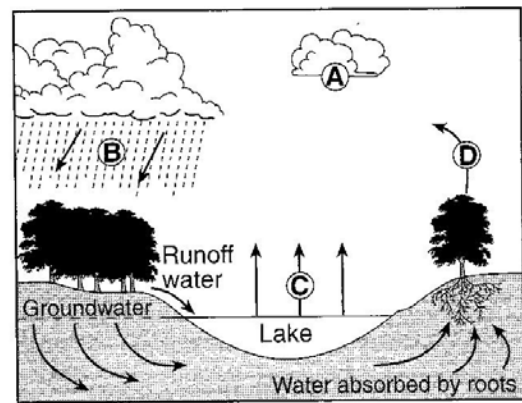
(3)

Letter	Process
A	evaporation
B	condensation
C	precipitation
D	transpiration

(2)

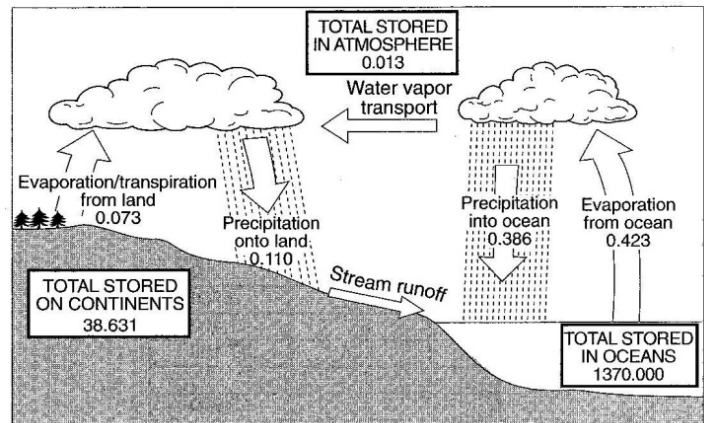
Letter	Process
A	condensation
B	precipitation
C	evaporation
D	transpiration

(4)

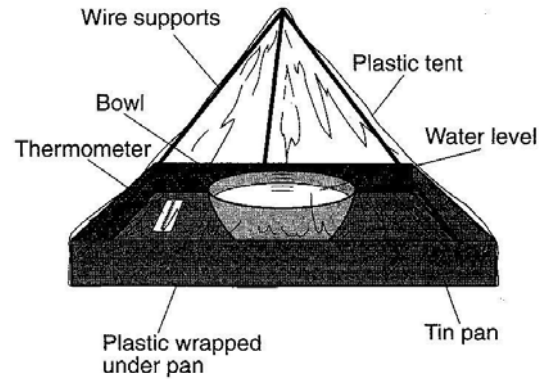


3. Calculate the total amount of water stored in the atmosphere, the oceans, and on the continents at any one time.

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



Base your answers to questions 5 through 8 on the model and data table shown to the right. A student constructed a model to demonstrate how water is recycled by natural processes on Earth. The model consisted of a clear plastic tent over a pan containing a bowl of water. The model was sealed so no water could enter or leave the tent. The data table shows the observations recorded when the model was placed in direct sunlight for 60 minutes.



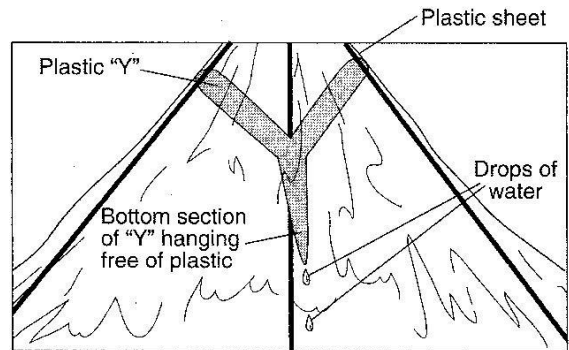
Data Table

Time (min)	Observations
0	Water level in bowl = 10 cm Inside walls of the plastic tent are dry. Inside air temperature = 20°C
30	Water level in bowl = 9.9 cm Small drops of water form on the inside walls of the tent. Inside air temperature = 23°C
60	Water level in bowl = 9.8 cm Large drops of water form on the inside walls of the tent. Inside air temperature = 26°C

- Identify the process that caused the water level in the bowl to decrease.
- How much heat energy, in calories per gram, is released as water droplets are formed on the inside walls of the tent?

7. If the model is changed and the bowl of water is replaced with a green plant, by which process would the plant supply water vapor to the air inside the tent?

- A student glues a Y-shaped piece of plastic, as shown to the right, near the top of the inside of the tent and repeats the demonstration. Drops of water are seen dripping from the bottom of the Y after 60 minutes. Which process of the water cycle is being represented by the dripping water?



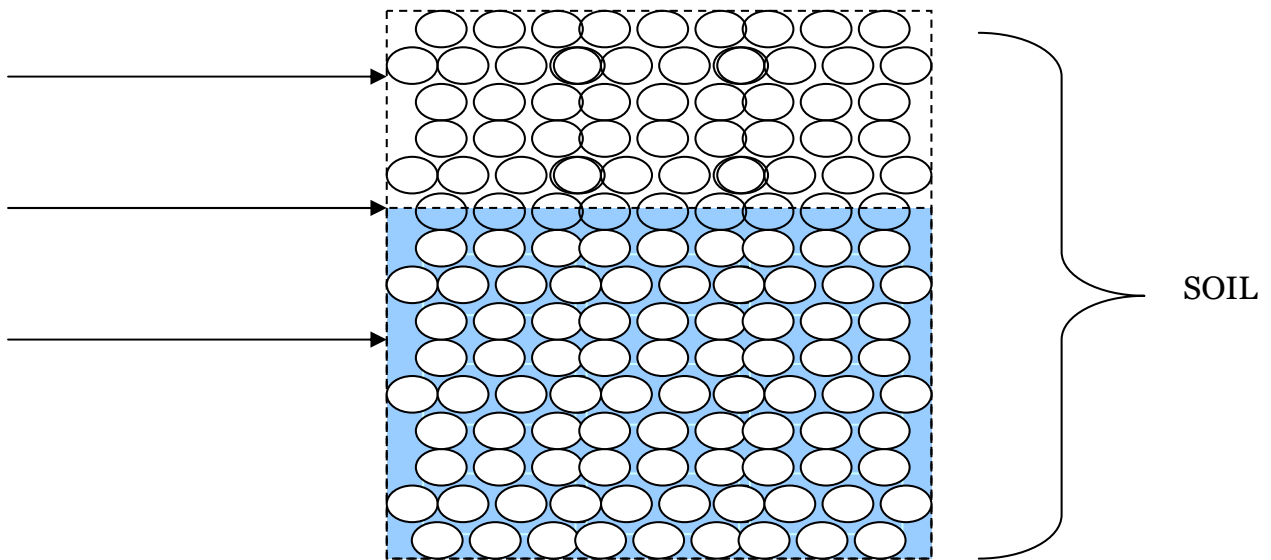
Fact(s) to memorize: 16 - 18

Underground Water Terms

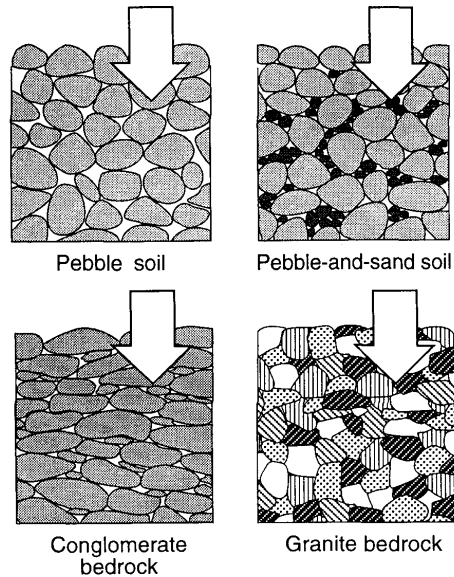
1. Zone of Aeration _____

2. Zone of Saturation _____

3. Water Table _____



% 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?

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

& Which type of soil would water infiltrate most slowly?

- (1) silt
- (2) pebbles
- (3) fine sand
- (4) fine clay

' . 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

- (1) increase
- (2) decrease
- (3) remain the same

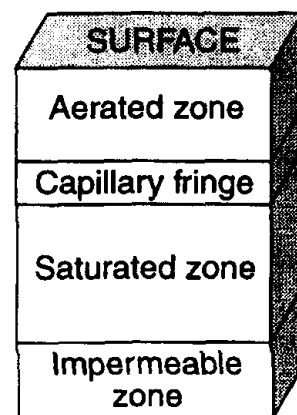
(. Flash flooding often occurs in city areas because

- (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
- (4) the heat generated by city areas decreases actual evapotranspiration

) . 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 occurring 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



- *. 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

- +. 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 _____

2. Permeability rate _____

3. Impermeable _____

3. Porosity _____

4. Capillarity _____



Factors that Effect Permeability Rate & Infiltration

Factor that effect infiltration

Permeability rate (infiltration) is *greatest* when the following characteristics are true

- (a) _____ - _____
- (b) _____ - _____
- (c) _____ - _____
- (d) _____ - _____

Factors that cause runoff

Runoff increases (infiltration decreases) when the following conditions occur

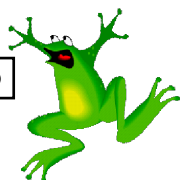
- (a) _____ - _____
- (b) _____ - _____
- (c) _____ - _____
- (d) _____ - _____
- (e) _____ - _____

Factors that Effect Porosity

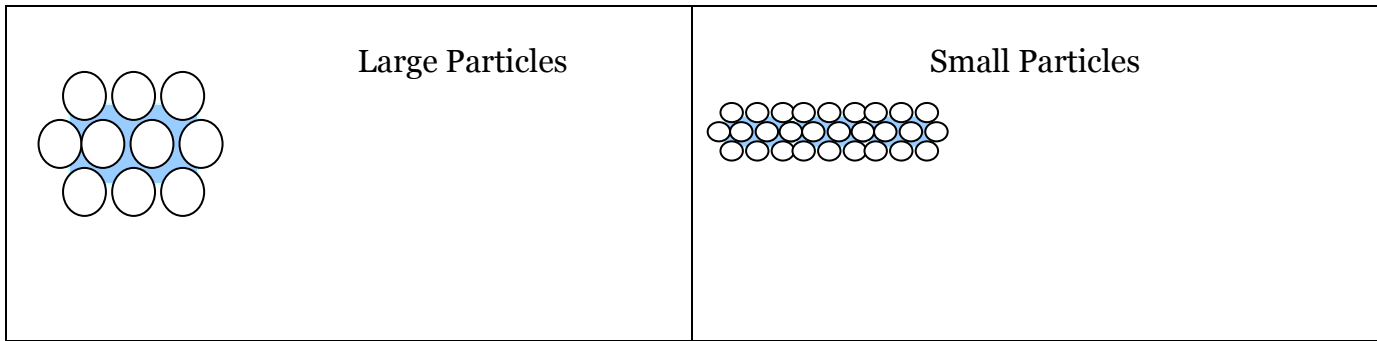
(a)

(b)

(c)



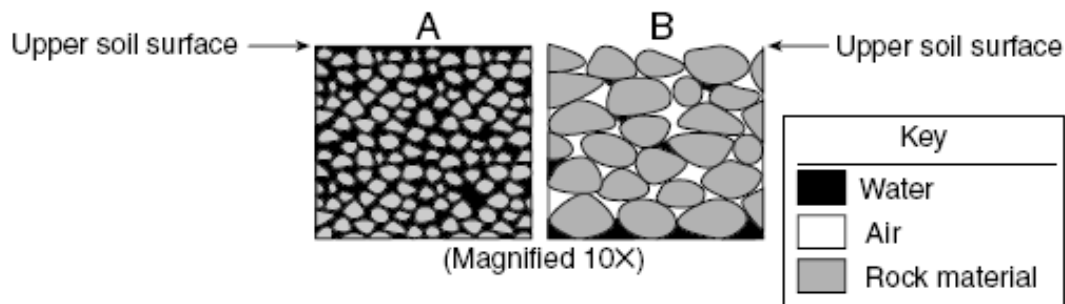
Size does NOT affect Porosity when the particles are sorted:



Factors that Effect 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.

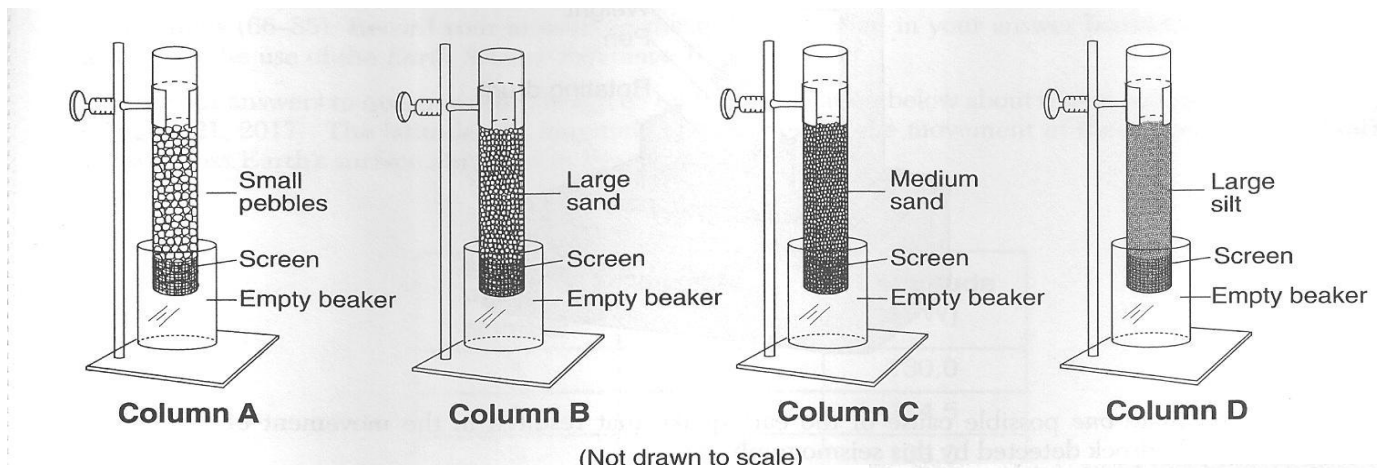


Which statement best explains the observed change in the water content of the soil samples?

- (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

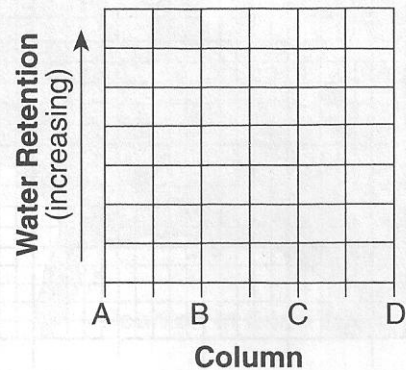
1. A soil sample with a large amount of space between the particles will have a:
- (1) low permeability rate
 - (2) low infiltration rate
 - (3) high porosity
 - (4) high capillarity



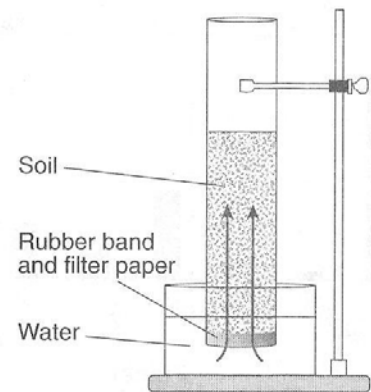
2. Which column above contains particles with a diameter of 0.4 cm?

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.

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.



Data Table

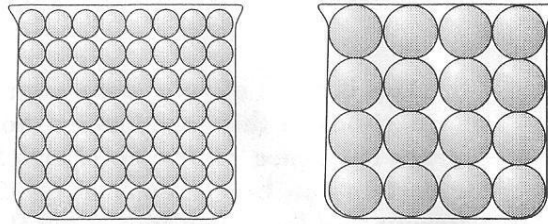
Average Soil Particle Diameter (cm)	Height of Water in Column (cm)
0.006	30.0
0.2	8.0
1.0	0.5

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

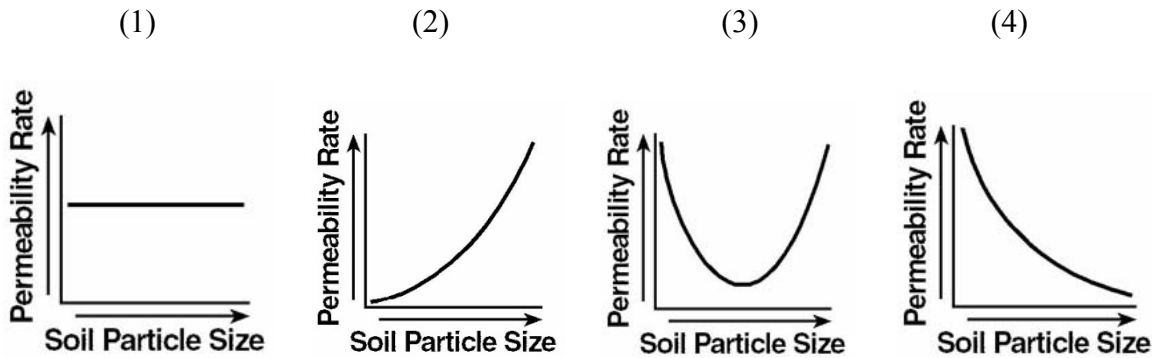
6. Refer to the diagram to the right to answer this question. Which characteristic is most likely the same for these particle-filled containers?

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



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

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



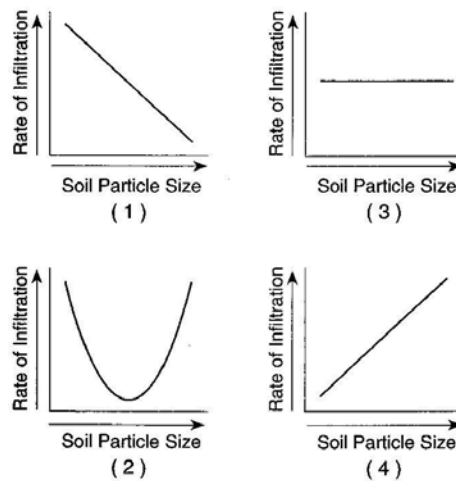
8. Which soil conditions normally result in the greatest amount of runoff?

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

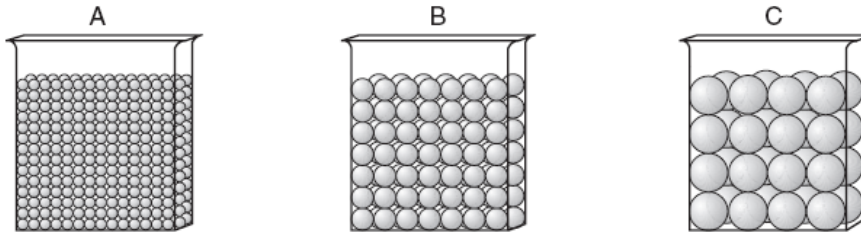
9. A soil sample with a large amount of space between the particles will have a

- (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?



% 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?

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)

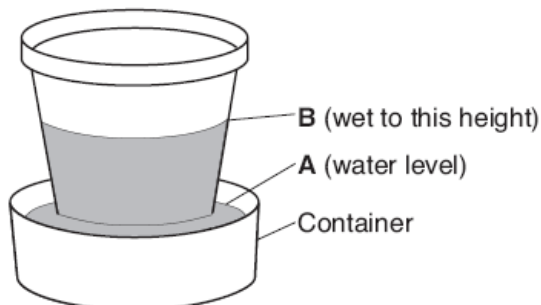
Beaker	Porosity (%)	Infiltration Time (sec)
A	40	0.4
B	40	2.8
C	40	5.2

(2)

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

(4)

% 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