



How do you adjust the
nutrient content of a
solution?

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Do Now (5 min.)

- Explain why organisms of the plant kingdom need nutrients.
- Describe the relationship between elements and nutrients.
- Explain how electrical conductivity relates to nutrients.

Objectives

- I can adjust EC levels of a nutrient solution.
- I can adjust the pH levels of a nutrient solution.
- I can explain the importance of adjusting a nutrient solution for plants.

Review

- Most plant **nutrients** (plant food) are made of charged molecules or **salts**.
- The more **nutrients** (salts) the *faster* the electricity will travel through the solution.

Table 1. Sachs' Nutrient Solution

Salts	Anions	Cations
Calcium nitrate, $\text{Ca}(\text{NO}_3)_2$	NO_3^-	Ca^{++}
Magnesium sulfate, MgSO_4	SO_4^{-2}	Mg^{++}
Ferrous sulfate, FeSO_4	SO_4^{-2}	Fe^{++}
Potassium acid phosphate, KH_2PO_4	PO_4^{-3}	K^+, H^+

Elements + Element = Molecule

- ◉ When some elements come together they form *charged* molecules.
- ◉ Nutrients and plants (+ *all living things*) are made of molecules!

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EC levels for most plants

	Fruiting Plants	Leafy Plants
Initial growth	1600-1800 $\mu\text{S/cm}$	1400-1600 $\mu\text{S/cm}$
Average EC	2500 $\mu\text{S/cm}$	1800 $\mu\text{S/cm}$
Fruiting	2400-2600 $\mu\text{S/cm}$	
Winter (low light)	2800-3000 $\mu\text{S/cm}$	2000 $\mu\text{S/cm}$
Summer (high light)	2200-2400 $\mu\text{S/cm}$	1600 $\mu\text{S/cm}$

Safety

- ⦿ Remember none of the equipment was made to be dropped.
- ⦿ Wear gloves, aprons, and goggles.
- ⦿ Don't rub your eyes or eat if you got chemicals on your bare hands.
- ⦿ WASH HANDS BEFORE LEAVING!

Materials

- ◉ Hanna Combo meters
- ◉ Plastic solution cup
- ◉ Plastic waste water cup
- ◉ Squirt bottle with filtered water
- ◉ Skewer for stirring
- ◉ Group Beaker for excess solution
- ◉ Probe storage solution
- ◉ pH solutions
- ◉ Spoon
- ◉ Safety + clean up equipment

EC Procedures

- Setting up
 - > Listen to instructions.
 - > Read instructions and procedures if available.
 - > Take everything off your work area except for lab instructions (if applicable) and make sure area is clean.
 - > One person at a time from each group should gather materials carrying them safely.
 - > Put on safety equipment.

EC Procedures

- Measuring EC
 - Take the cap off the meter, place it in a safe spot, and rinse off the probe with the squirt bottle into the waste water cup.



EC Procedures

- Measuring EC
 - > Do not touch the probe with the plastic tube of the bottle. Just spray the probe until it is clean.
 - > Work neatly or you'll have to clean up more at the end.



EC Procedures

- Measuring EC
 - > The units that measure EC are “ μS ” and they appear at the top right-hand portion of the screen.
 - > Press the set button firmly and continuously until it appears.



Electrical Conductivity Units

⦿ μS = MicroSiemens/cm³

Preparing the Solution

- Add a TINY amount of nutrient powder to the solution with the spoon and mix with the skewer.
- After mixing with a skewer or probe measure the EC.
- What level of EC is correct?

EC levels for most plants

	Fruiting Plants	Leafy Plants
Initial growth	1600-1800 $\mu\text{S/cm}$	1400-1600 $\mu\text{S/cm}$
Average EC	2500 $\mu\text{S/cm}$	1800 $\mu\text{S/cm}$
Fruiting	2400-2600 $\mu\text{S/cm}$	
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DON'T BE A SPOON
WETTER!

Preparing the Solution

- If your EC is too high then you need to add filtered water.
- If your EC is too low then you need to add more nutrient powder.
- If you run out of cup space to adjust then spill 1/3 out into the glass beaker at the center of the room.

pH Procedures

- AFTER ADJUSTING EC YOU ADJUST pH.
- What should the pH be?



What's the perfect pH for a plant?

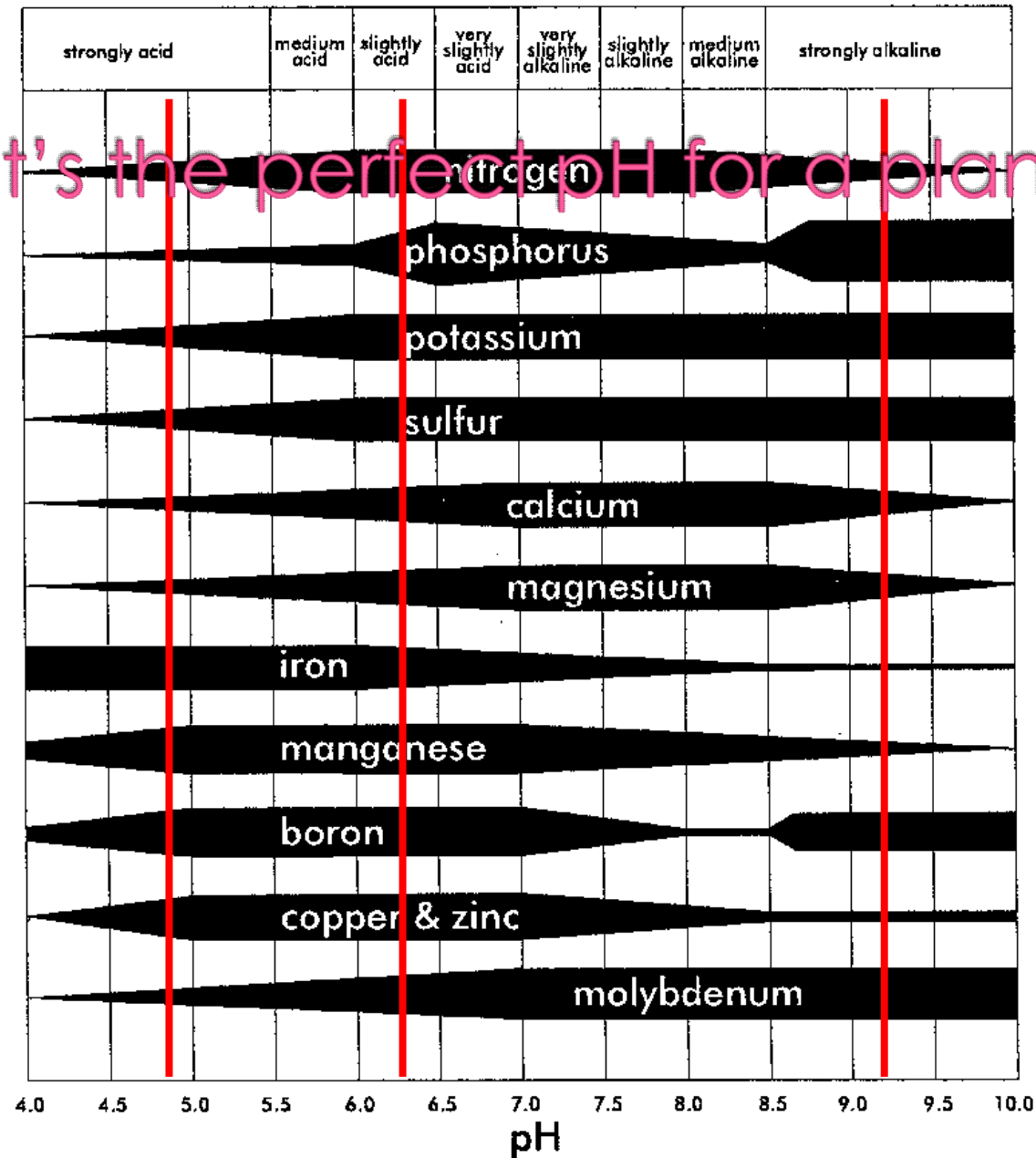


Table 2. Effects of soil reaction on availability to plants of soil nutrients (after Truog). The width of the bar determines the relative availability of each element with a change in soil reaction.

pH Facts

Item	pH
Human Blood	7.41
Ocean Water	8.2
Acid Rain	< 5.6
Milk	~ 6.4
Beer	4-5
Vinegar	~ 3
Human Stomach	1.5 - 3
Nitrification	7
Hydroponics	5.8 – 6.2
Ultra-filtered/Distilled water	~ 4.5

pH Procedures

- AFTER ADJUSTING EC YOU ADJUST pH.
- What should the pH be?
- Adjust to around 6.0.
 - 5.8 – 6.2 is fine!



Clean-up



- Rinse the probe when finished.
- After your final rinse place 4 drops of pH storage solution into the little cup located inside the probe cap.
- Give your materials to Sheridan when finished.

Clean-up



- Recap the probe FIRMLY by lining up the lettering on the cap and the face of the meter.
- Wait for clean-up instructions.
- Clean up your area, dump your waste water out, clean gloves, and return materials.
- Begin work on analysis questions.