Hydrological Cycle

The Hydrological Cycle

- What is the Hydrological Cycle?
- Hydrological cycle = The Water cycle
- What is precipitation, evaporation and condensation?
- Evaporation = Liquid to Gas (gains energy)
- Condensation = Gas to Liquid (loses energy) [Clouds]

Evaporation

- What affects evaporation?
- Evaporation affected by:
- Heat –> Hotter = more energy → increase.
- Surface area → Larger surface area heating up = increase.
- Humidity level → Dry air can let more evaporation occur.
- Wind → Wind replaces humid air with dryer air.

Humid Air

Wind

Dry air ------> Humid Air

Evaporation

- What is Transpiration?
- Transpiration – Water loss by plants (Tree & plant evaporation)

Evapotranspiration?

Evapotranspiration = evaporation and transpiration

What is Sublimation?

Sublimation = Solid → Gas (No liquid phase)

Ex. Glaciers, Dry Ice

What is the opposite of Sublimation?

Desublimation or deposition is Gas → Solid (frost on windows)

Credit: Ming kei College, Hong Kong

- **Potential Evaporation –**
- Potential evaporation is the ability to evaporate.

  ex. Deserts do not evaporate a lot due to lack of water.

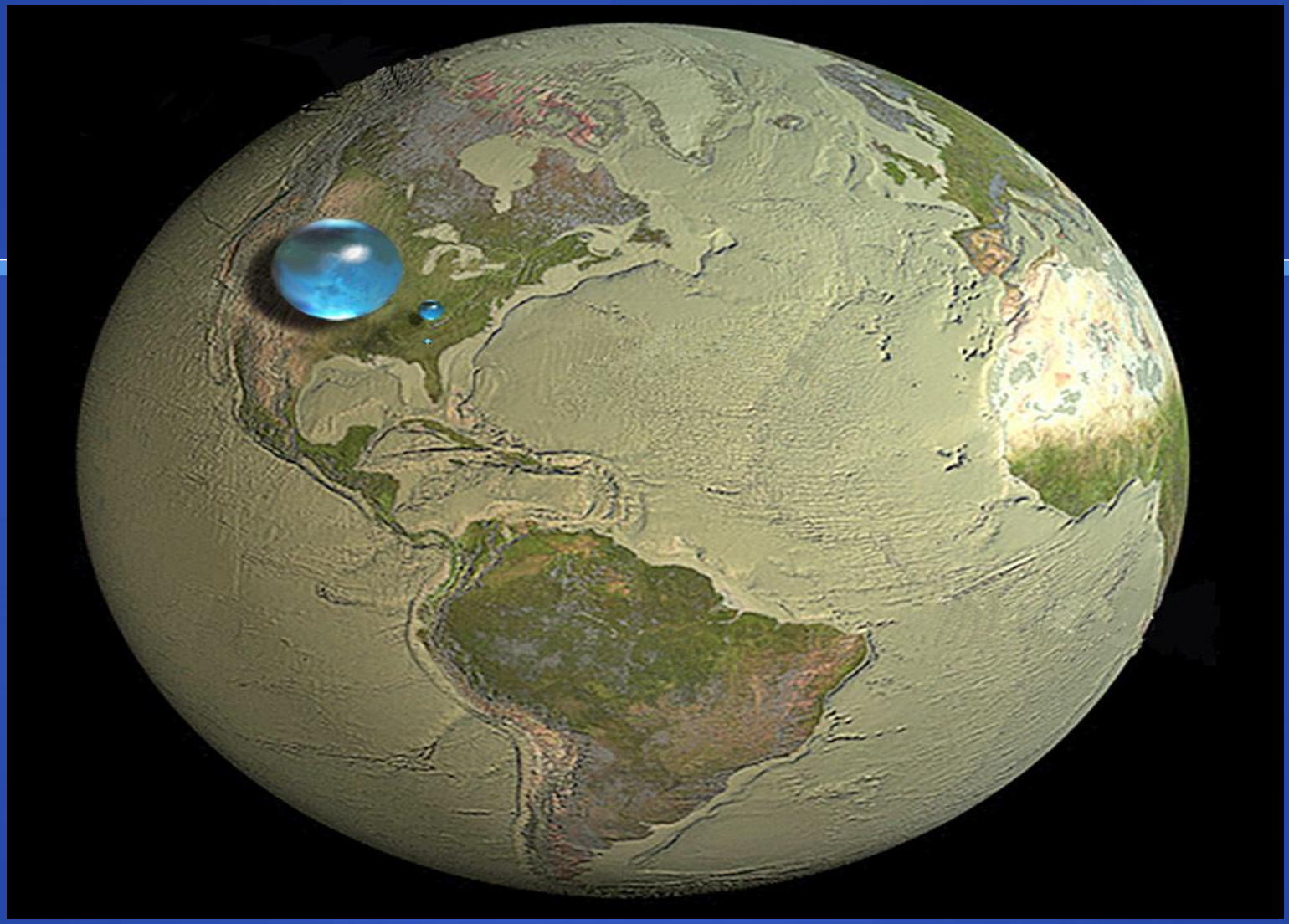
  However, their potential evaporation is very high.
- **Arid –**
- Arid = Dry

How does most of the water enter the atmosphere?

Most water enters the atmosphere by ocean evaporation.

70 % of Earth is covered by the oceans.

- Earths Water breakdown
- ~ 97% of Earths water is in the ocean.
- ~2% retained in glaciers
- ~ 0.6% ground water (drinkable)
- ~ 0.2% surface water (lakes, rivers)
- ~0.0001% is in the atmosphere
- Overall less then 1% of Eaters water is drinkable



- Big Water drop = All water on Earth
- Medium = Fresh water
- Small = Drinkable water

Evaporation Lab

- Data – Evaporation sheet
- Conclusion –
- Define evaporation.
- Explain the four things that effect evaporation.
- Draw & label phase change diagram.
- What phases gain / lose heat?

Condensation & Precipitation

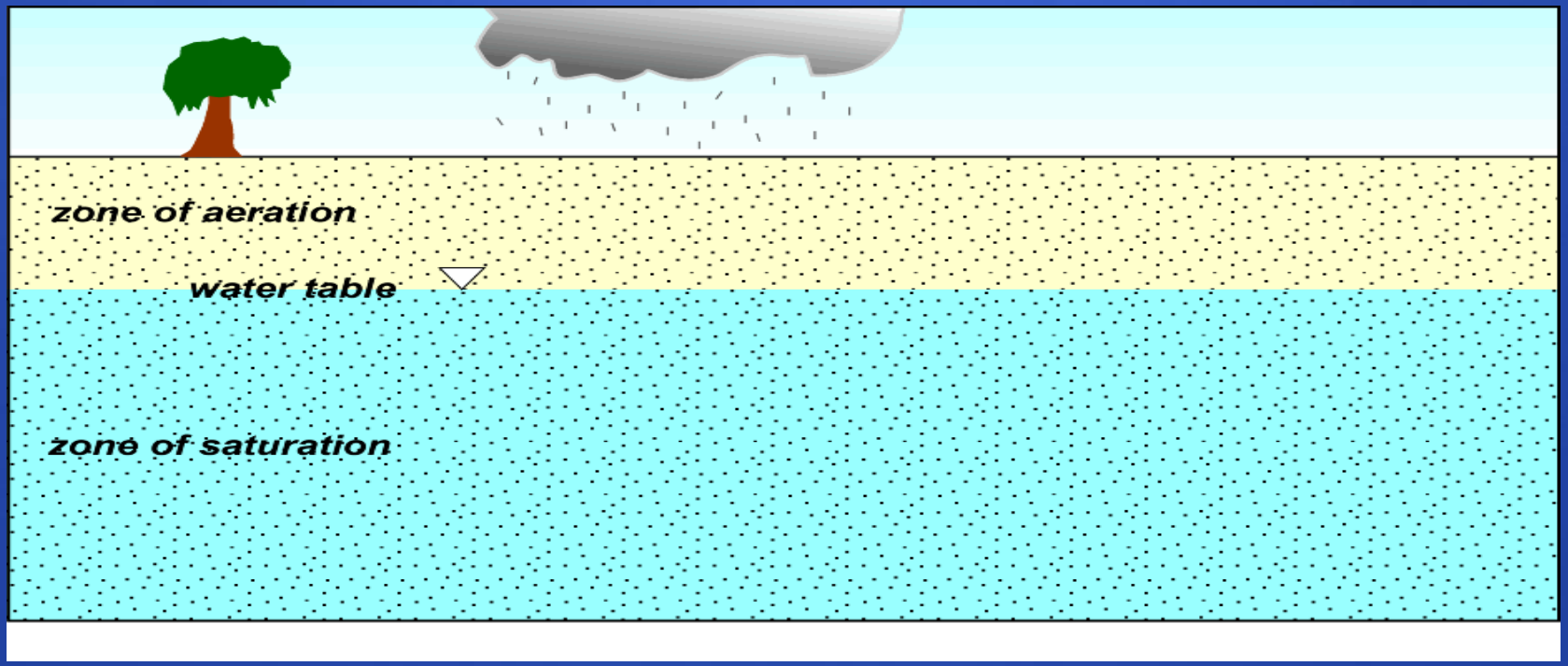
- Condensation?
- Review from last unit.
- Condensation:
- At D.P. water vapor → Liquid
- or Gas → Solid (desublimation).
- Precipitation
- Precipitation
- When the liquid or solid is too heavy it falls.

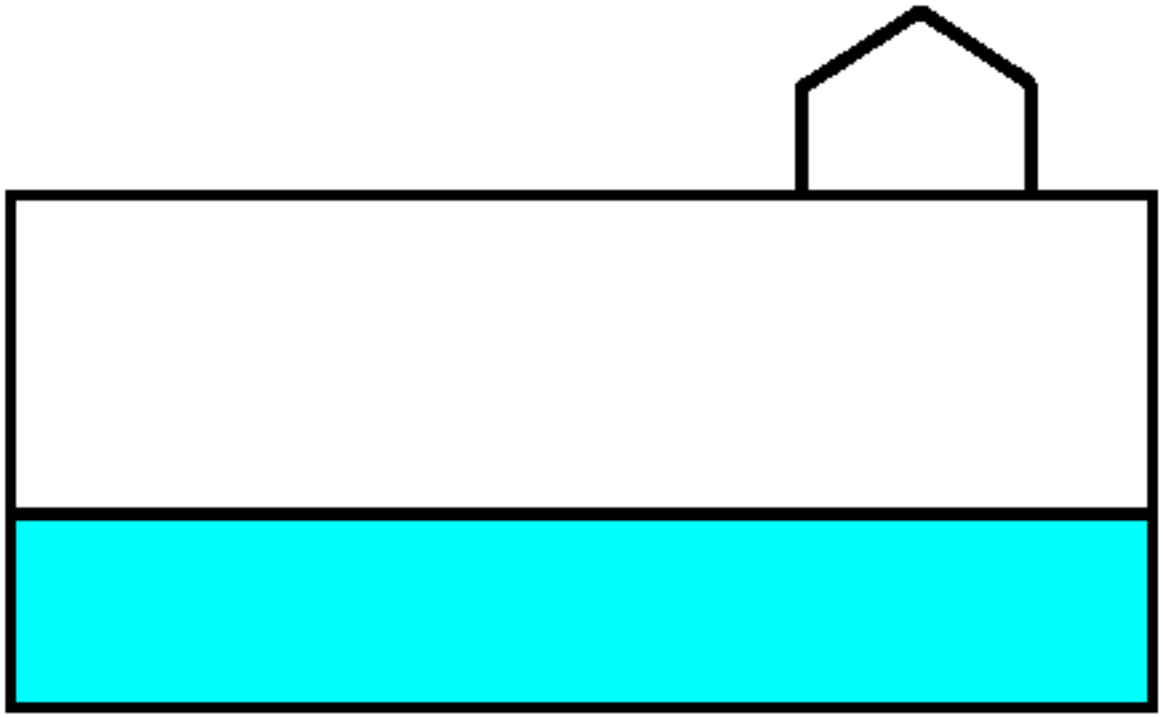
Precipitation

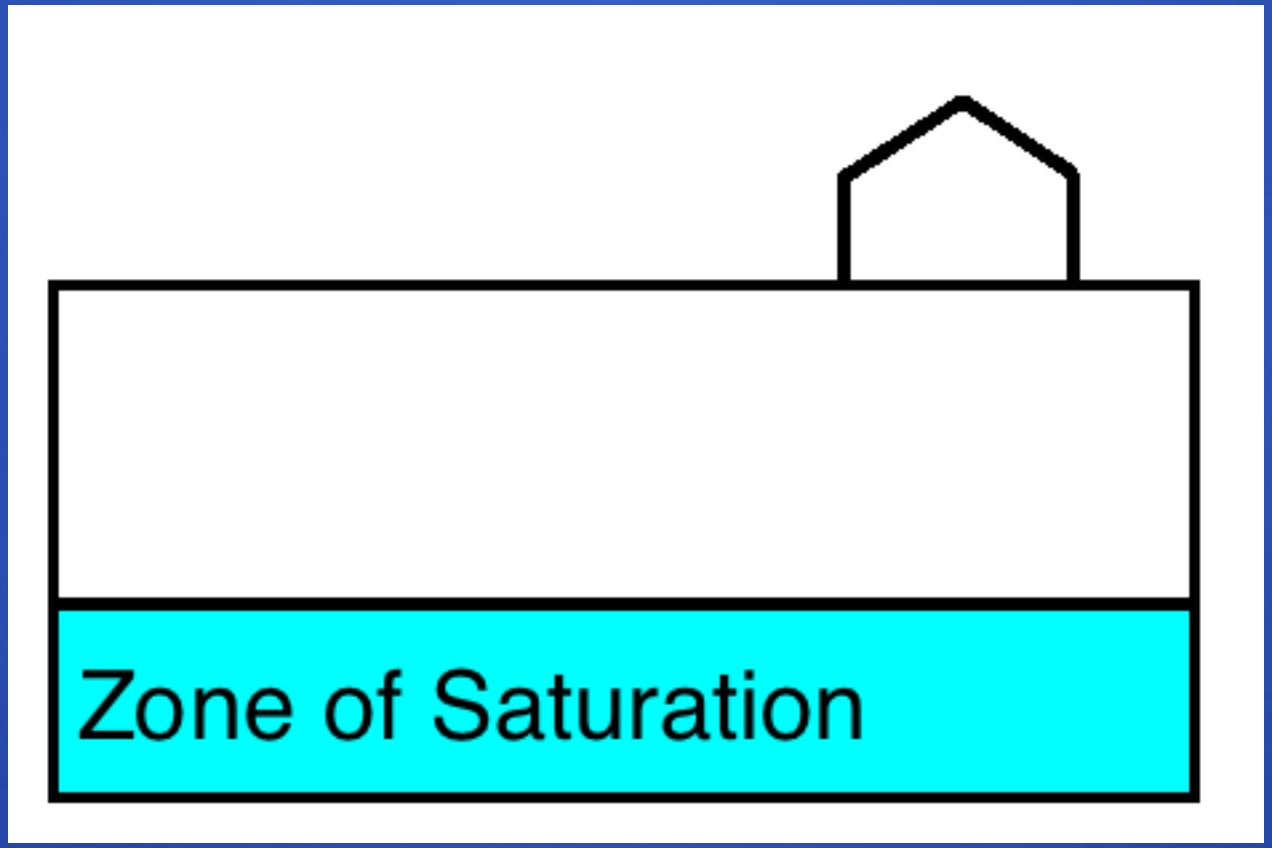
- What can happen to precipitation?
- Precipitation outcomes:
- 1) Infiltration –
- 2) Runoff –
- 3) Retention –
- 4) Evaporate -

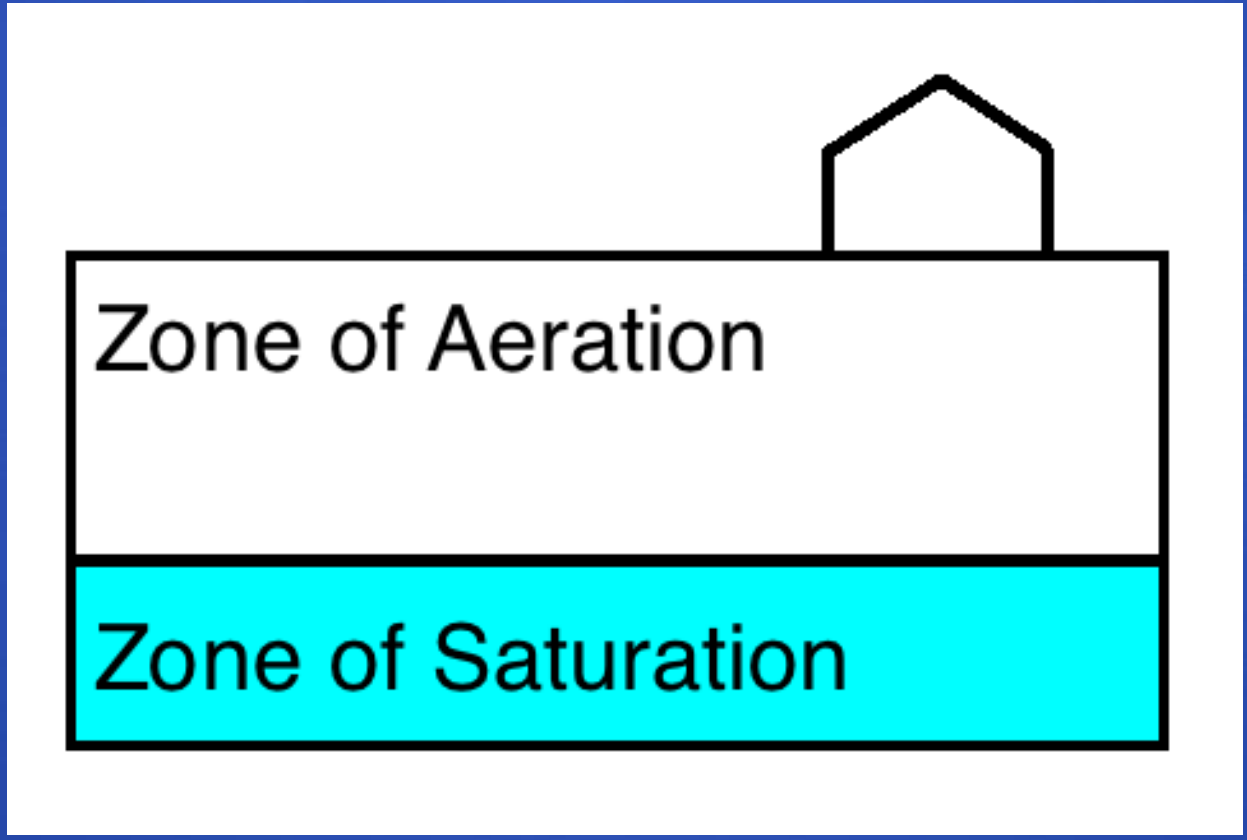
Infiltration

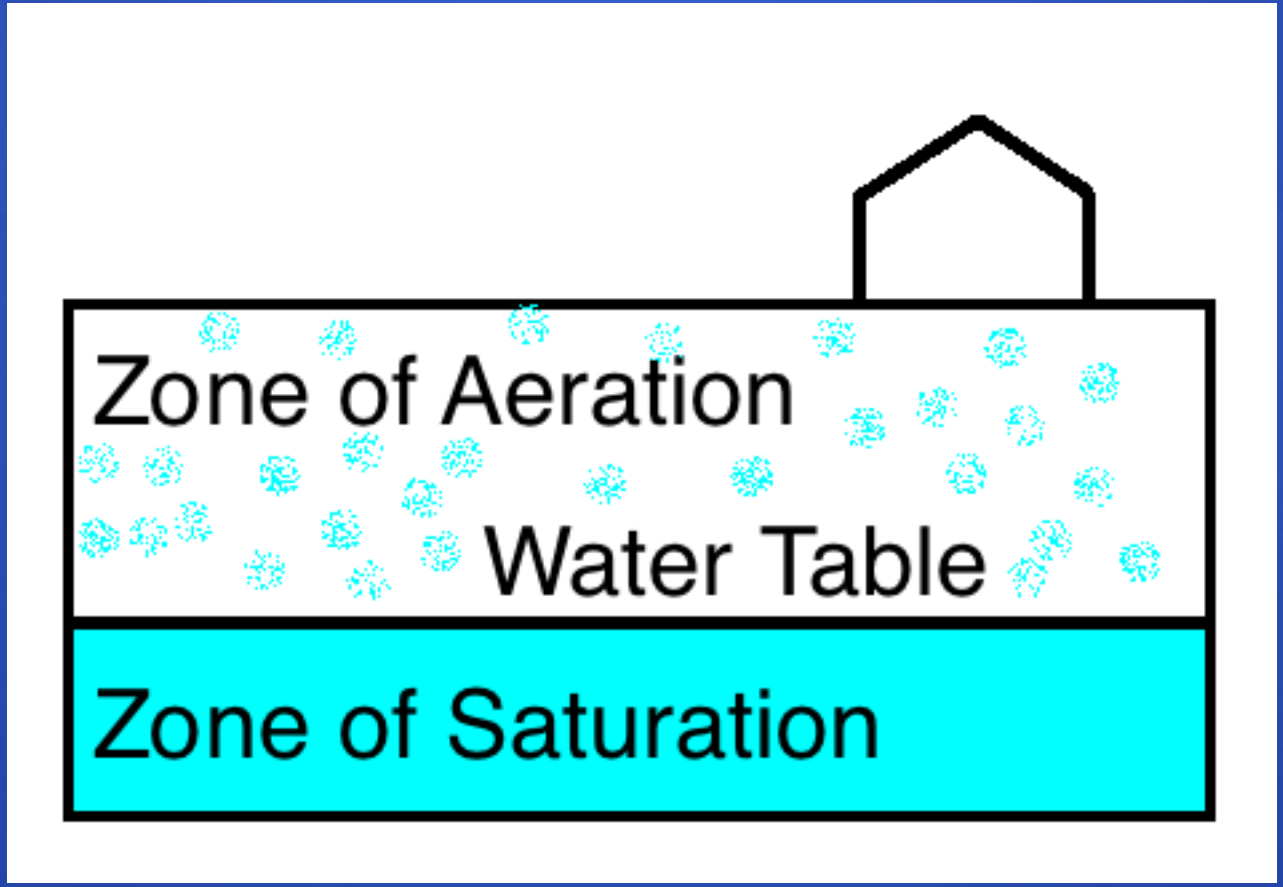
- Infiltration?
- Infiltration – When water enters the ground (filters in)
- Groundwater = subsurface water.






Zone of Saturation


Zone of Aeration
Zone of Saturation


Zone of Aeration
Water Table
Zone of Saturation

- Groundwater levels:
- Zone of Aeration?
- Zone of Aeration – Top, Unsaturated (not full, may still contain some H_2O)

  Has some air (airation)

Zone of Saturation?

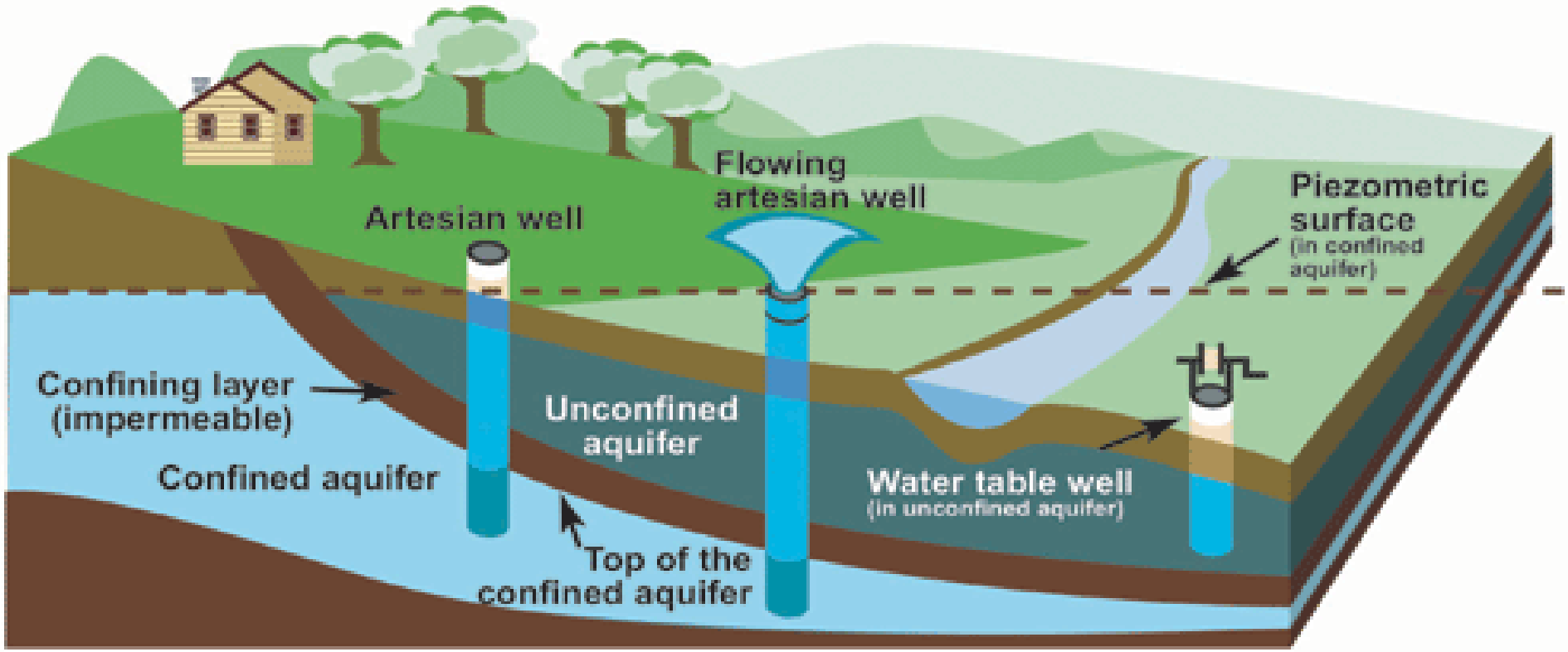
Zone of Saturation – Lower, Saturated (full)

Water table?

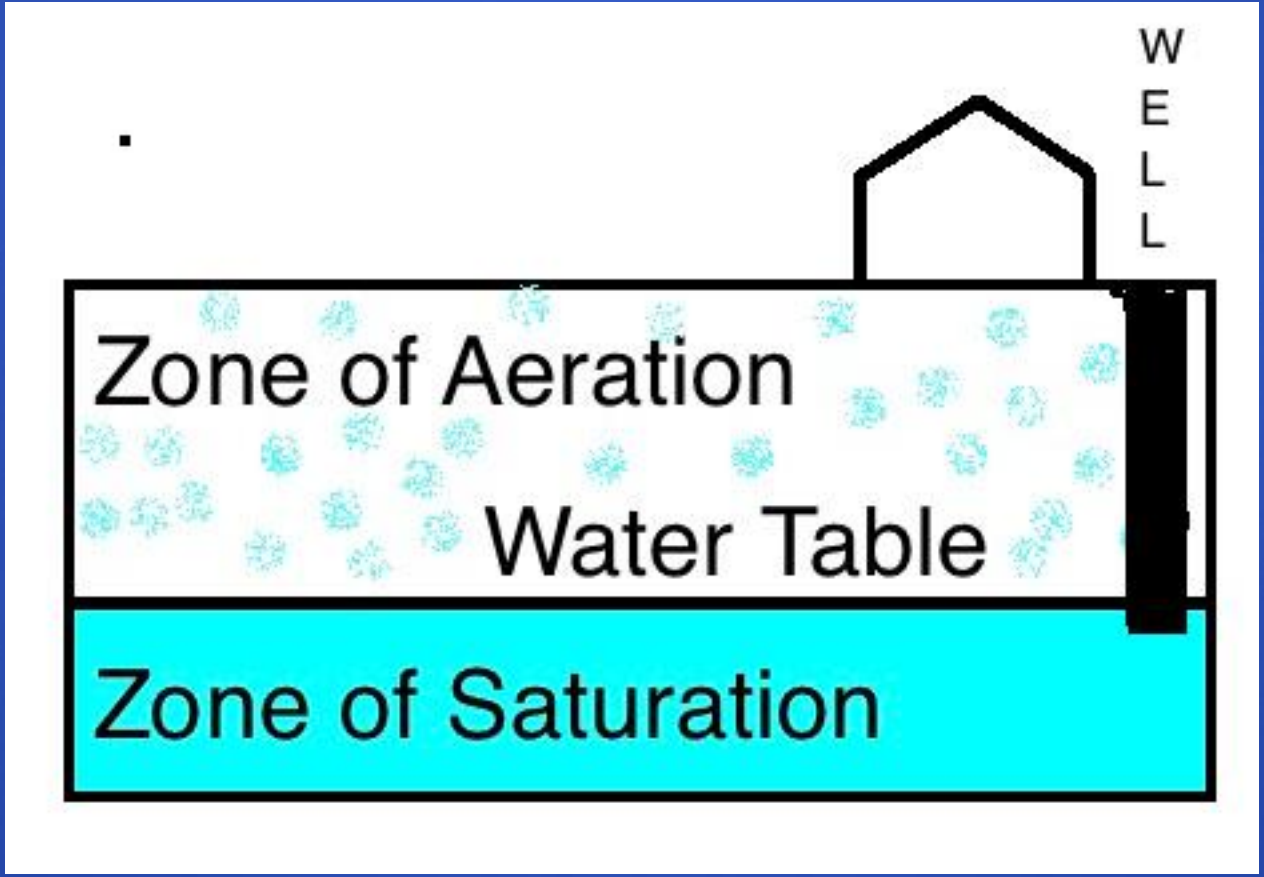
Water table – interface (boundary) between Aeration / Saturation

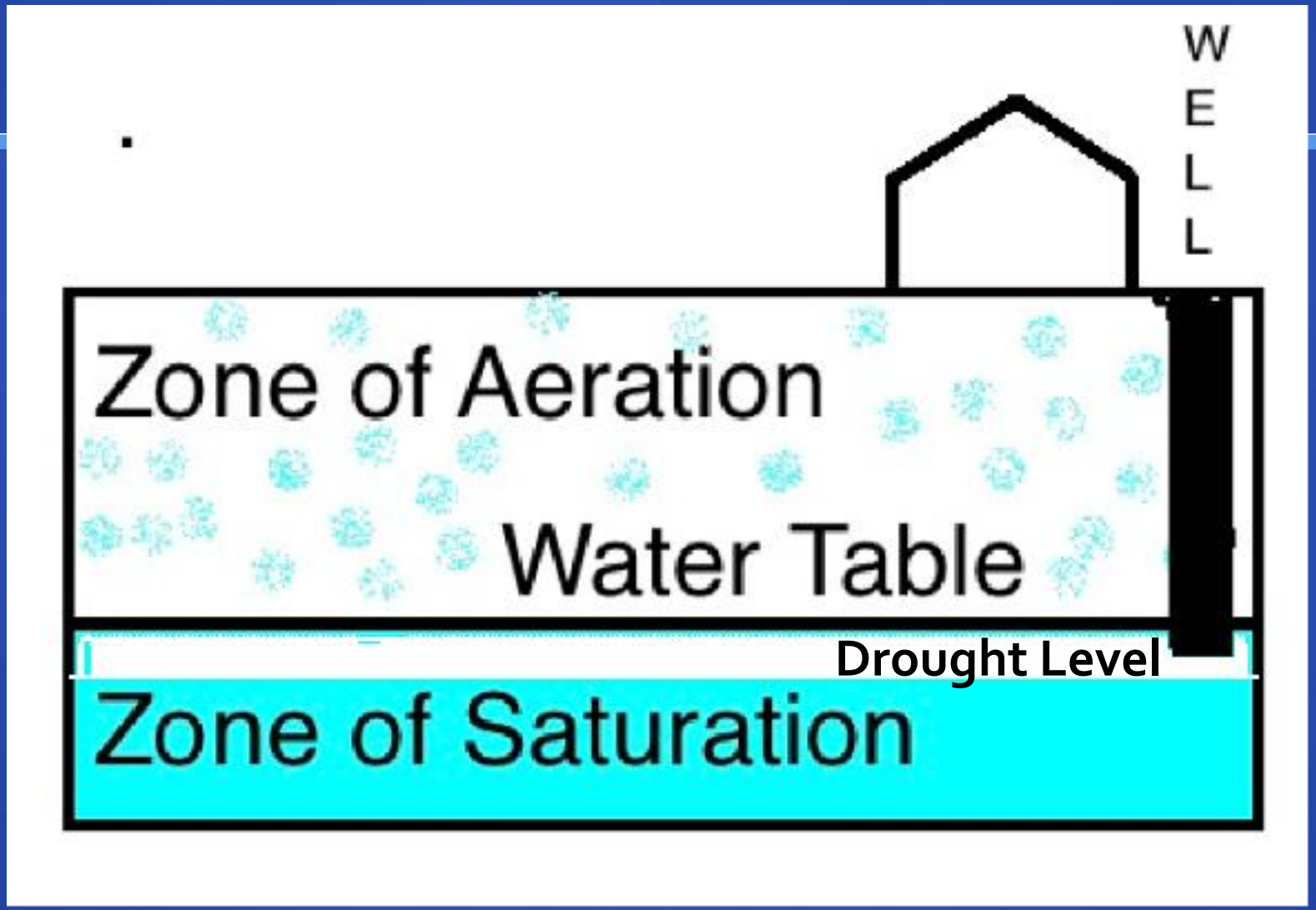
water table raises and falls depending on saturation levels

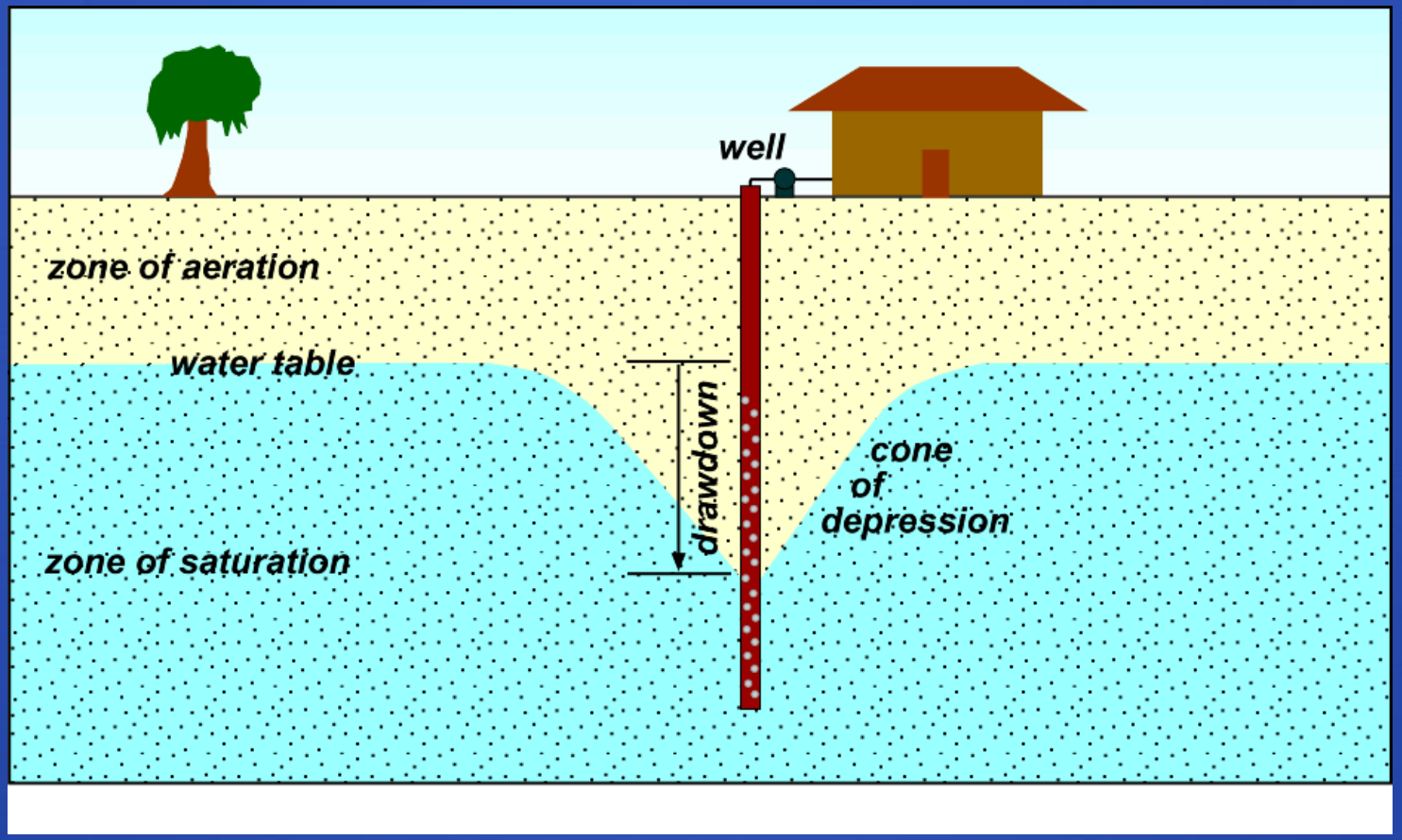
Aquifers and wells



- Aquifer?
- Aquifer – Underground area where water can flow freely.
- (Wells are dug into these)
- Spring?
- Spring – Where groundwater reaches the surface
- Artesian Well?
- Artesian Well – Spring under pressure , H_2O forced above aquifer. (fountains, drinking water)
- geyser – Spring shot up due to heat. (like a tea kettle)


WELL
Zone of Aeration
Water Table
Zone of Saturation


WELL
Zone of Aeration
Water Table
Drought Level
Zone of Saturation


well
zone of aeration
water table
drawdown
cone
of
depression
zone of saturation

- What to take into account when drilling a well.
- Drilling a well:
- Place below drought shortage levels
- Remember cone of depression (leave room between wells)

- Impermeable Rock?
- Impermeable rock does not let water flow through.
- Permeable Rock?
- Permeable rock lets water flow through.

  (Permitted through)

- What can water do when underground?
- Cavern (Cave) – Underground opening.

  ex. Water wearing away lime stone

- Runoff –
- Runoff is when water can not infiltrate.
- What happens?
- Water runs over the surface and can?
- - infiltrate later
- - join a river, stream etc…
- - Evaporate back into the atmosphere.

  (About 2/3rds is evapotranspirated back into atm)

- **Retention?**
- Retention is when water is held back either as snow or ice. It will melt later and rejoin the water cycle. (snowmelt)
- **Best time to white water raft is in the Spring**

- What is a Water Budget?
- Water Budget – Comparing water income (precipitation)

  to outgo (evaporation).

Excess –

Excess = More Precipitation than evaporation (surplus)

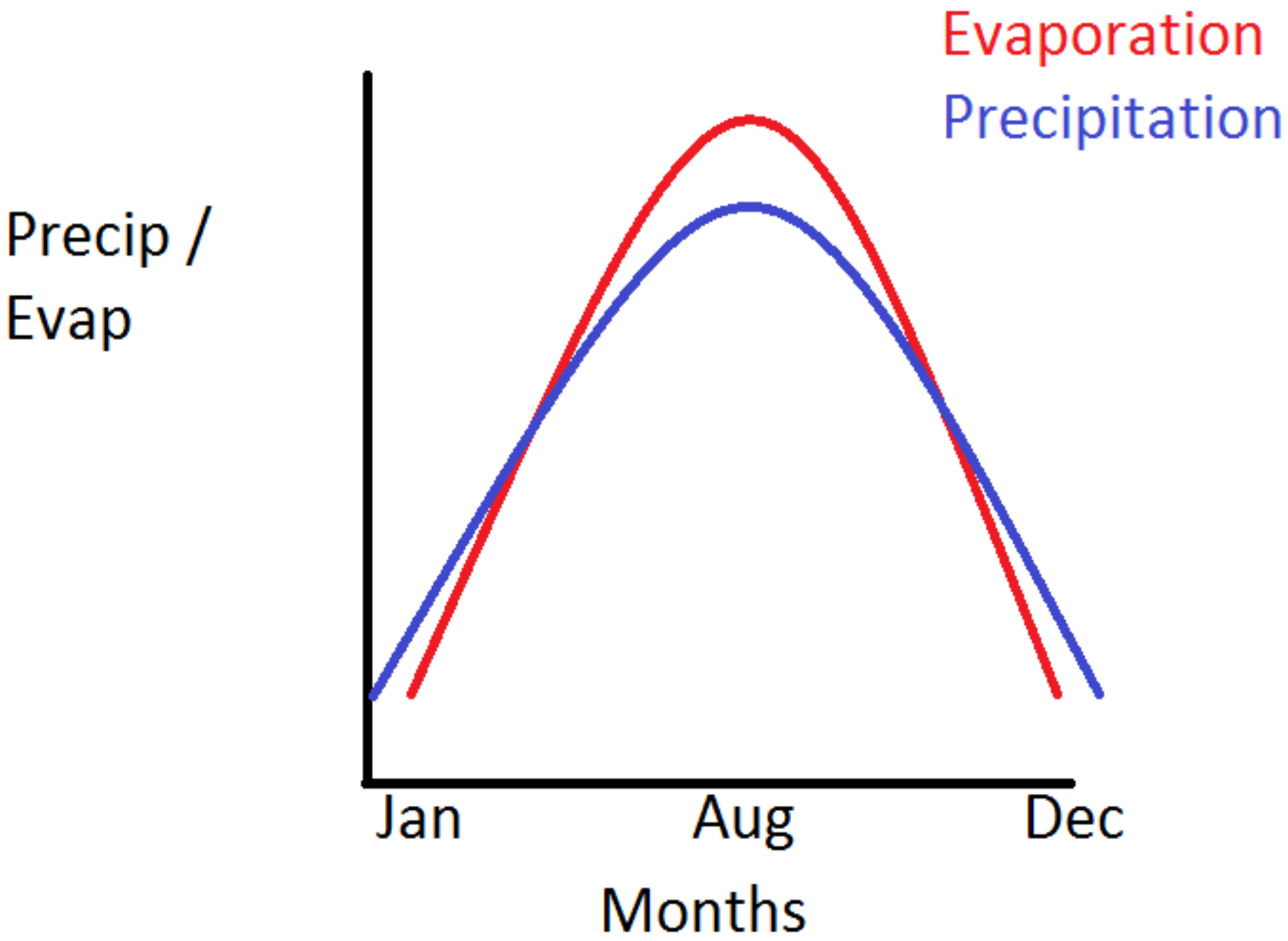
Deficit -

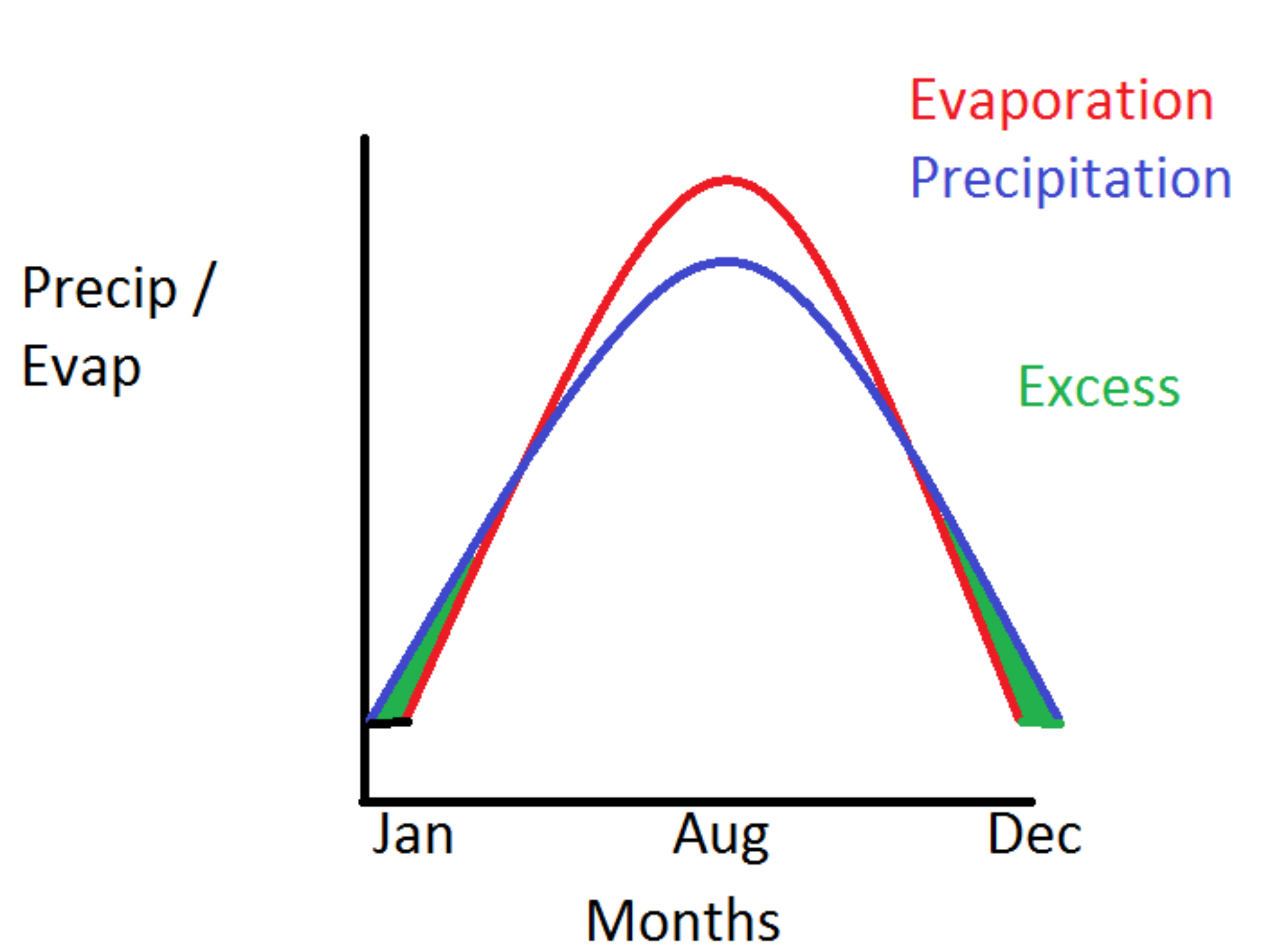
Deficit = More Evaporation than Precipitation (shortage)

Storage –

Ground water is your storage. (Your savings account)

You can have a shortage without a drought and vice versa.


Evaporation
Precipitation
Precip /
Evap
Jan
Aug
Dec
Months


Evaporation
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Excess
Jan
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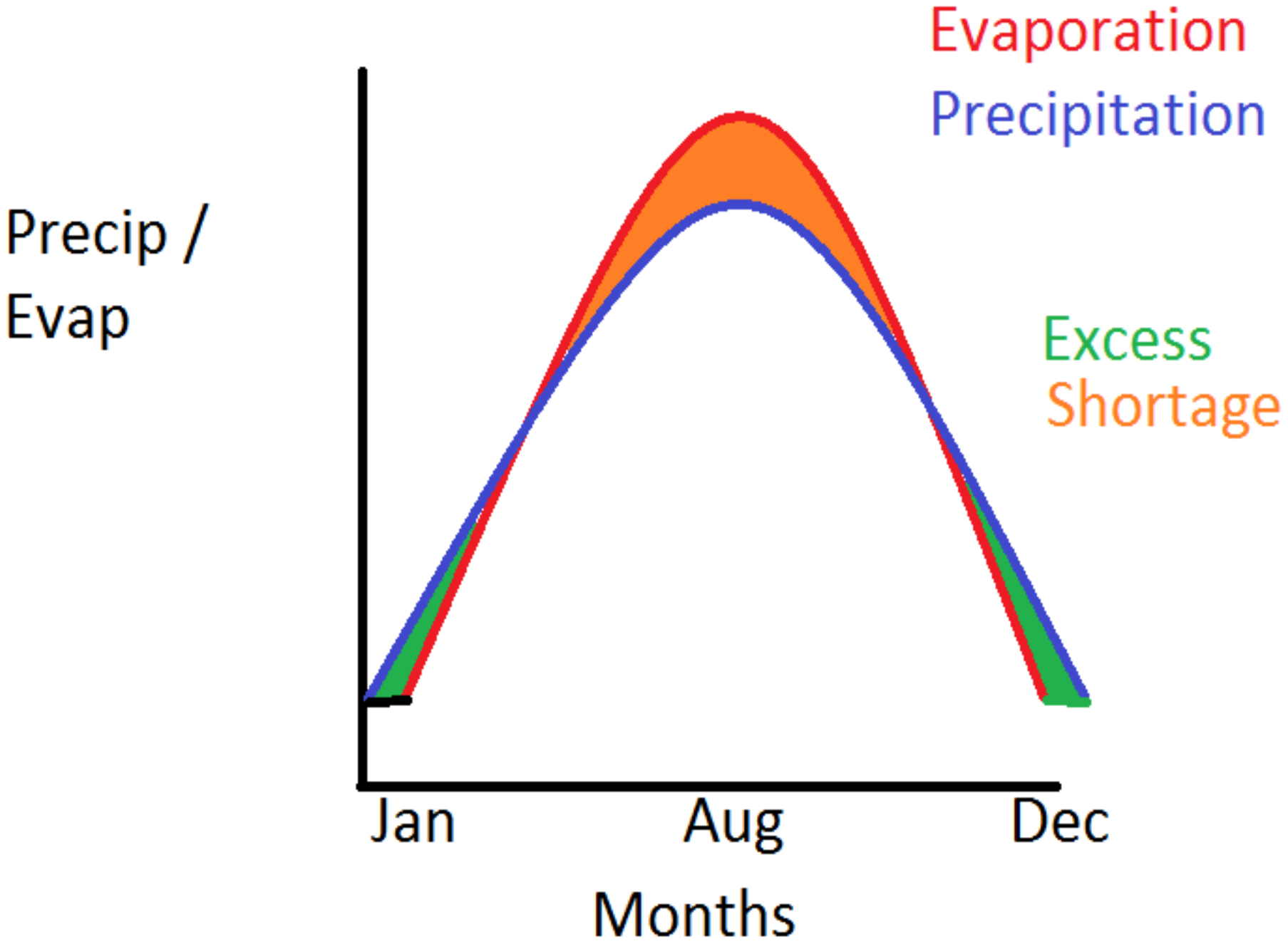
Months


Evaporation
Precipitation
Precip /
Evap
Excess
Shortage
Jan
Aug
Dec
Months

Water Budget Lab (regents)

- Data – worksheet with monthly / yearly budget

  - graph on water budget

Conclusion –

What is a water budget

Income (definition, what is income in WB)

Outgo (definition, what is outgo in WB)

Excess (definition, time of year & why)

Shortage (definition, time of year & why)

Why is knowing your water budget important.?

Porosity

What are pores?

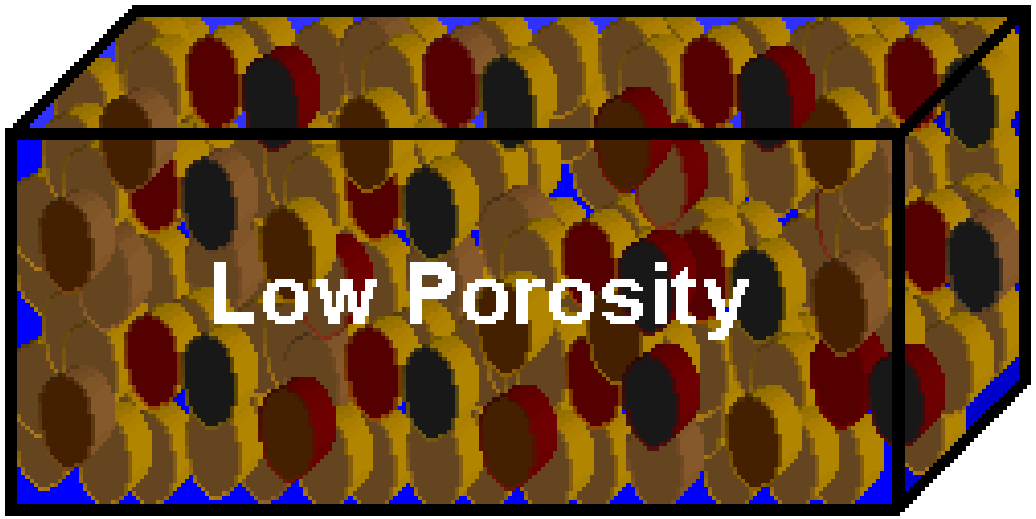
Pores are open spaces (skin pores)

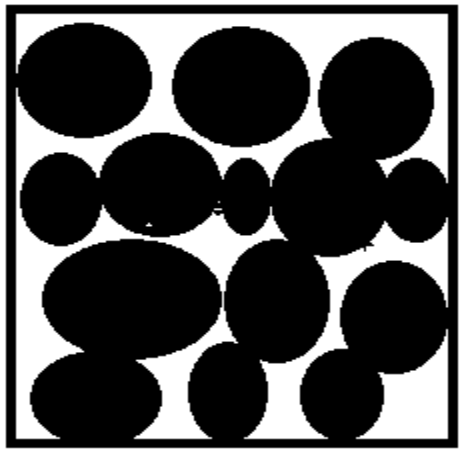
What is porosity?

Porosity = % of open space compared to total volume of material.

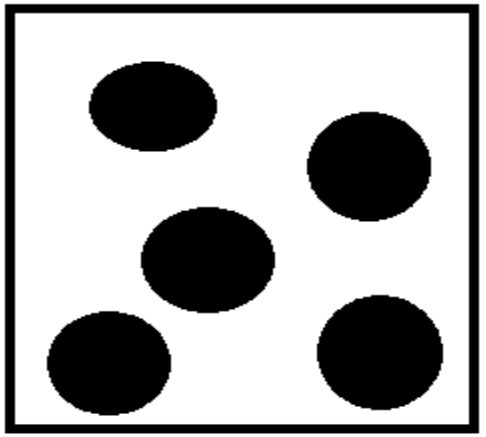
porosity → Total Pore Space / Total Volume x 100

Absorbent and yellow and porous is he.

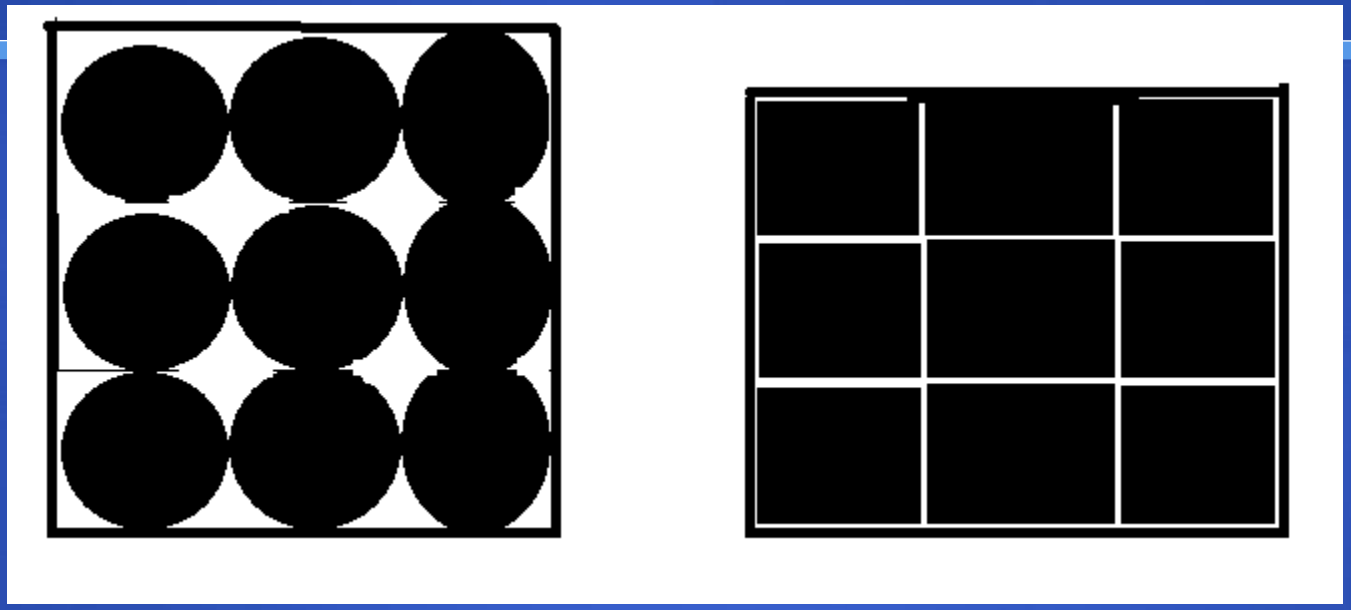




Low Porosity



High Porosity



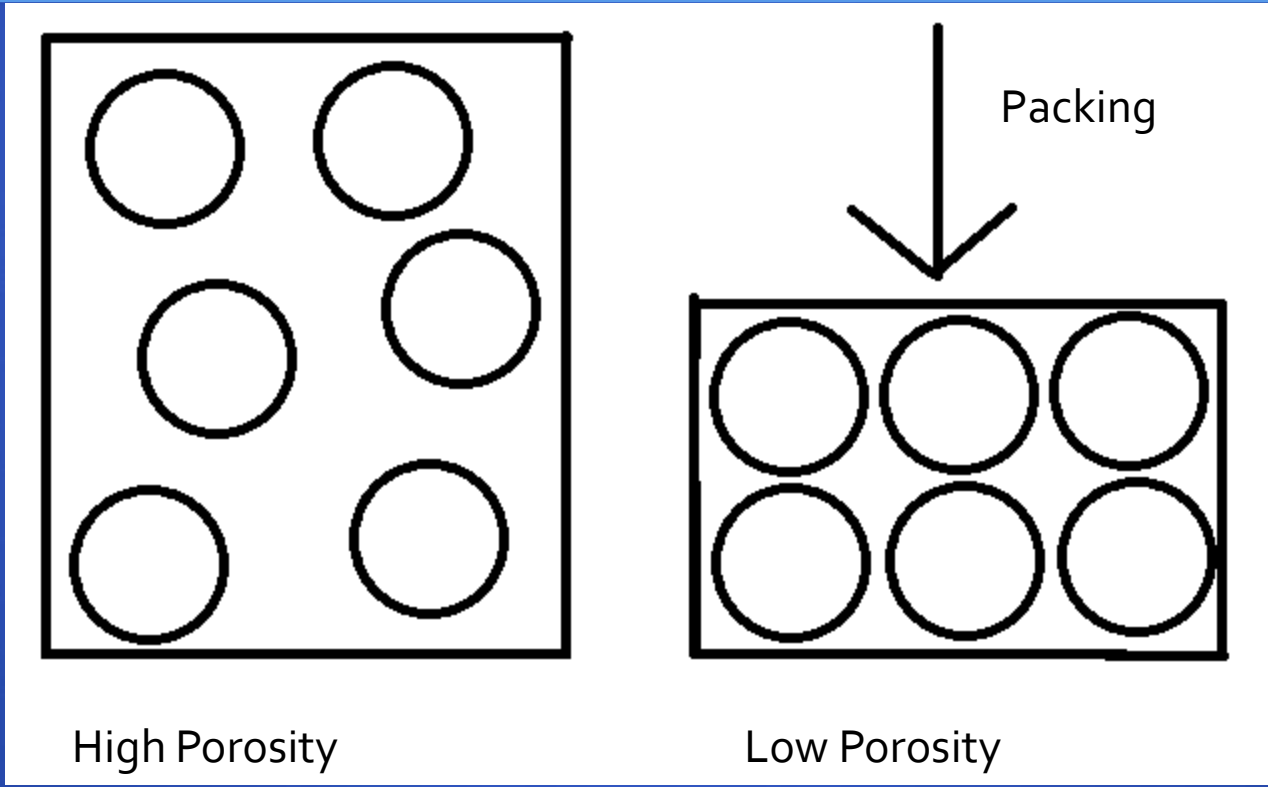
High Porosity

Low Porosity

What affects porosity?

What affects Porosity?

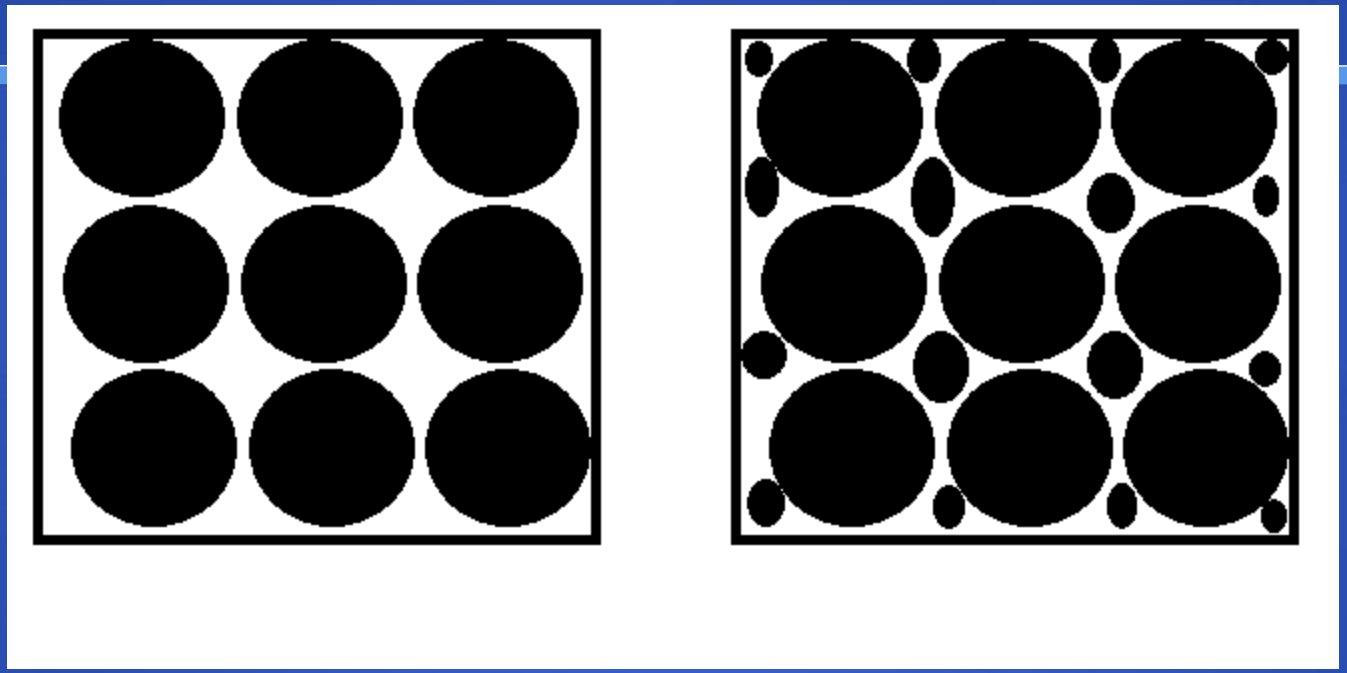
1) Shape – Rounder particles do not fit together well and have greater porosity.
   Round = Higher Porosity



2) Packing – Loosely packed particles have more space between them
Loose packing = Higher Porosity.

Sorted

Unsorted



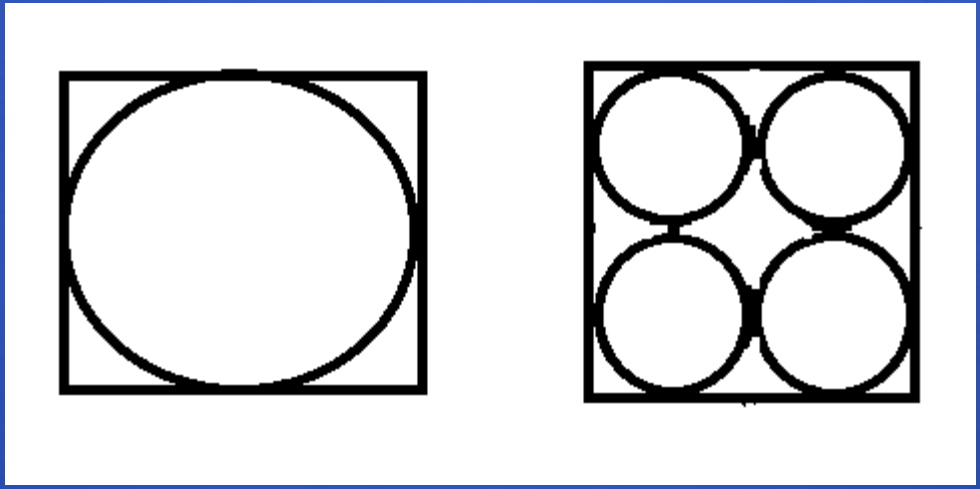
High Porosity

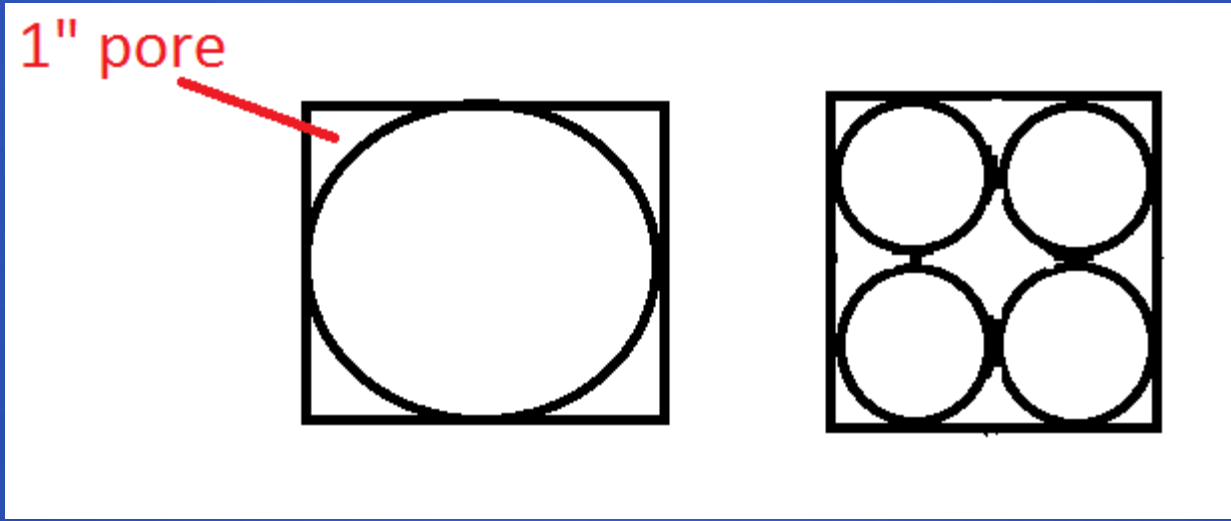
Low Porosity

3) Sorting (grouping)– Particles that are all the same size do not fit together well. When you add smaller particles in with larger particles they can fill in the gaps

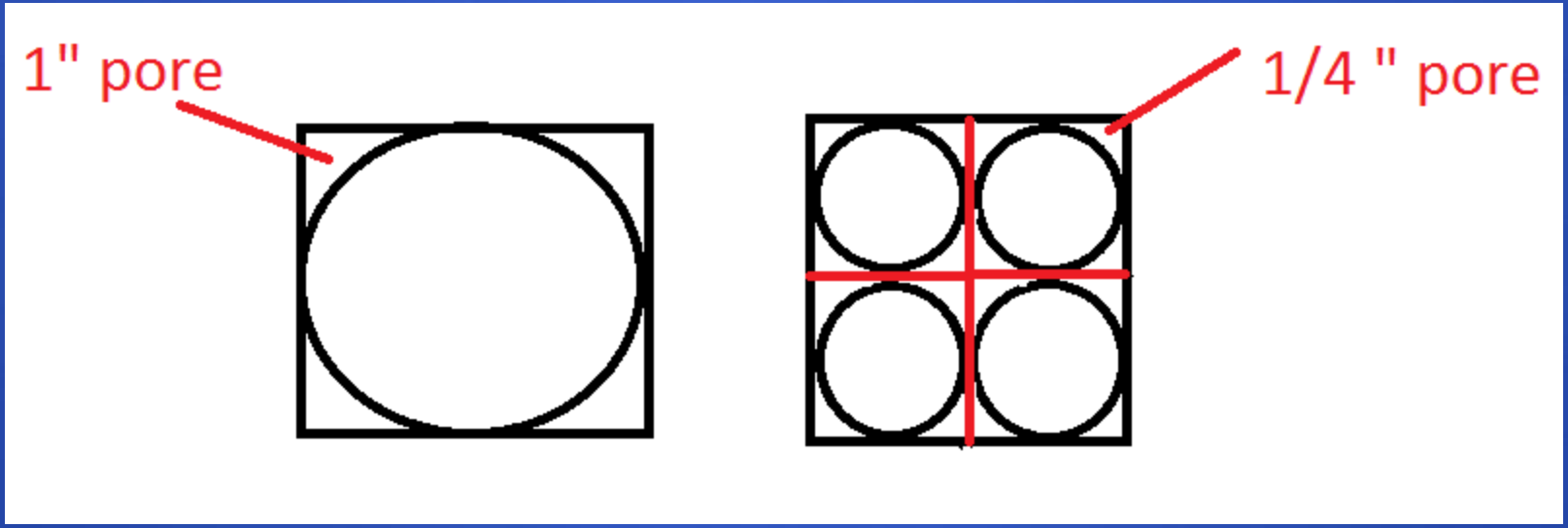
Sorted = High Porosity

- Does the size of the material affect the pore space?
- Size and Pore Space





4 pores x 1″ =
4″ pore space



4 pores x 1” = 4” pore space

16 pores x ¼” = 4” pore space

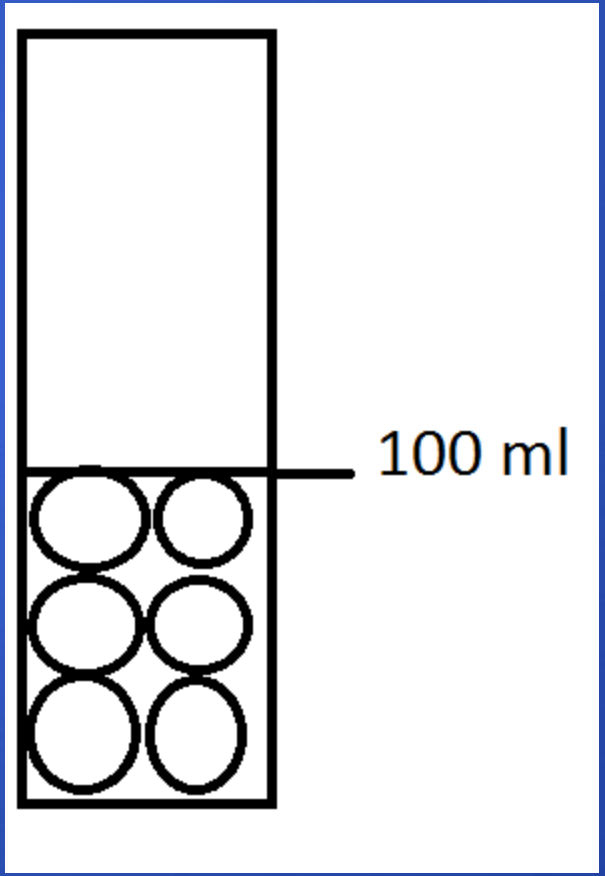
- Does size affect pore space?
- Size does not affect pore space.
- Small objects have small pores but many of them.
- Overall the porosity is the same.
- Like Density "Size does not affect pore space"

- How do you find Porosity %?
- To find % Porosity.
- 1) RECORD

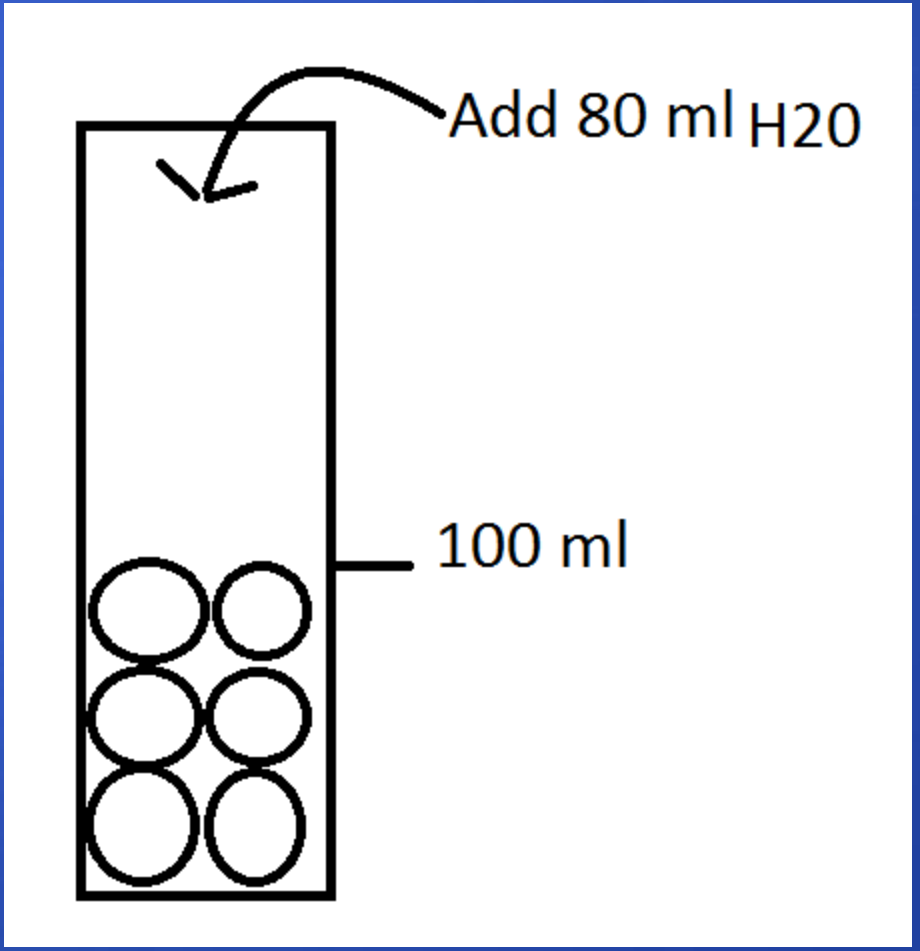
  starting substance

  amount.

  100 ml

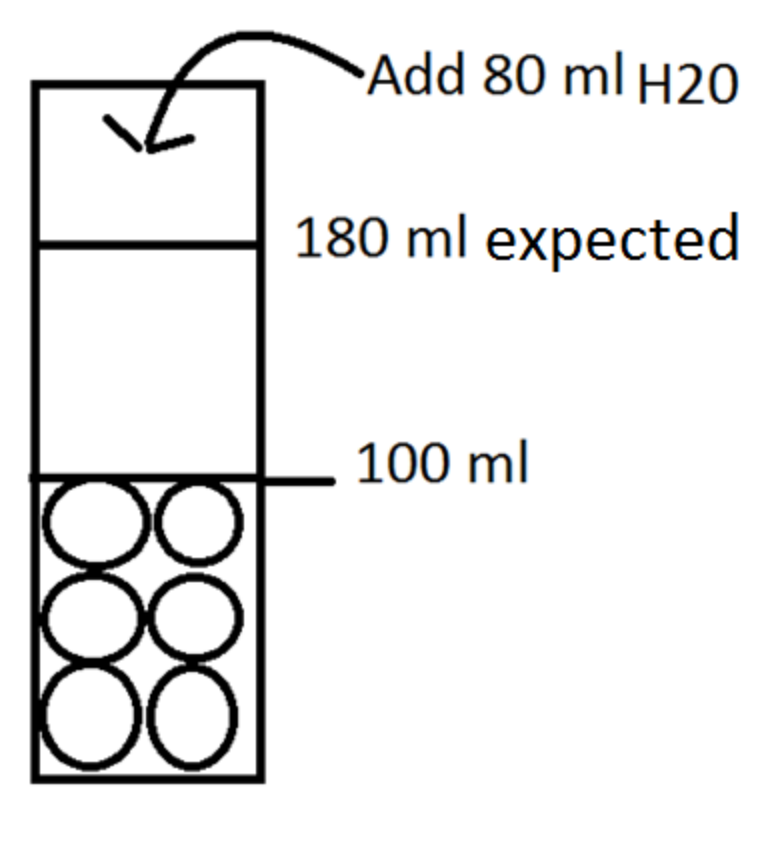


- 2) Add a set amount of H_2O



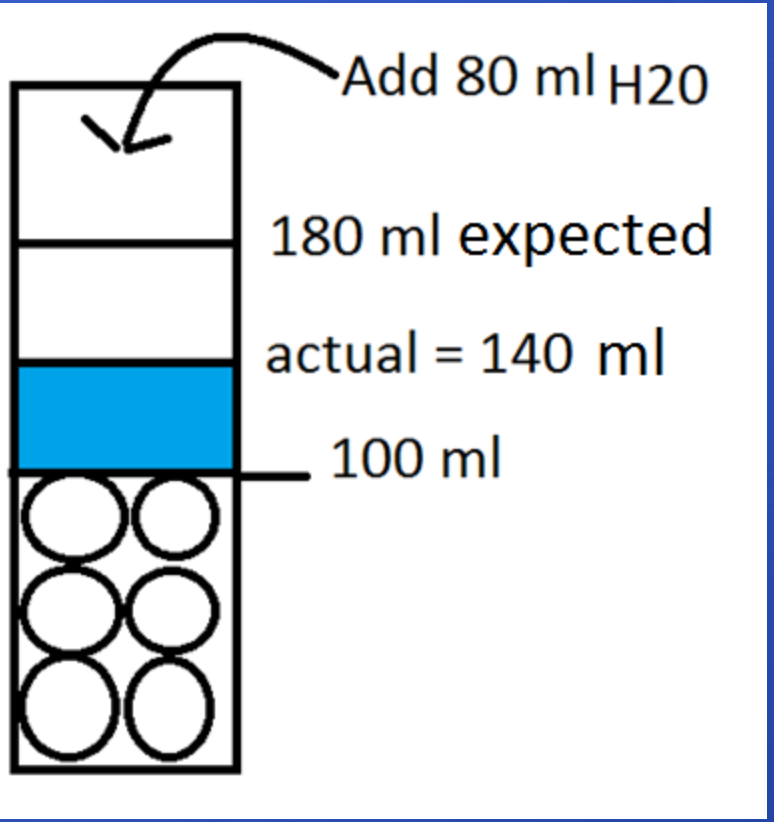
2) Figure out how High the water was Expected to go…

100 + 80 = 180

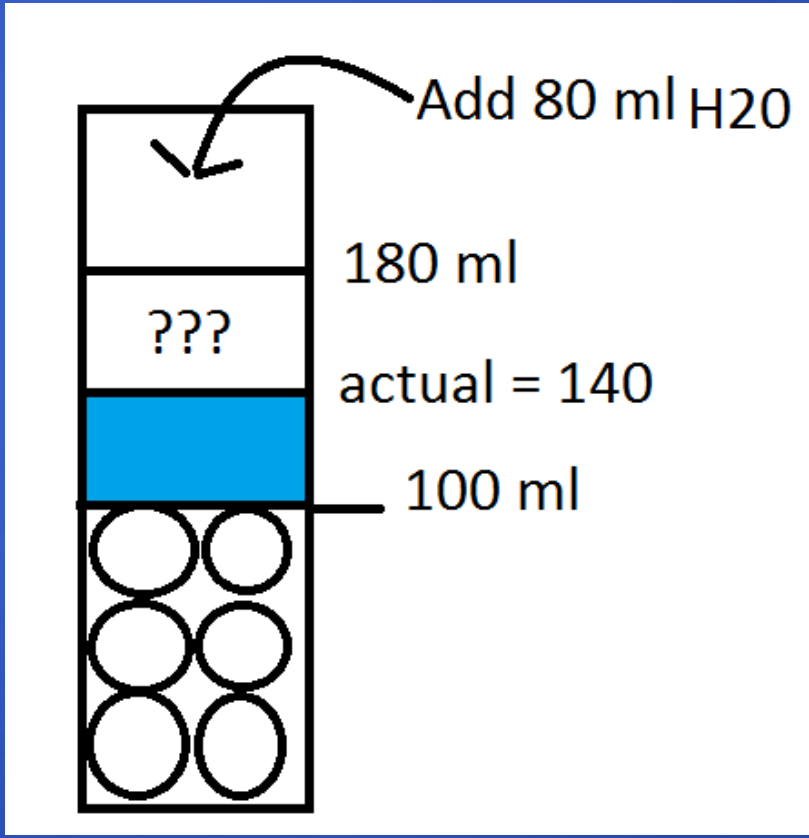


- 3) Find how high the water actually went.

actual = 140 ml

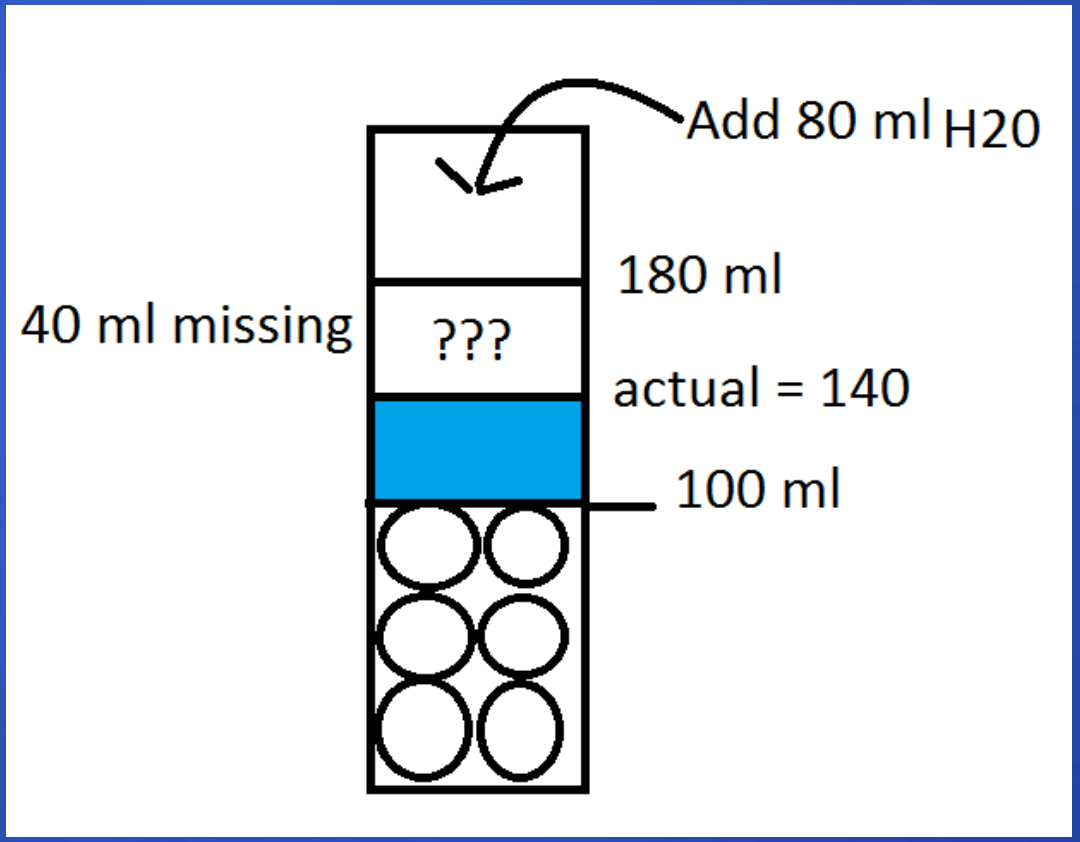


3) Find out how much water is missing.



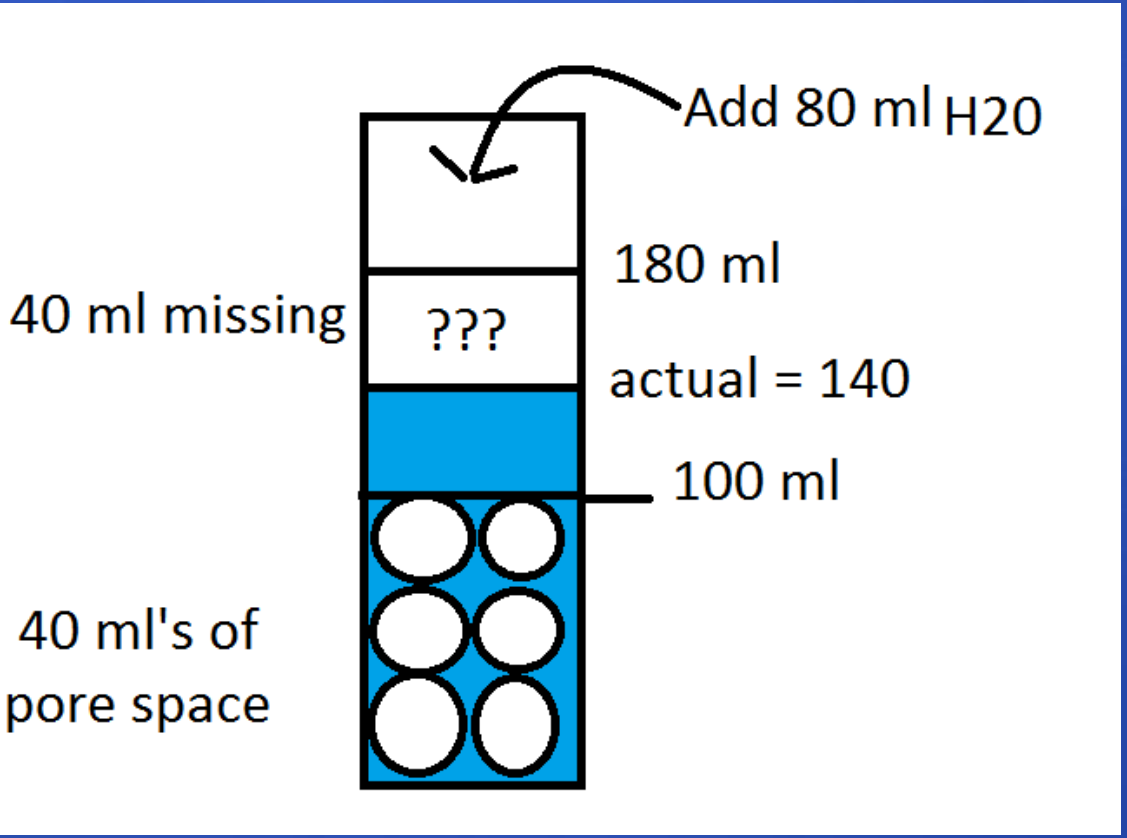
40 ml Missing

Where did that missing Water go???



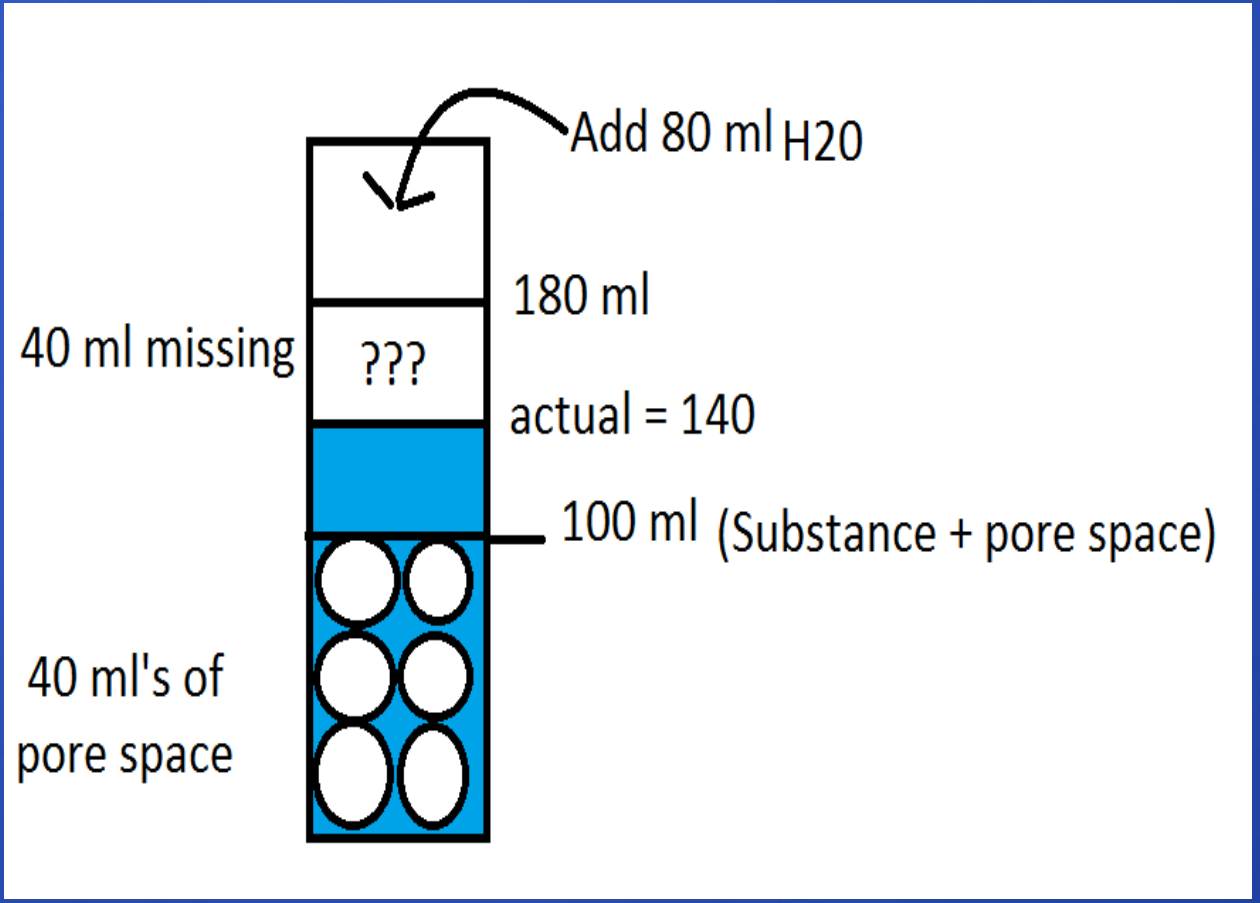
Missing water
Had gone into
The Pore space

40 ml Pores

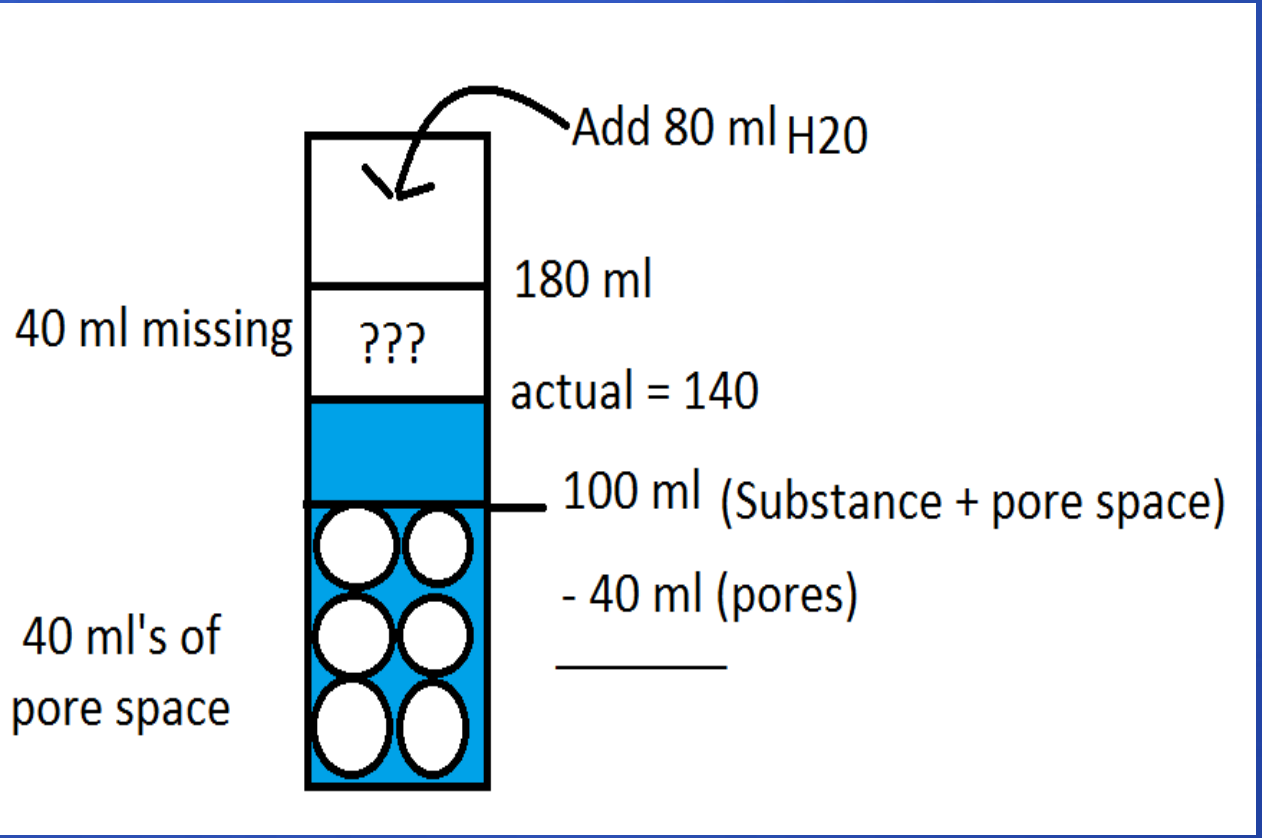


If you know how much pore space you have. How do you find out how much substance you started with?

Your original number is
Made of pores
And substance.

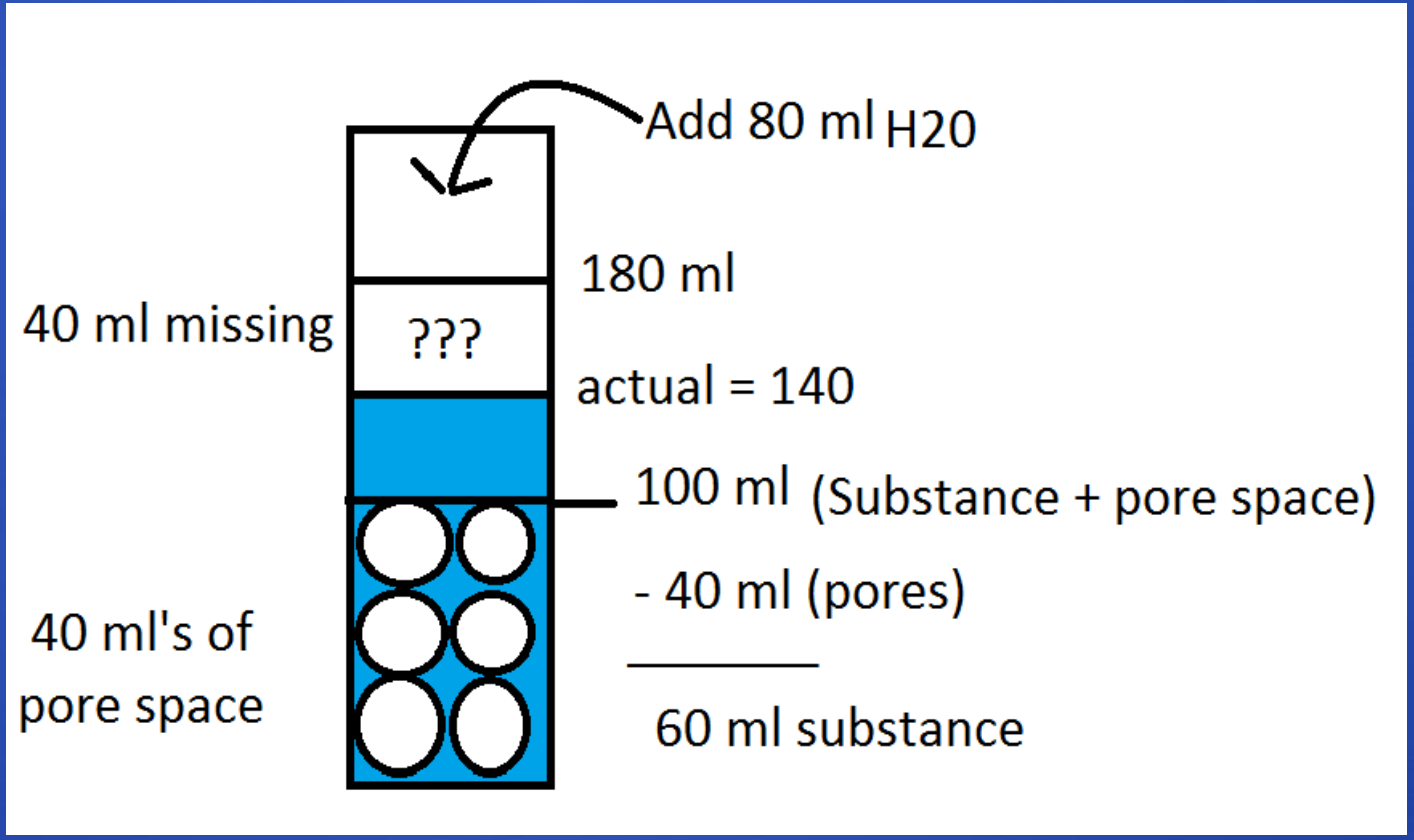


How do
You find the
Amount of
Substance.



To find
Substance amount.
Subtract
Pore amount
From original number

60 ml substance



- What do you know.
- Original = 100 ml
- Pores = 40 ml
- Substance = 60 ml

- How do you find the % pore space and substance?
- To find % Pore space… Amount of pore space

Original amount X 100

40 ml / 100 ml X 100 = 40 % pore space

How do you find % substance?

Find % Substance….. Amount of substance

Original amount X 100

60 ml / 100 ml X 100 = 60 % Substance

How can you check your work?

To check work → % pores + % substance = 100 % (or 99.?)

- Start – 130 ml, Add – 70ml H_2O, New Level 150
- Find % porosity and % substance
- Should be at 200 ml.
- It is at 150 ml
- That means 50 ml missing, so it has 50 ml pore space
- Original = 130 ml. 130 ml – 50 ml = 80 ml substance
- Porosity = 50 / 130 X 100 = 38.5 % porosity
- Substance = 80 / 130 X 100 = 61.5 % substance
- Substance 61.5 + porosity 38.5 = 100 % original ☺

- Porosity Lab

Permeability

- Permeability?
- Permeability – The ability to let a fluid pass through. (permitted)
- What affects permeability?
- Affects on permeability:
- 1) Size of pore space – Larger pores let fluid pass through quick and easy (think large hallways)
- 2) How connected the pores are.

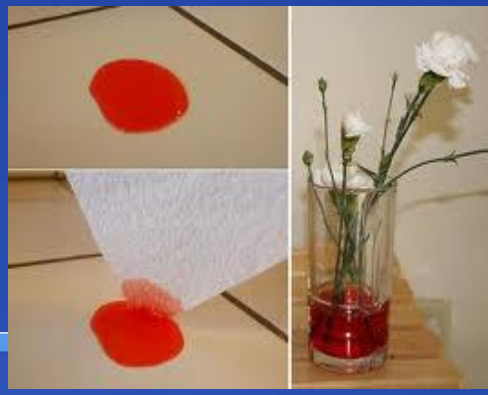
  (If hallways are blocked you cannot pass)

Materials can be porous yet impermeable if pores are not connected.

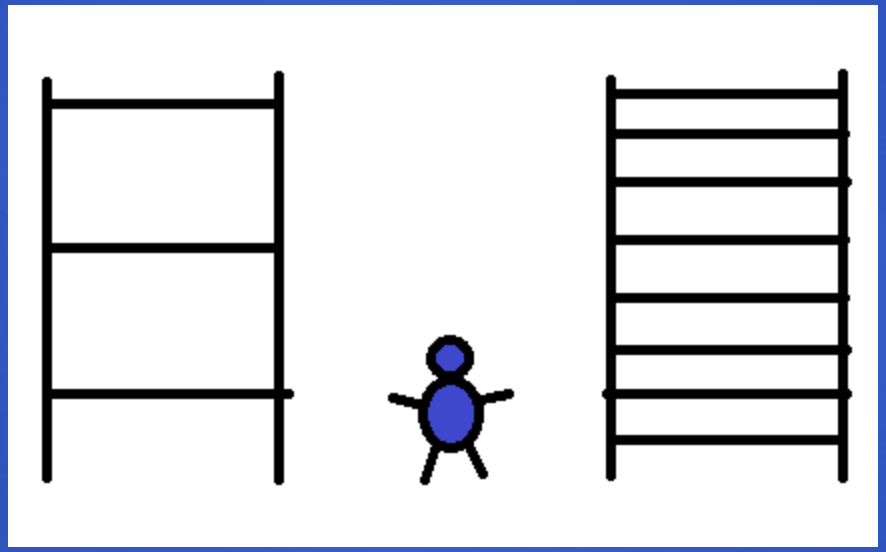
Impermeability

- Impermeable?
- Impermeable – Fluid cannot pass.
- What affects impermeability?
- Impermeability can be affected by:
- 1) Tight packing (reduces pore sizes)
- 2) Temperature (frozen H_2O in pores, pores not connected)
- 3) Land use (putting cement over land, pores not connected)

Capillary Action



- Capillary Action?
- Capillary action is the upward movement of a fluid against gravity.
- What size pores are best?
- Big pores let water pass through fast.
- Small pores slow water, until they are so small they bring water upwards (think capillaries are small)



Big pores
Hard to climb
Fast to Fall

Little pores
Easy to climb
Slow to fall

- Factors that affect infiltration vs. runoff
- 1) Permeability (can it infiltrate)
- 2) Porosity (can it hold water)
- 3) Degree of Saturation (if ground is full, it can't infiltrate)
- 4) Slope (water runs fast over steep land and can't infiltrate)
- 5) Vegetation (plants slow H_2O, break up soil, help infiltration)
- 6) Precipitation rate vs. infiltration rate

- Additional terms.
- Stream Discharge?
- Stream discharge is the amount of water flowing past a certain point in a given amount of time ex 5 gal/sec
- Flooding?
- A flood is when a stream overflows its normal channel typically due to more precipitation than infiltration.

Porosity Lab

- Data – Data Chart on porosity, Question (on back)
- Conclusion –
- What is Porosity? (What 3 things affect it)

  (What doesn't, explain)
- What is Permeability? (What 2 things affects it)
- What is infiltration? (What affects it)
- What is capillary action (what particle size is best, why)