Plants Need Nutrients

Fertilizer's role in soil management
(Grades 6-8)

UCCE Master Gardener Program of Riverside County

Master Gardeners

The University of California Cooperative Extension (UCCE) Master Gardener Program (MGP) is an educational program designed to teach and effectively extend information to address home gardening and non-commercial horticulture needs in California.

UCCE is the outreach arm of UC's division of Agriculture and Natural Resources (ANR). Master Gardener volunteers (MG volunteers) promote the application of basic environmentally appropriate horticultural practices through UCCE-organized educational programs that transfer research-based knowledge and information.

University of California
Agriculture and Natural Resources
UCCE Master Gardener Program

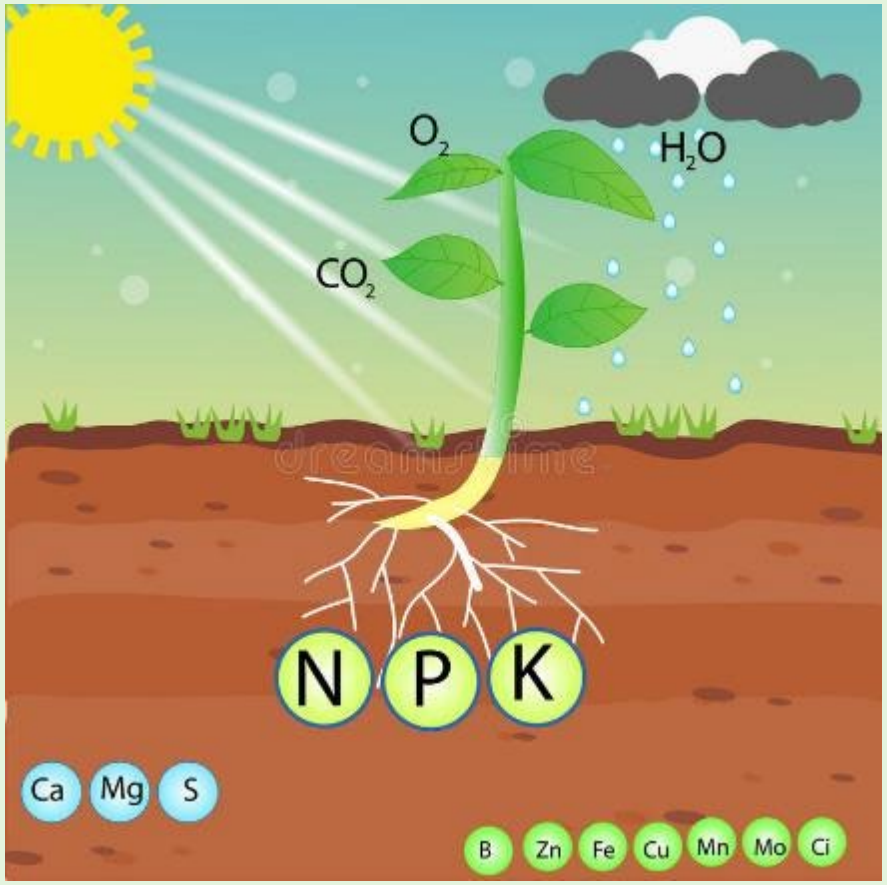
Why is This Important?

Fertile soil contains nutrient elements in amounts favorable for optimal growth of crop plants and in a plant available form that crop roots can absorb.

Learning Goal: Students will learn that plant nutrition is a plant's need for and use of 17 chemical elements for growth and development, and that factors can enhance plant use of these nutrients.

Plant Nutrients

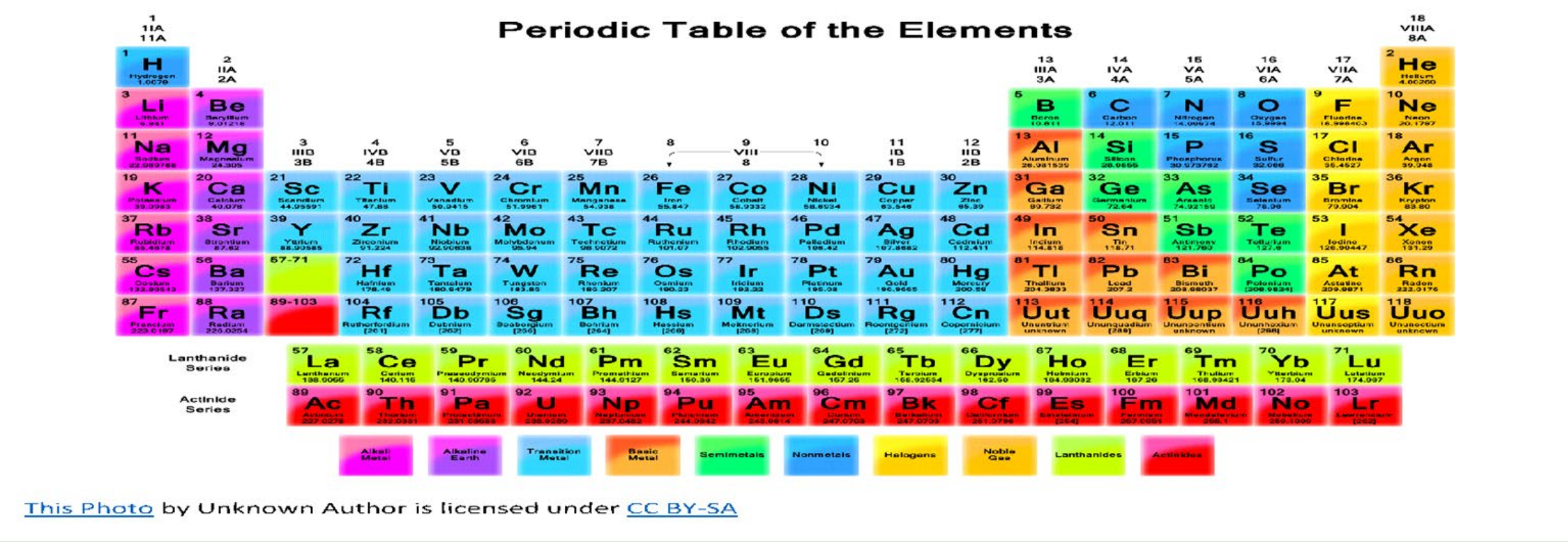
- Plant nutrients are chemical elements and compounds necessary for plant growth and reproduction.
- Healthy soil contains the 17 elements plants need
  - 3 from air and water
    - Oxygen (O), Hydrogen (H), and Carbon (C)
  - 14 from minerals in soil
- People can add nutrients to plants ***if needed***



What You Need to Know:

Definitions – Element

Element: A substance in its simplest form that cannot be broken down further (such as carbon, oxygen or nitrogen).



What You Need to Know:

Definitions –Compound

Compound: A substance formed when two or more chemical **elements** are chemically bonded together (such as water, made up of hydrogen and oxygen, H_2O).

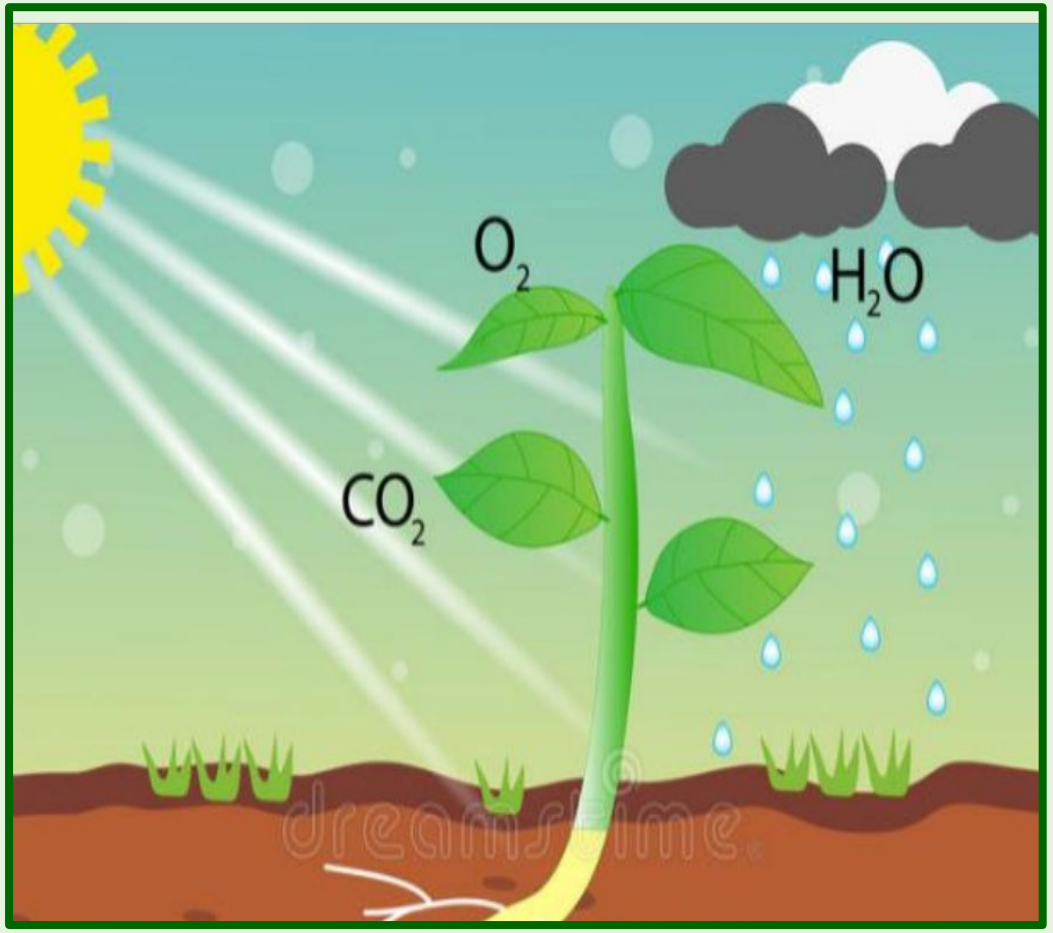
17 Essential Plant Elements

The 17 plant nutrients are divided up into mineral and non-mineral elements.

- *Mineral* nutrients enter plants primarily through the soil.
- *Non-mineral* nutrients may enter either through the soil or atmosphere.

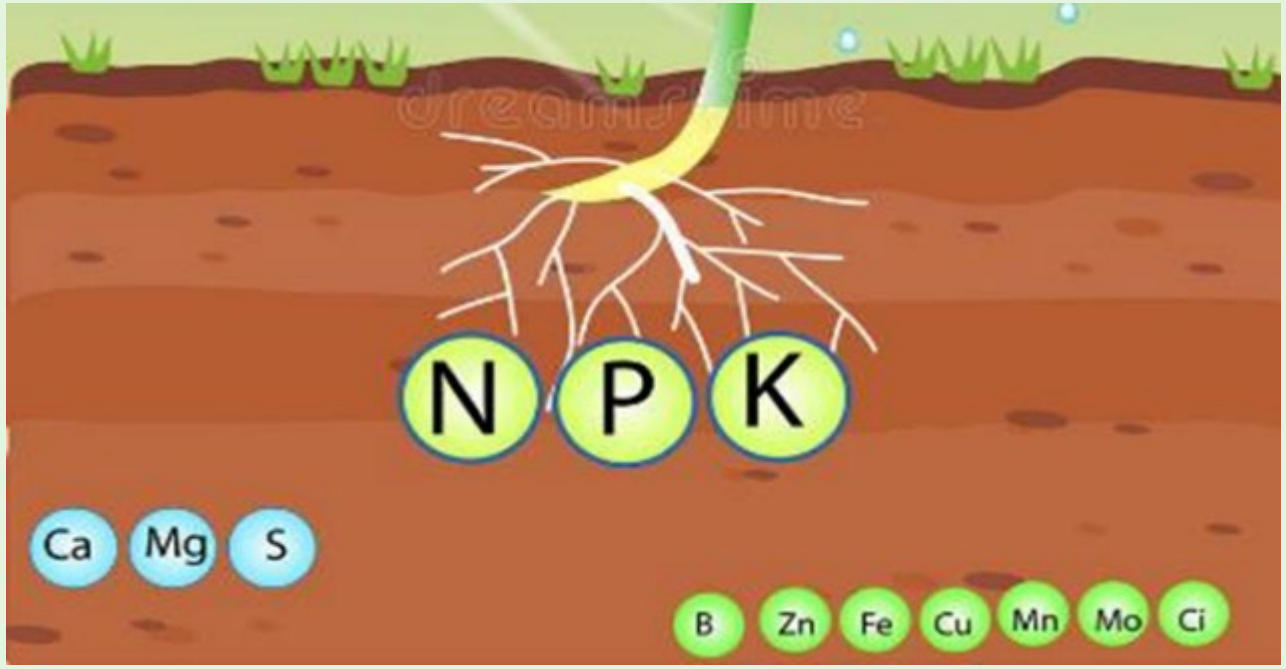
Non-Mineral Nutrients

Non-mineral nutrients are in the ***compounds*** required for photosynthesis. Water, supplied via irrigation or rainfall provides the hydrogen (and electrons) required to convert solar energy (light) into chemical energy (sugars.)



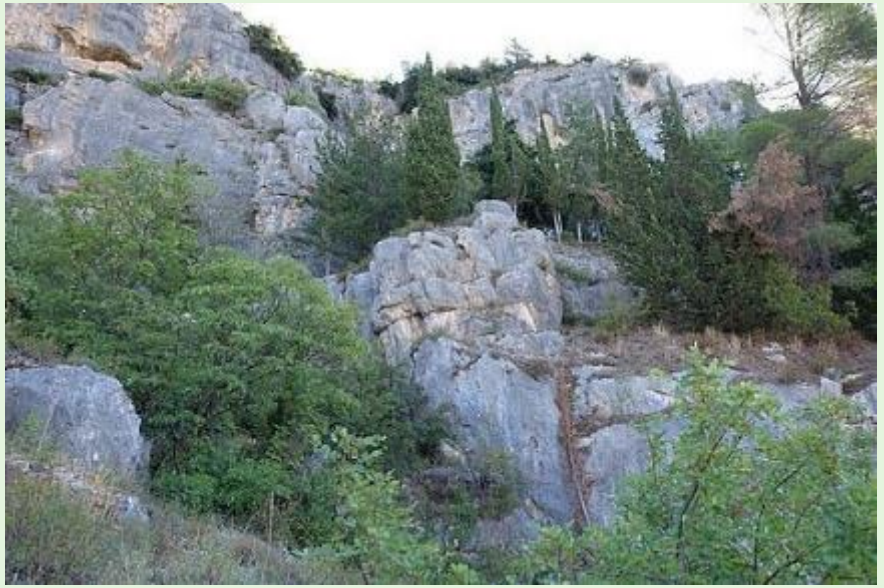
Mineral Nutrients

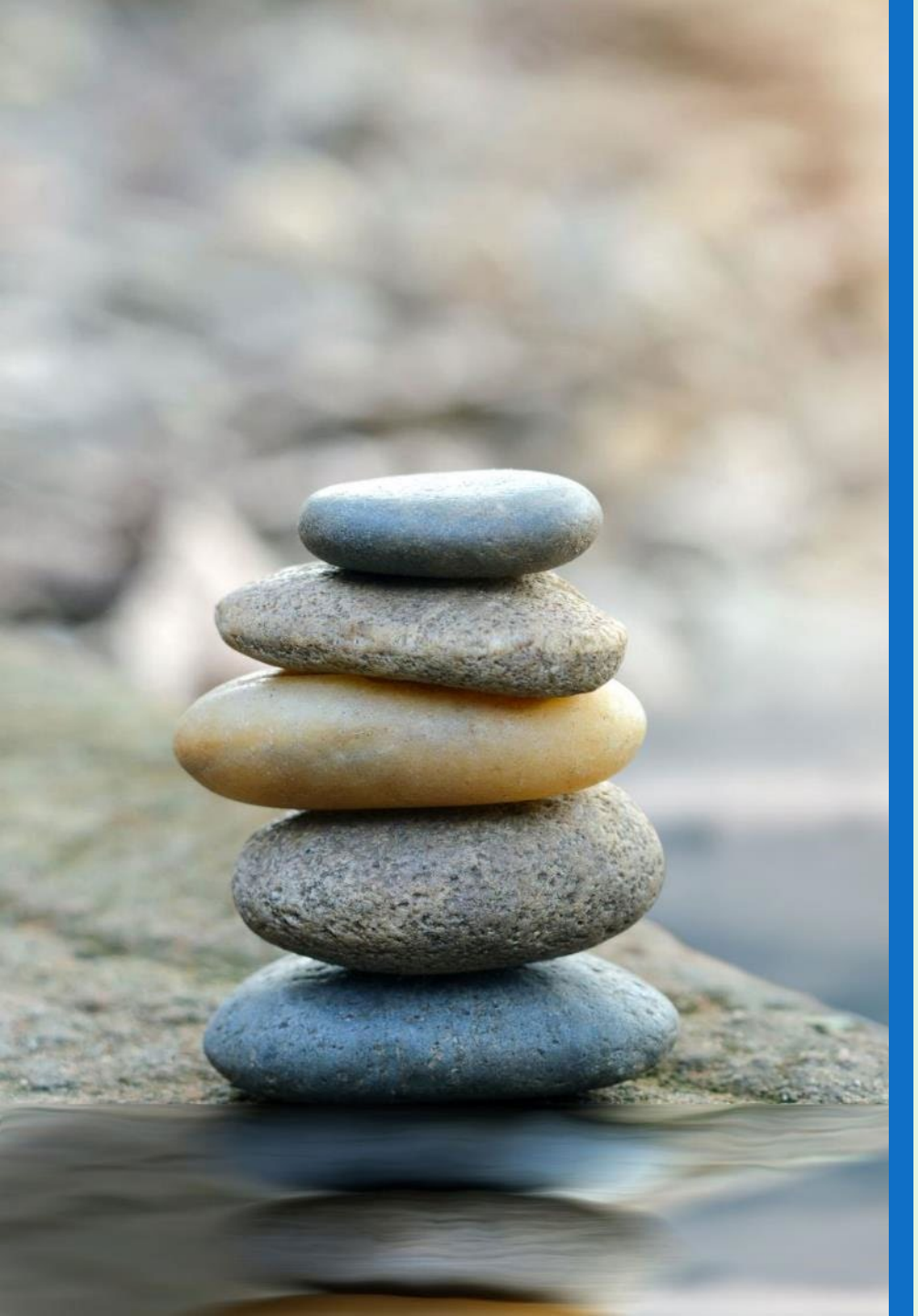
All other essential elements are mineral nutrients. These are dissolved in water and most commonly enter the plant when absorbed by plant roots.



Minerals in Soil

- **Minerals:** A solid material formed by natural events
  - Not from plants or animals
- Minerals in soil come from erosion or weathering of rocks
- **Minerals support plant growth:** They provide nutrition, or food for the plant





What You Need to Know

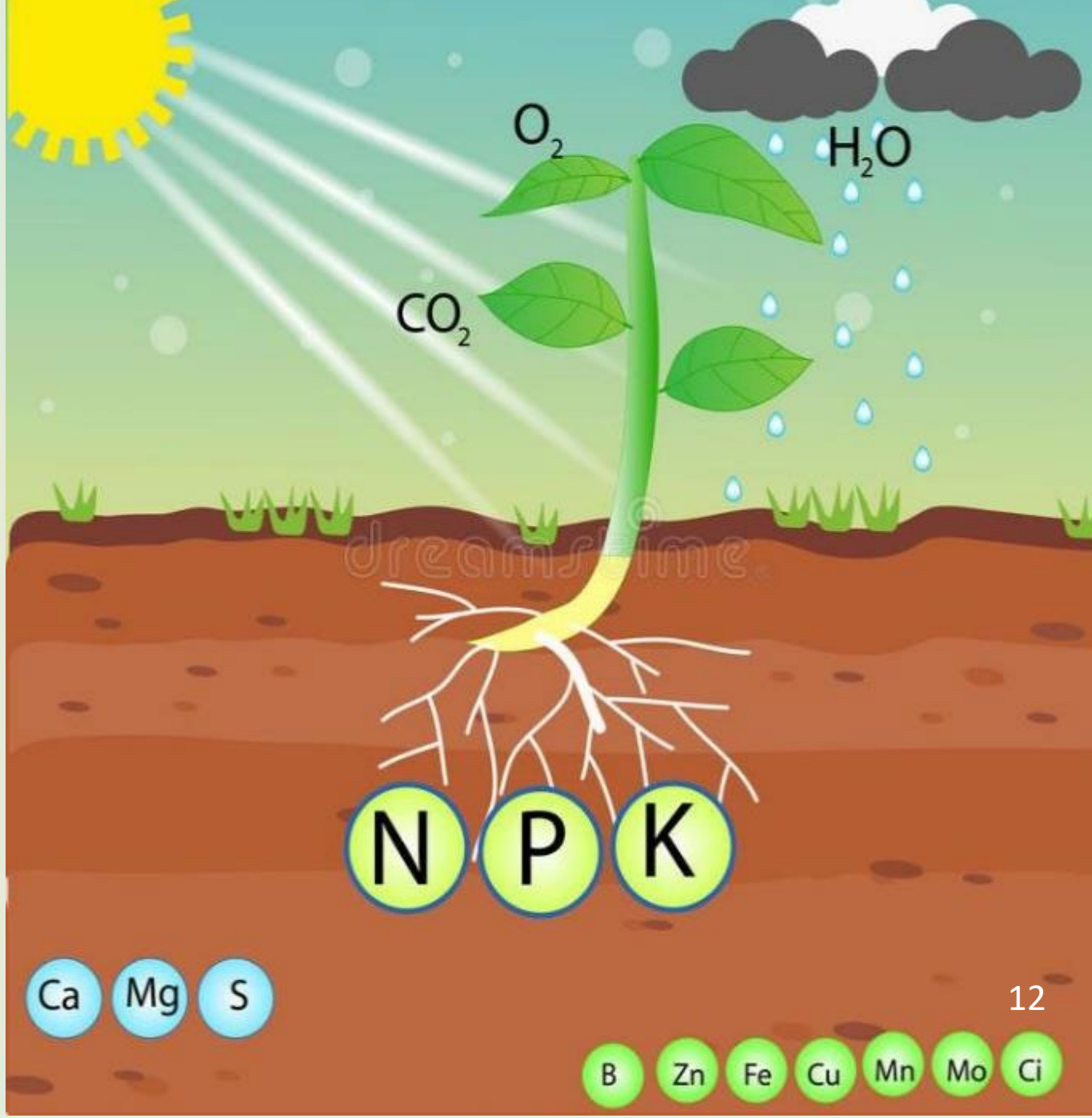
Definitions - Nutrients

There are 14 mineral elements that are needed by plants, but the required amount varies.

- **Macronutrient**
  - Plant-essential elements required in relatively large amounts by plants.
- **Micronutrient**
  - Plant-essential element required by plants in very small amounts.

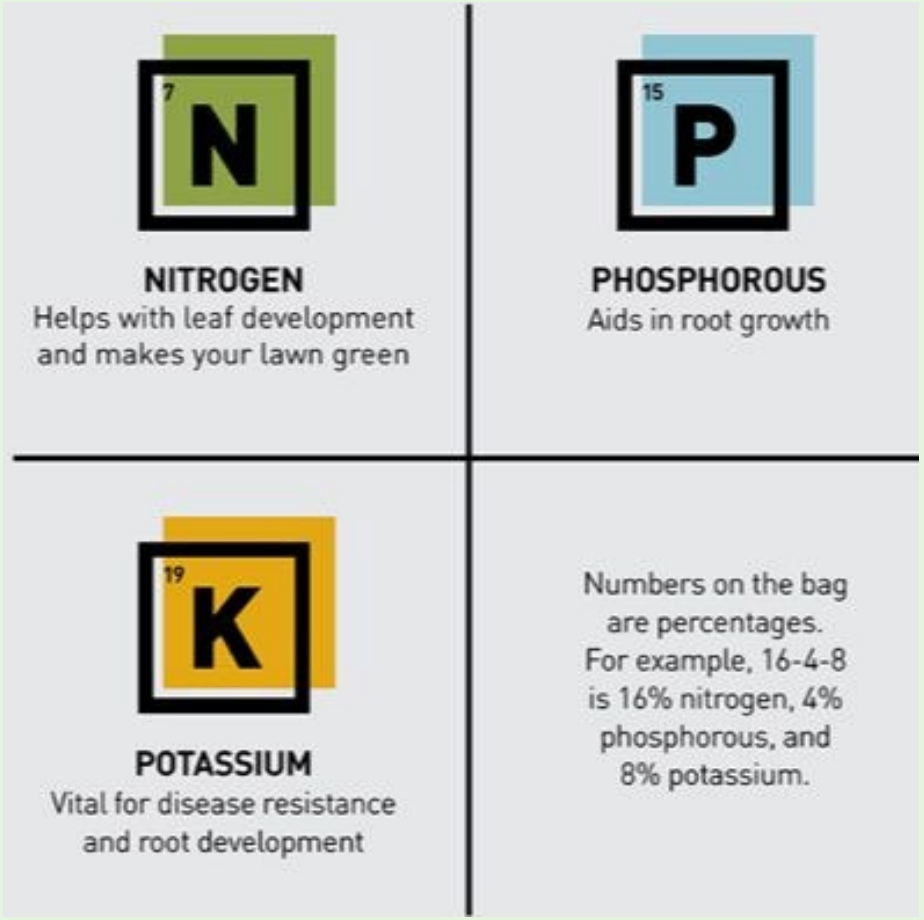
NPK

- Three **primary** mineral macronutrients for plants:
  - **N** Nitrogen
    - Greening of plant
  - **P** Phosphorus
    - Health and vigor
  - **K** Potassium
    - Movement of water and nutrients



Plants Need for NPK Varies

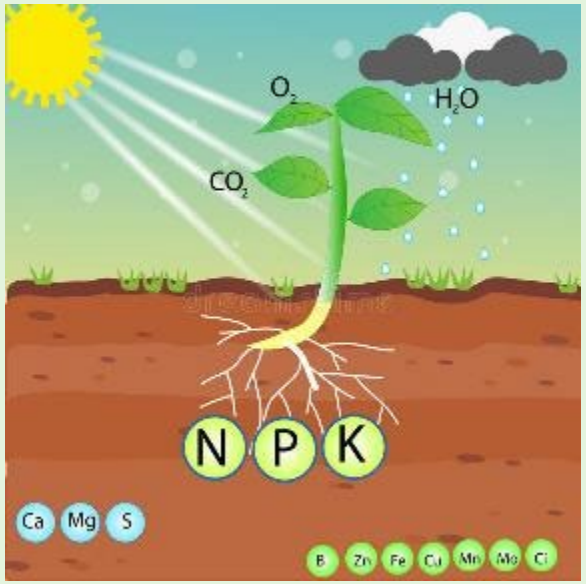
- Some plants need different levels of the three primary macronutrients, so fertilizers, or plant food products, list three values (percentages) for nitrogen, phosphorus and potassium.
- Numbers on products provide the % for each chemical element



Additional Mineral Nutrients

In addition to Nitrogen, Phosphorous and Potassium, plants need other minerals from the soil

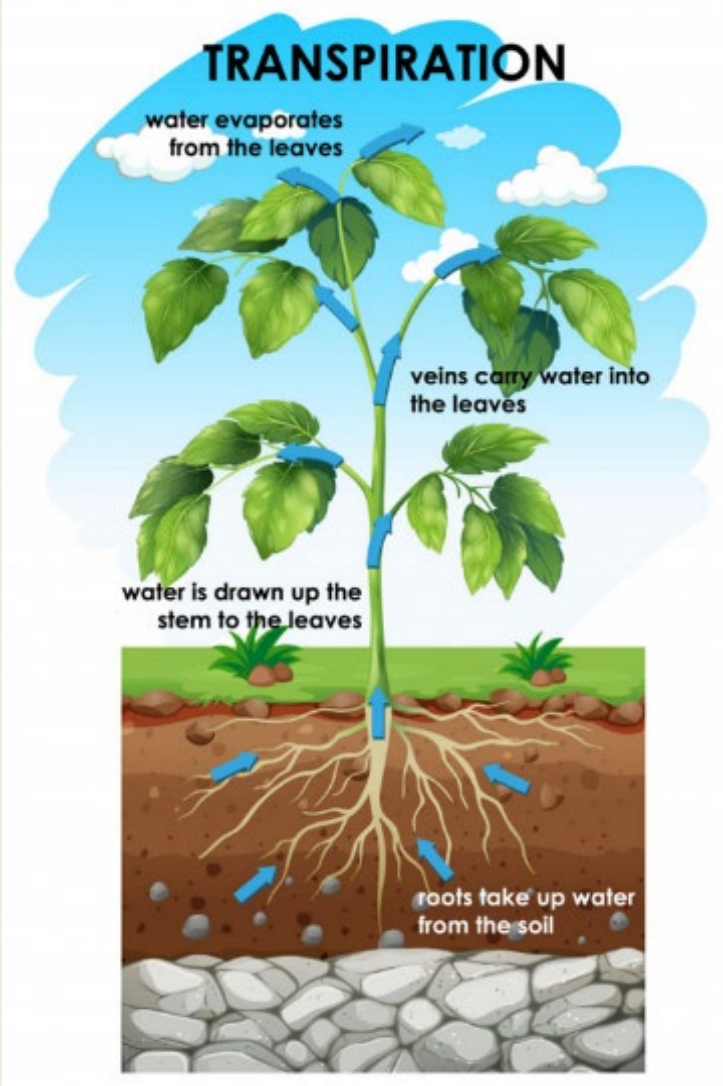
- Other *secondary macronutrients*
  - Calcium
  - Magnesium
  - Sulfur



- Eight *micronutrients*
  - Boron
  - Chlorine
  - Copper
  - Iron
  - Manganese
  - Molybdenum
  - Nickel (not included in this diagram)
  - Zinc

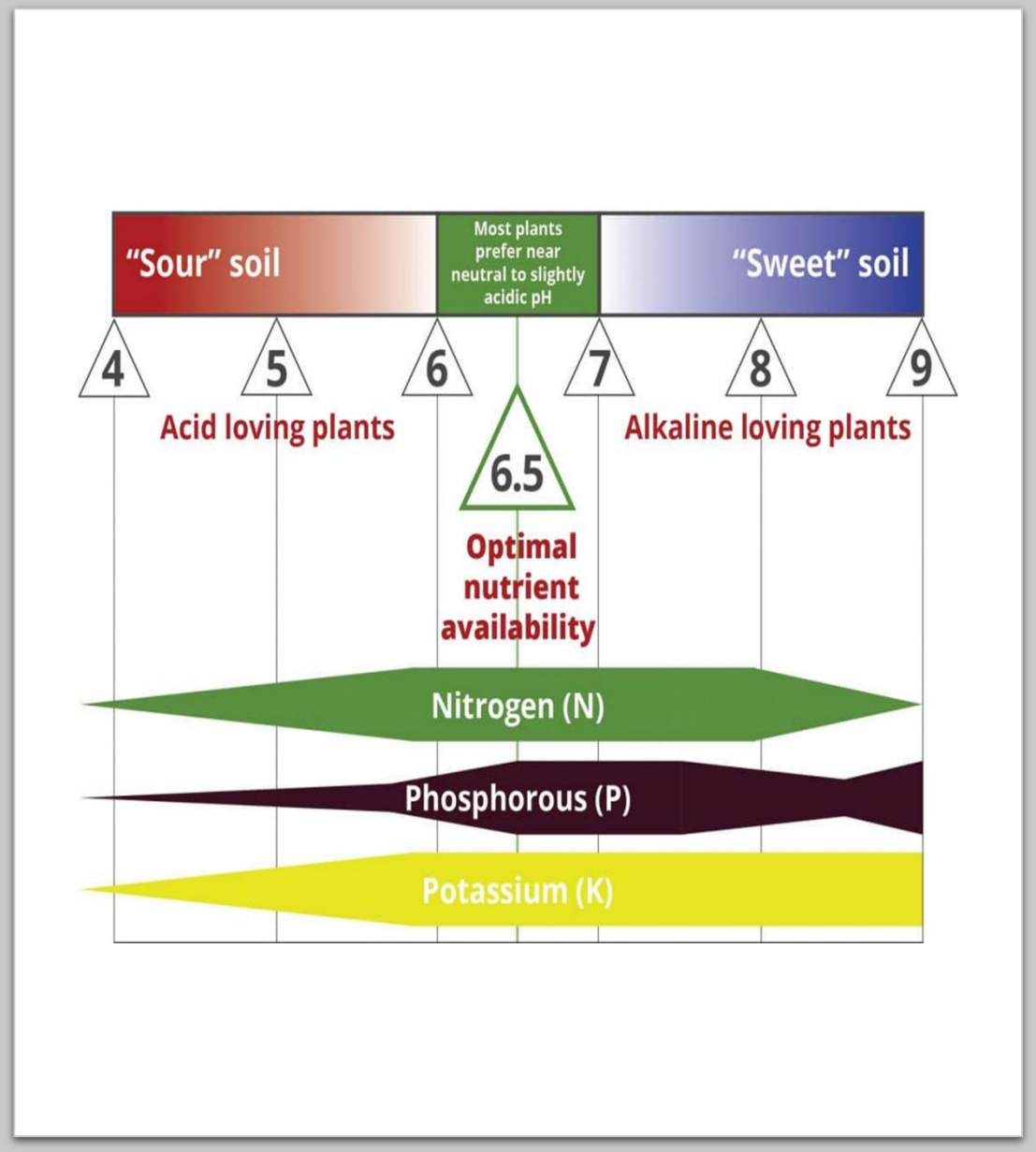
Uptake of Nutrients

- Before a nutrient can be used by plants it must be dissolved in a soil and water solution
- Nutrients are carried up through the plant with water absorbed through the roots
- Most minerals and nutrients are more available in acid soils than in neutral or slightly alkaline soils



pH Level in Soil

- The pH level measures the acidity and alkalinity of soil
- The scale ranges from 4.0 to 9.0
- pH Level affects the availability of nutrients to support plants
  - Nutrients can be absorbed at a pH level from 5.5 to 7.5
  - Many plants do well at a pH range of about 6 to 7



Nutrient Balance

- Although plants need much higher amounts of macronutrients than micronutrients, all 17 essential elements must be present for a plant to be healthy.
- A common problem in California is related to a plant's need for nitrogen, phosphorus, potassium, zinc and iron, as well as symptoms caused by excesses in boron, chloride and sodium.

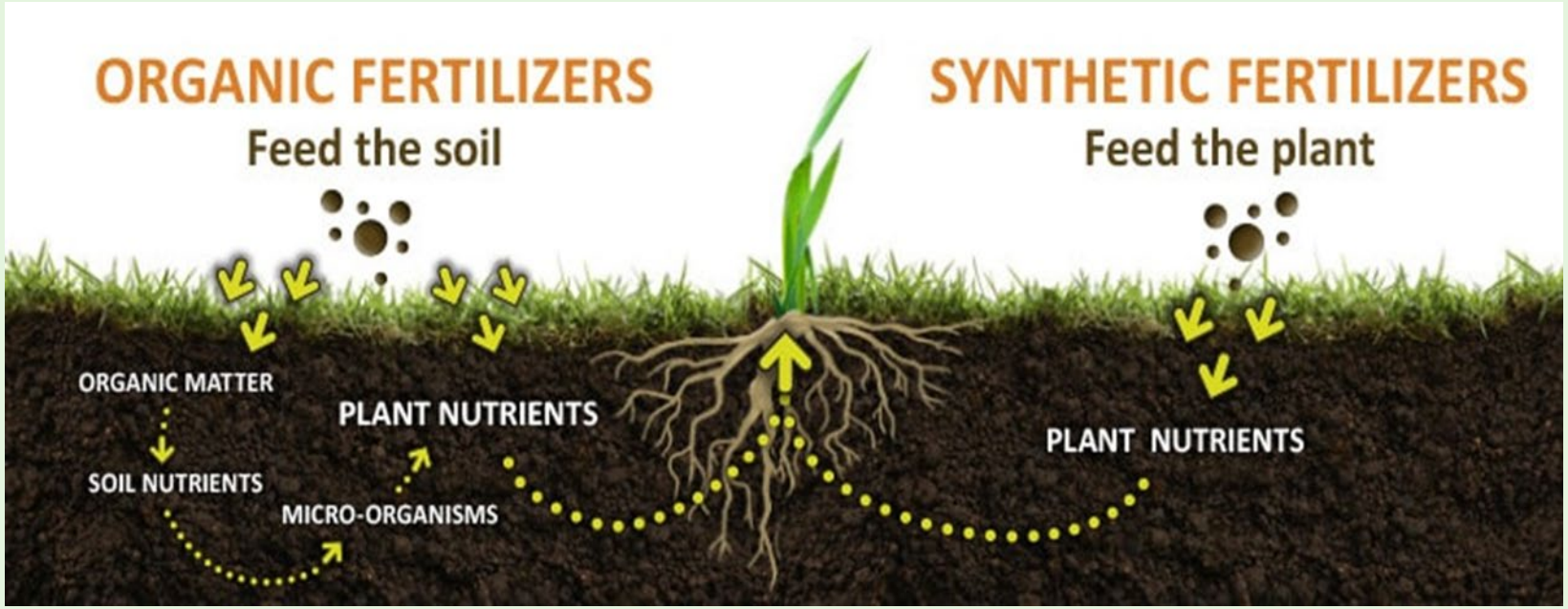
Source: California Master Gardener Handbook Second Edition, Pettinger, 2015

Hunger Signs in Plants

- Plant Distress
  - Under or overwatering- Yellowing or wilting of leaves
  - Disease-Fungus, virus, bacteria
- Deficiency or imbalance of nutrients

Correcting Nutrition Deficiencies

Nutrient deficiencies can be corrected by the addition of inorganic or organic fertilizer, along with soil and water management.



Types of Fertilizers

- **Inorganic (chemical)**
- Generally contains 3 primary nutrients:
  - NPK
- Fast acting
  - Reduces deficiencies in NPK
  - Promotes plant growth

- **Organic (from plants and animals)**
  - Animal excrement (manure)
  - Plant remains (compost)
- Slow acting
- Improves plant health
- Enriches soil with organic matter to improve the health of the soil

Many successful gardeners use a combination of inorganic and organic fertilizers.

Video: Determining Nutrient Level in The Soil

To learn whether you need to add nutrients, have your garden soil tested. You can begin by using a soil testing kit sold at most garden centers and nurseries.

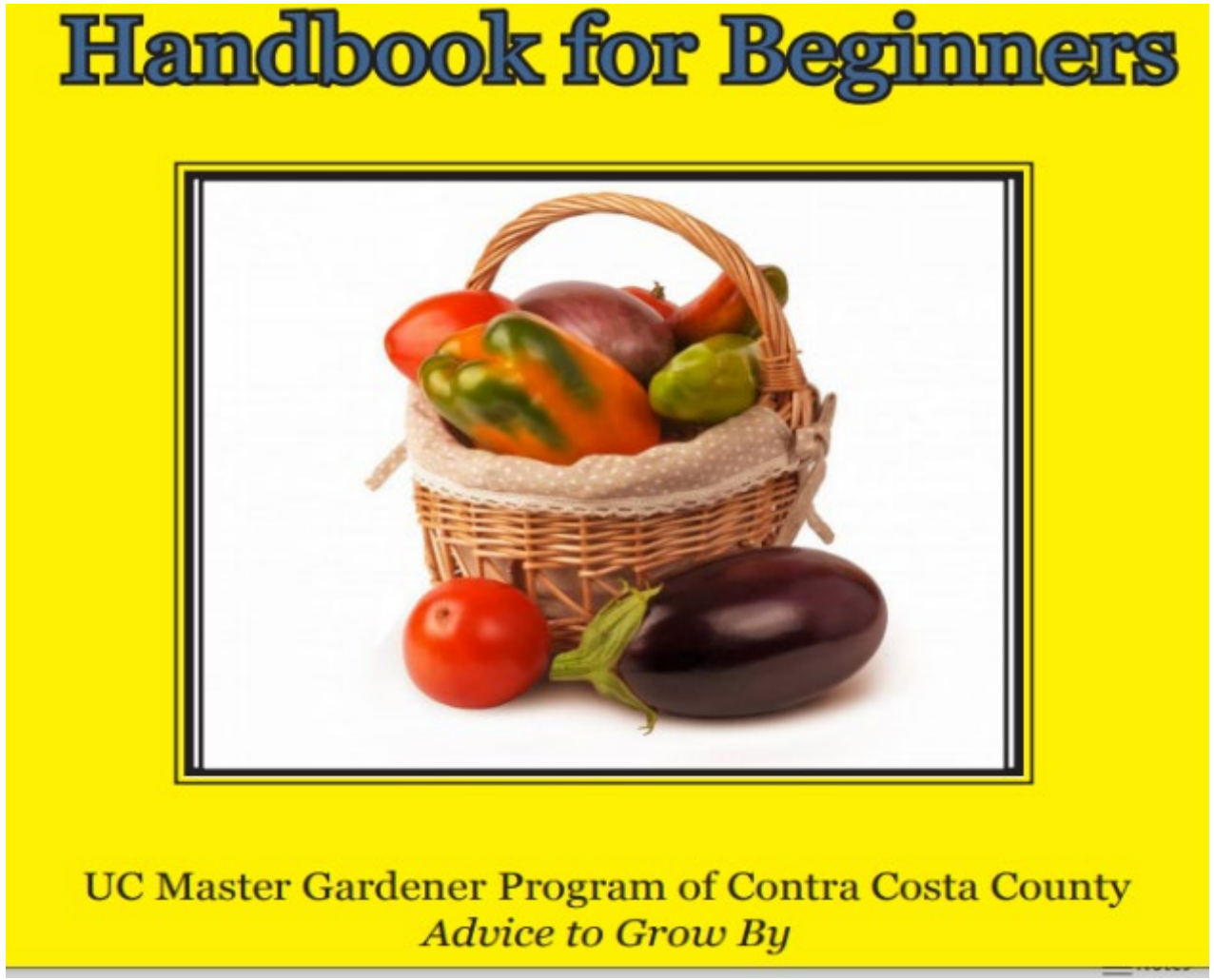
Note: Ideally, **distilled** water should be used when administering a soil test.

Check For Understanding

- What is the definition of nutrition for plants?
- What elements come from air and water?
- Name the three primary mineral elements for plant nutrition.
- How does pH level affect a plant's use of nutrients?
- What are three signs of a plant in distress?
- What are the two types of fertilizers?

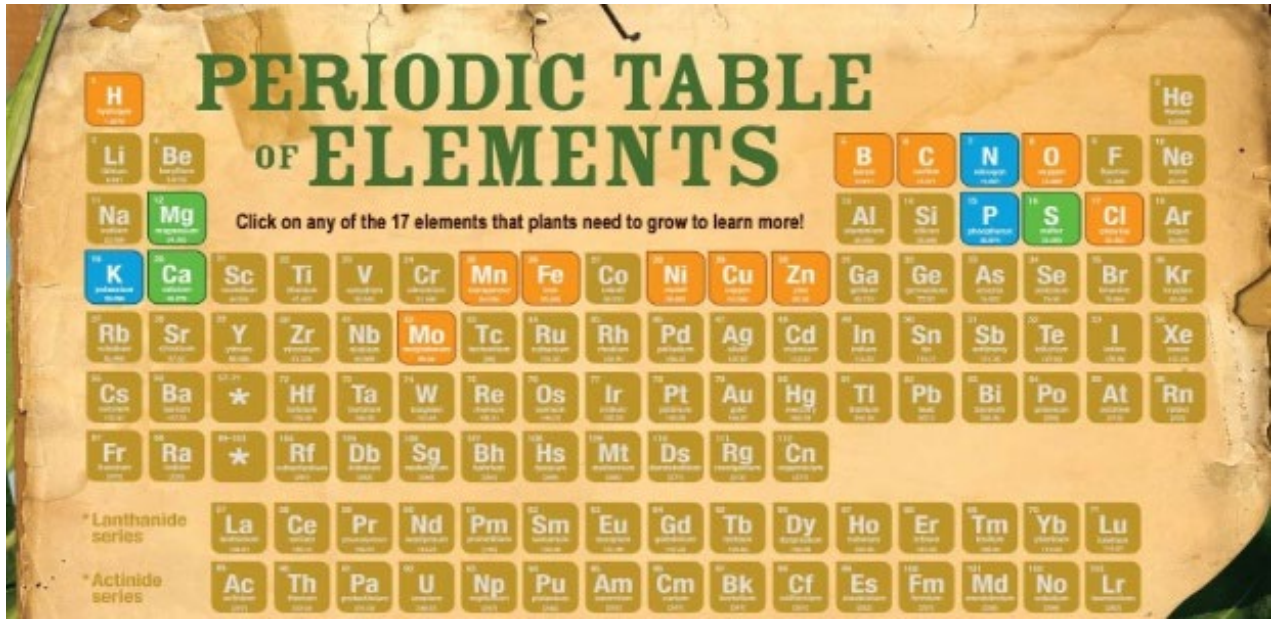
Apply Your Understanding

Research the best options for fertilizing your vegetable garden with inorganic and/or organic plant nutrients. Refer to pages 14-15 in Vegetable Gardening Handbook for Beginners .



Extend Your Understanding

Explore the interactive periodic table to learn more about how each chemical element is important to plant nutrition.



Next Generation Science Standards

PS1.A: Structure and Properties of Matter

▪ Substances are made from different types of atoms, which combine with one another in various ways. Atoms form molecules that range in size from two to thousands of atoms. (MS-PS1-1)

▪ Each pure substance has characteristic physical and chemical properties (for any bulk quantity under given conditions) that can be used to identify it. (MS-PS1-2),(MS-PS1-3)

LS1.C: Organization for Matter and Energy Flow in Organisms

▪ Plants, algae (including phytoplankton), and many microorganisms use the energy from light to make sugars (food) from carbon dioxide from the atmosphere and water through the process of photosynthesis, which also releases oxygen. These sugars can be used immediately or stored for growth or later use. (MS-LS1- 6)

▪Within individual organisms, food moves through a series of chemical reactions in which it is broken down and rearranged to form new molecules, to support growth, or to release energy. (MS-LS1-7)

Career Technical Education
Agriscience Pathway Standards

C10.0 Explain soil science principles.

- C10.2 Summarize how soil texture, structure, pH, and salinity affect plant growth.
- C10.4 Differentiate among the types, uses, and applications of amendments and fertilizers.

C11.0 Analyze plant growth and development.

- C11.2 Identify plant growth requirements.

Resources

- California Master Gardener Handbook, Second Edition, Dennis R. Pittenger, Editor, 2015
- Suny College of Environmental Science and Forestry, https://www.esf.edu/pubprog/brochure/soilph/soilph.htm
- Essential Plant Nutrients - November 27, 2002, Jeff Schalau, County Director, Agent, Agriculture & Natural Resources, Arizona Cooperative Extension, Yavapai County
- Nutrients For Life Foundation

Resources Continued

- Images www.kiddle.co www.Britannica.com www.lowes.com www.cepolina.com www.dreamstime.com www.worldatlas.com www.extension.imn.edu
- Imagehttps://www.fertilizer.org/Public/Media/Change_Makers_Drivers/2019_01_29_Plant_Nutrition_Pioneers.aspx
- Image www.ucanr.edu
- Image www.milorganite.com
- Creative Commons
- Getty Images

Gardening Questions?

- Email the UCCE Master Gardeners of Riverside County
- Email Helpline
  - anrmgriverside@ucanr.edu
- Riverside Master Gardeners Website

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