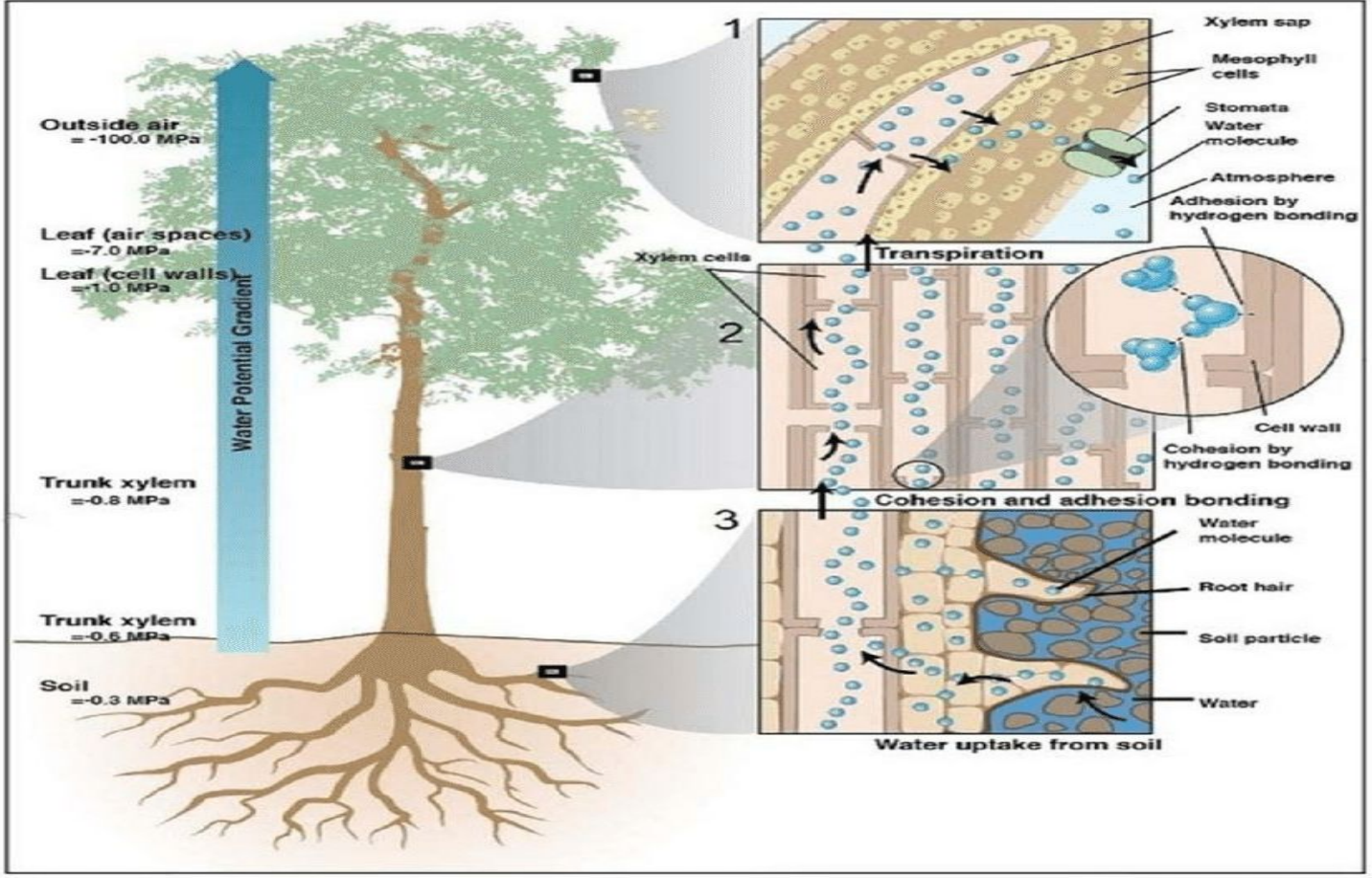




# Bhagalpur National College, Bhagalpur

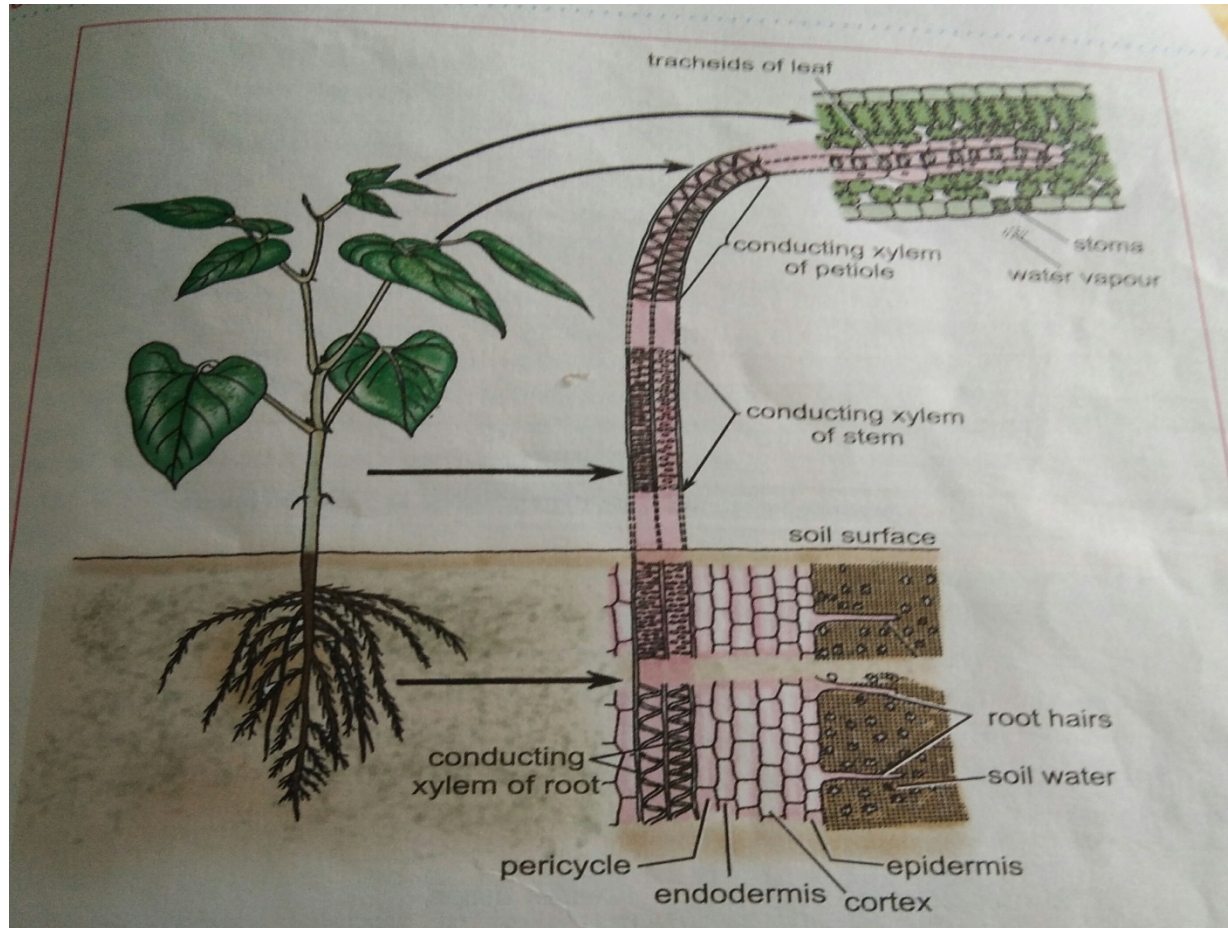
( A Constituent unit of Tilka Manjhi Bhagalpur University,  
Bhagalpur )

## PPT Presentation for B.Sc. II- Ascent of Water



Presented by - Dr. Amit  
Kishore Singh  
Department of Botany  
B.N. College, Bhagalpur

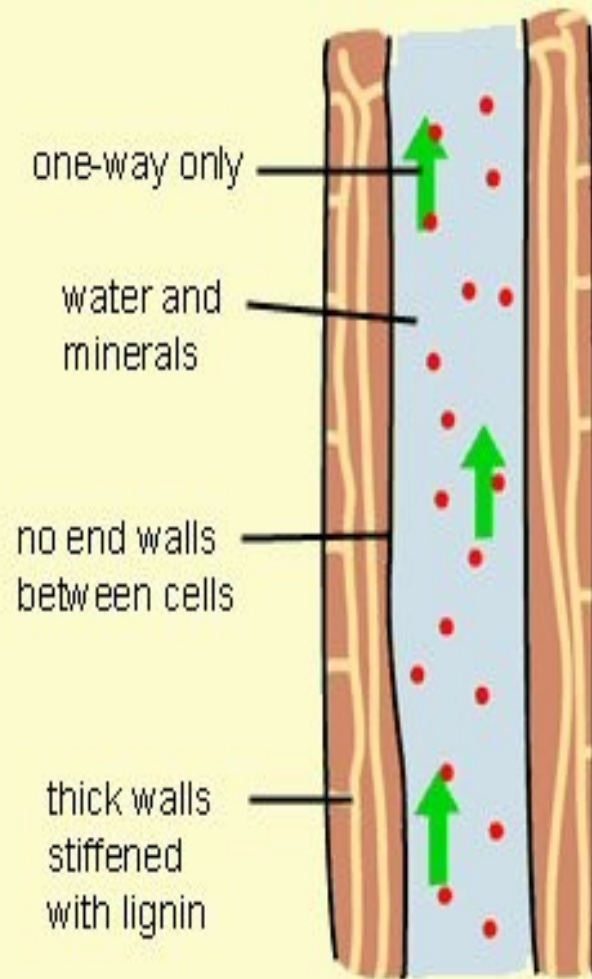
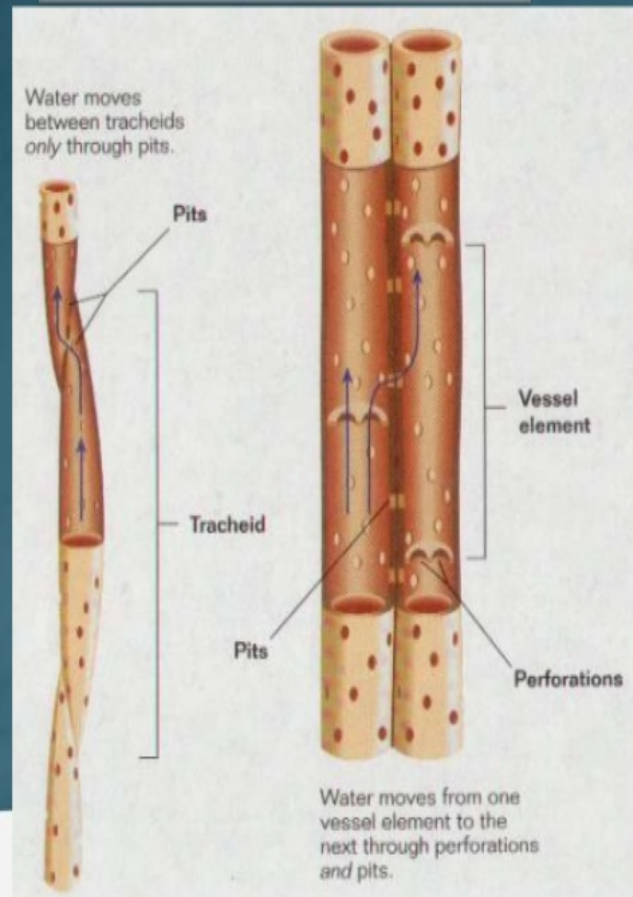
# Ascent of Sap



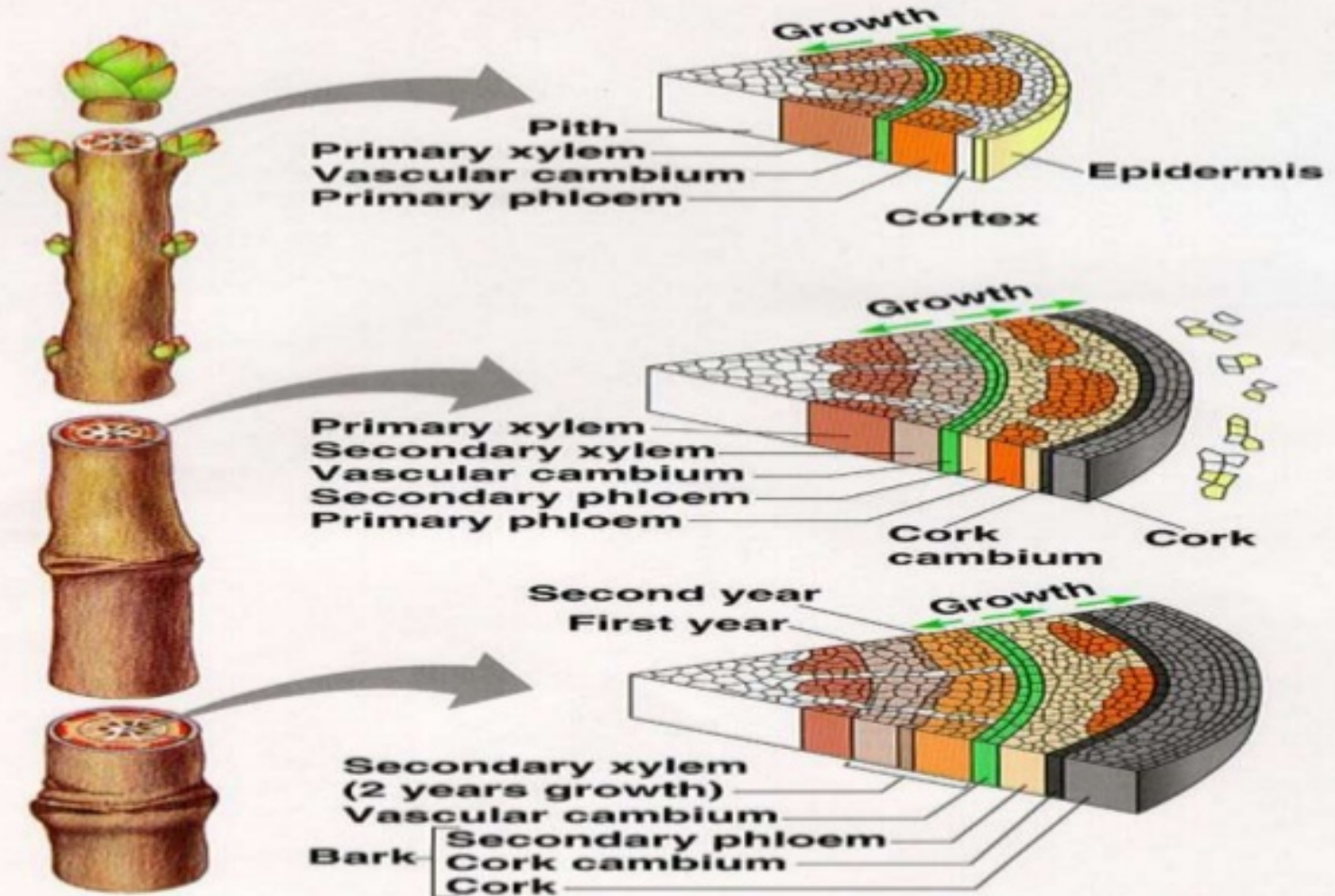
- Upward movement of water and mineral is called as **ascent of sap or translocation of sap**

# STRUCTURAL ORGANISATION OF XYLEM ELEMENTS ...

- Xylem cells
- Xylem vessels
- Xylem tracheids
- Pits

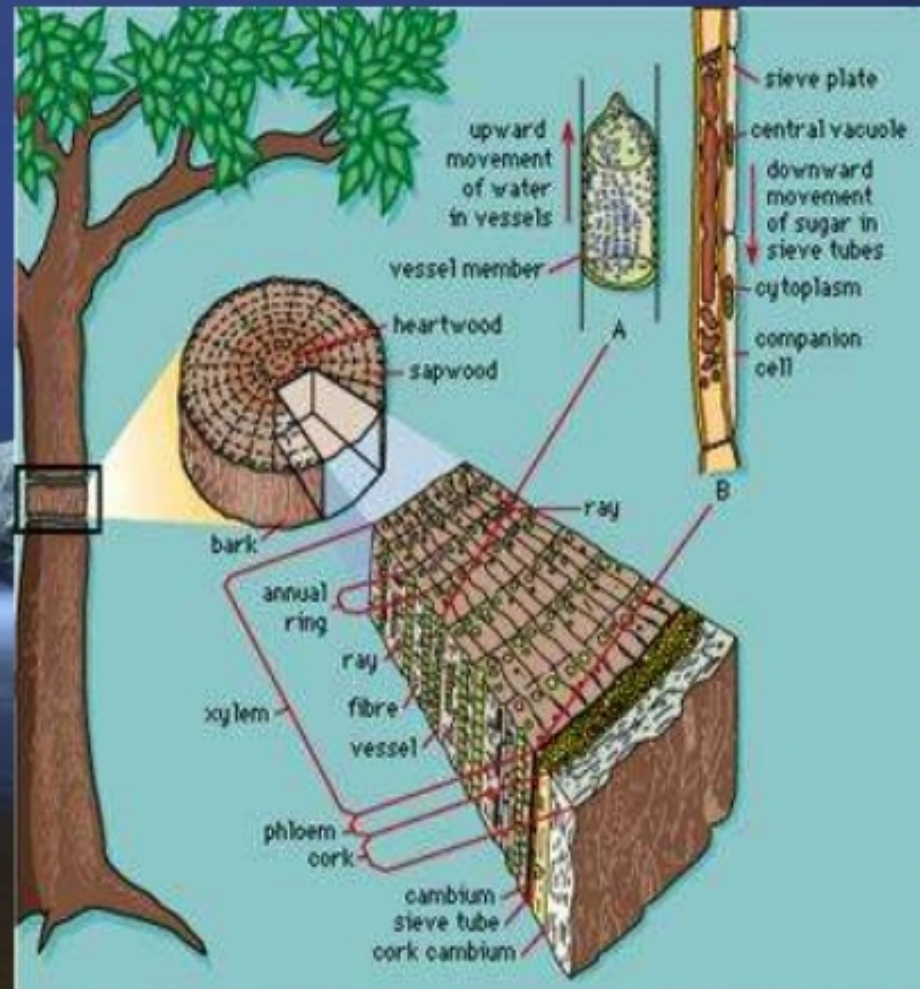


# Girdling Experiment



# RATE OF MOVEMENT

Using dyes and radioactive isotopes, it has been determined that the average rate of movement of water in xylem is 60-75 cms/minute. This is under normal transpiring conditions. However, this rate is not constant and it varies depending upon the environmental conditions, particularly Relative Humidity (RH) of the atmosphere.



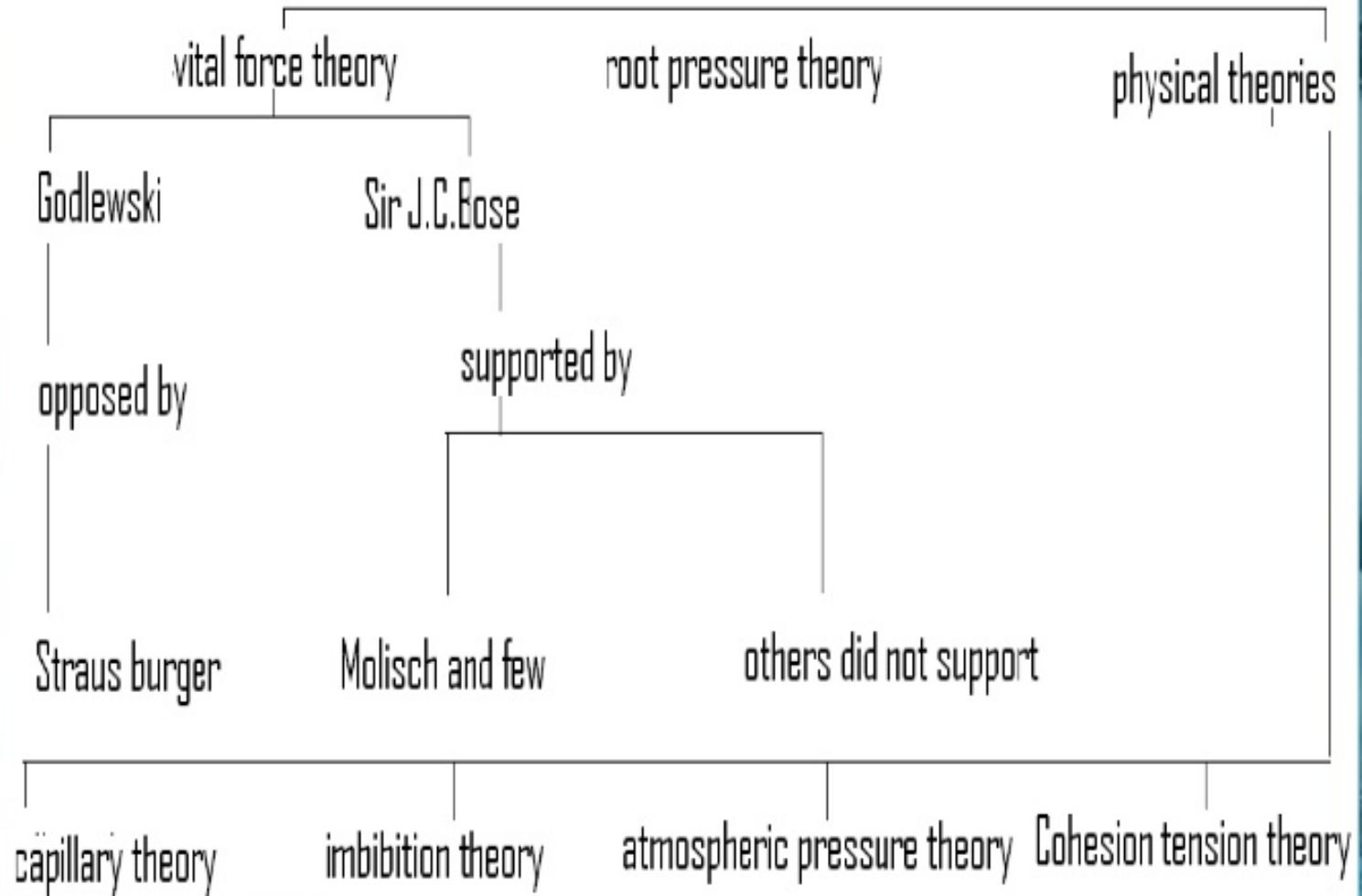
# Theories for transport of water....

- vital theories
- Root pressure theory
- Physical theories

Vital theories are stated here ..

- Godlewski's relay pump theory
- Pulsation theory
- Root pressure theory

theories of ascent of sap.



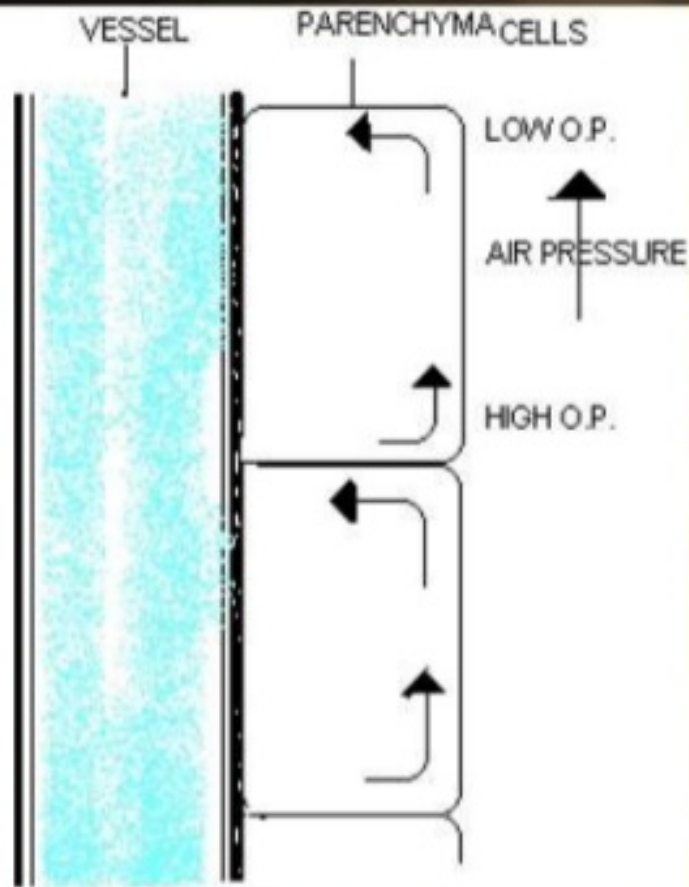
# **VITAL FORCE THEORY**

According to these theories the forces required for ascent of sap are generated in living cells of plants. Some of the important vital force theories are **GODLEWSKI RELAY PUMP THEORY AND PULSATION THEORY.**



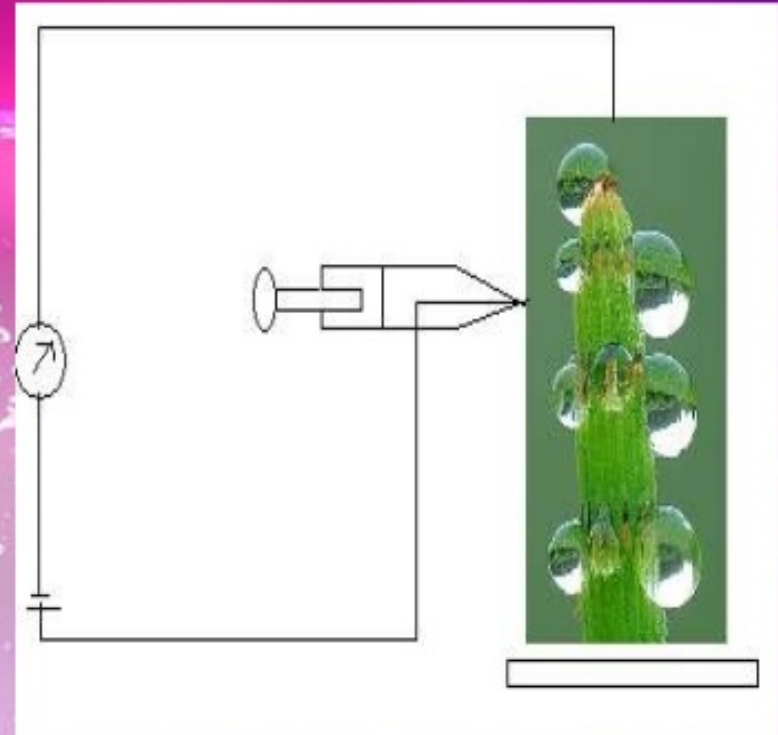
# Godlewski relay pump theory

- Due to rhythmic change in OP of xylem elements
- Living cells absorb water by osmosis
- And finally water is pumped into xylem vessel due to lowering of pressure in living cells
- Thus staircase type of movement occurs



# Pulsation theory { sir J.C. Bose }

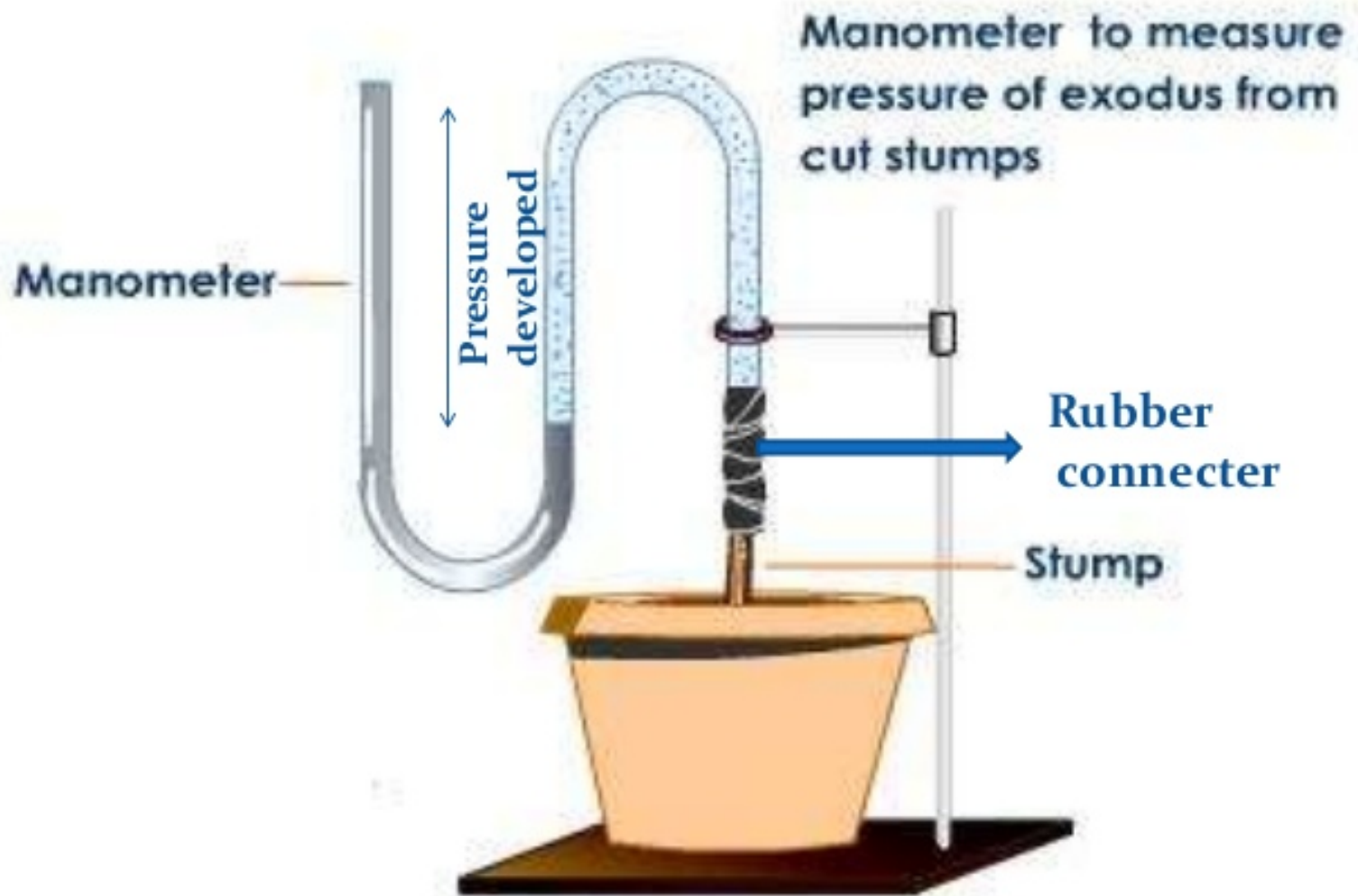
- Living cells of innermost layer of cortex had rhythmic pulsations.
- These pulsations are responsible for the upward movement of water.
- Fine needle attached to galvanometer was inserted in plant stem
- Galvanometer shows slow oscillations but when it touched cortex cells it turned violent indicating that the cells were pulsating.



# Root pressure theory ..

- When watered plant is cut near base xylem sap flow out at the end with a pressure.
- Mainly observed in herbaceous plants
- Water oozes out due to bleeding
- This is due to hydrostatic pressure inside root c/a root pressure
- Root pressure appear due to osmotic pressure.
- If root is supplied with isotonic or hypertonic solution root pressure disappears.





Experiment to demonstrate root pressure-B

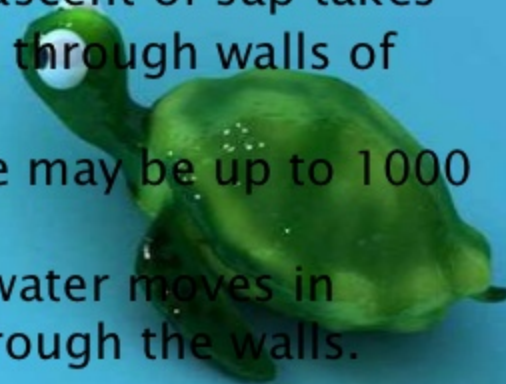
# Physical theories ....

1) Capillarity : water rises in narrow tubes due to the force of surface tension

- It stated that it is the capillary action of narrow xylem tubes and it is further supported by atmospheric pressure

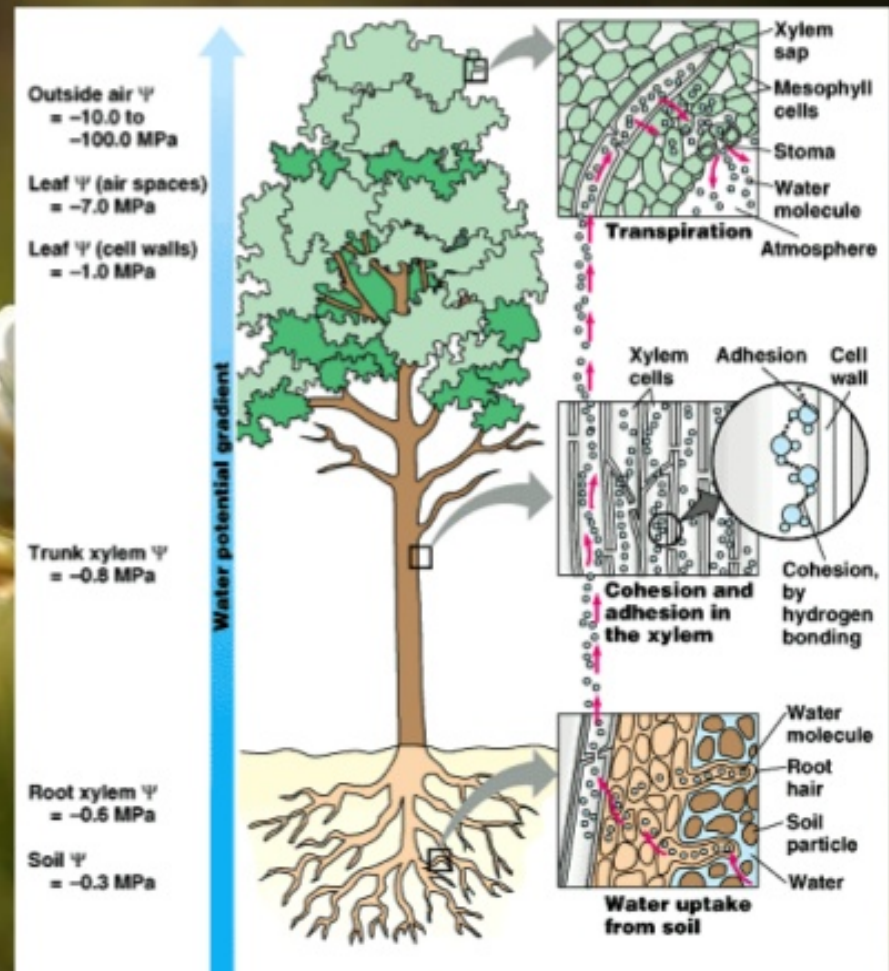
2) Imbibitional theory : ascent of sap takes place due to imbibitional forces through walls of xylem cells.

- Magnitude of imbibitional force may be up to 1000 atm,
- But discarded due to fact that water moves in lumen of vessels rather than through the walls.



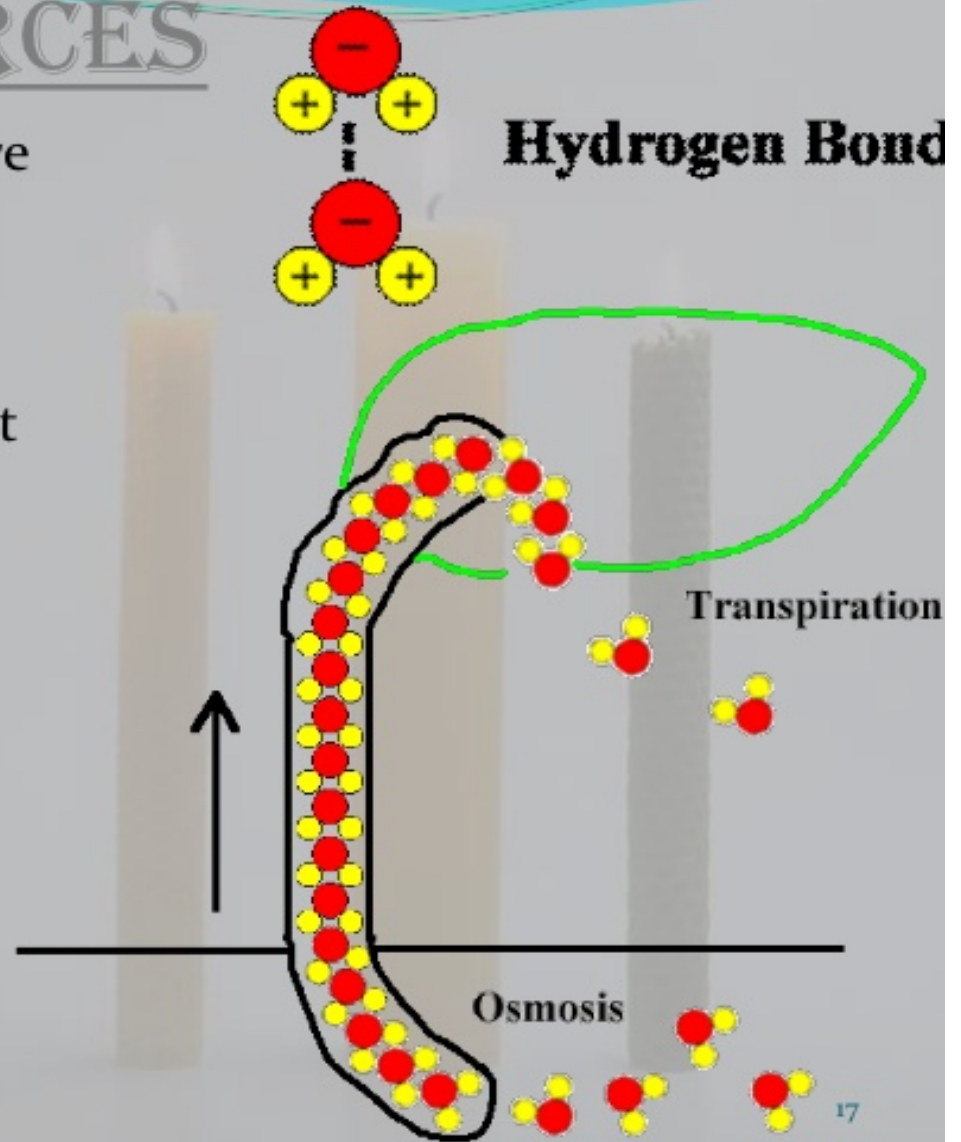
# COHESION TENSION THEORY.....

- Theory was proposed by Dixon and Jolley, but the theory has been expanded.
- This theory is also called as Suction force theory.

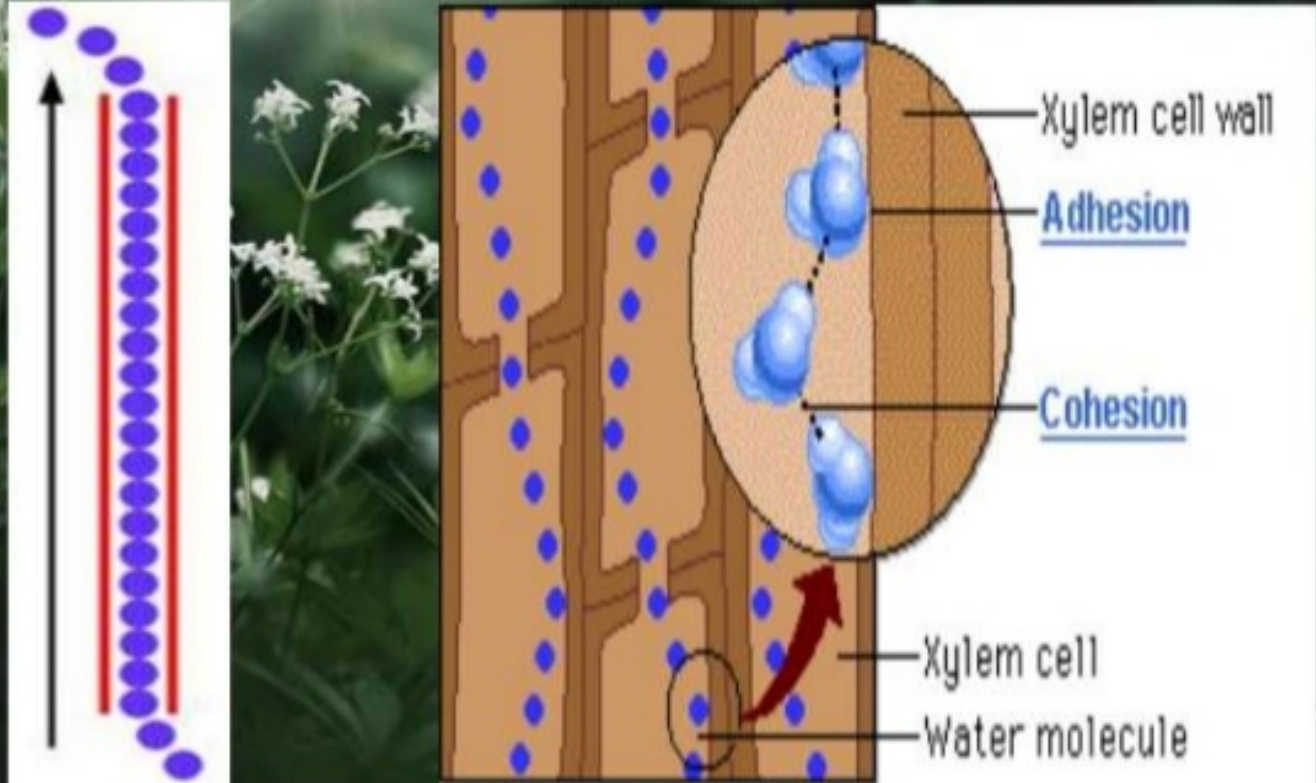


# COHESIVE FORCES

When fine water columns are subjected to a transpiration pull as great as 1000 bars or more, the water column is likely to snap, but it does not because inter molecular forces that hold the water molecules together are greater than the opposing forces,

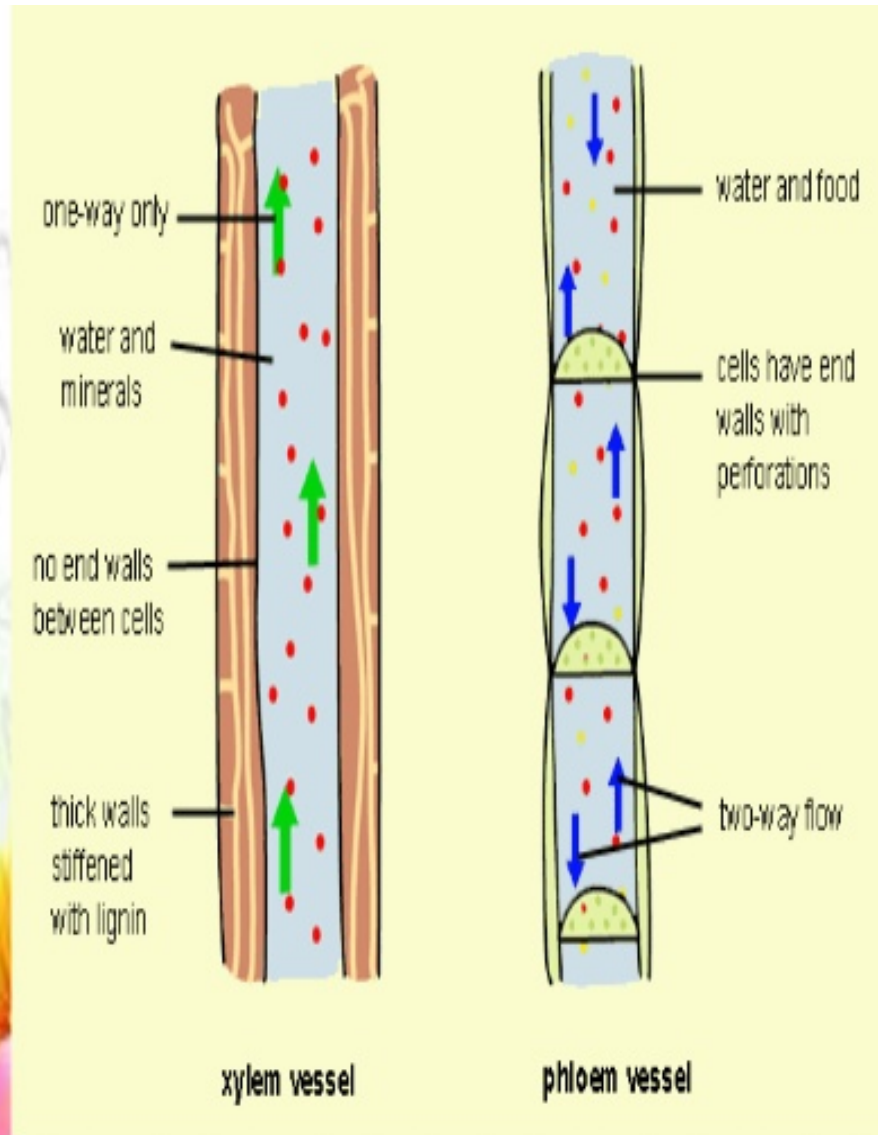


Such forces are called cohesive forces; they are nothing but hydrogen bonds between the water molecules. The overall strength of water column in such narrow xylem elements has been estimated to be many folds higher than the transpiration pull and the gravitational pull put together





Such forces are called cohesive forces; they are nothing but hydrogen bonds between the water molecules. The overall strength of water column in such narrow xylem elements has been estimated to be many folds higher than the transpiration pull and the gravitational pull put together.



## **EVIDENCE IN SUPPORT OF COHESION TRANSPIRATION PULL THEORY**

1. Transpiration pull developed in the aerial regions at 50% RH in the air is more than 1000 bars.
2. Cohesive force that holds the water molecules in a column as narrow as xylem vessels is very strong and they withstand the opposing transpiration and gravitational pulls.
3. Because of the opposing forces, tension develops in the water column. As a result, xylem elements become slightly narrow. This results in the contraction and expansion of the stem which has been demonstrated by using dendrometer. The diurnal behavior of rhythmic contraction and expansion is a good evidence for the water column to be in tension which the transpiration is rapid or not.
5. The forces that operate cohesion transpiration pull are just passive forces and no metabolic energy is involved in this phenomenon, because present the movement of water upwards.

**Thank you!**

