In Search of Essential Nutrients
Nutrition Label Activity

Grade Levels: 5-12
Time: 45 minutes
Group Size: 30

This activity is a mix of Lesson 1 in the High School/Middle School curriculum and a health lesson.

Brief Description: Students explore the meaning of essential nutrients, using periodic tables to compare the elements that are essential to people and plants. Students make predictions as to where in the environment plants obtain each of their essential elements.

Subjects Taught: Science, Language Arts

Objectives: The students will:

1. Define an essential element;
2. Compare and contrast the essential nutrient requirements of plants and humans;
3. Explain why plants cannot use elemental nitrogen found in the atmosphere; and
4. Identify the sources for each essential nutrient needed by plants.

Materials Needed:
Provide nutrition labels from boxes of cereal (or photocopies), like Quaker Oats® Breakfast Bars, which feature phosphorus and potassium on the label or Cheerios®. Also, have a nutrition label from a snack food, such as a candy bar.
Prepare the images from Masters 1.1to 1.6 in the media available to you.
Colored Pencils – one per student
Projectable images from *Nourishing the Planet in the 21st Century*:

Master 1.1, ***Essential Nutrients;***
Master 1.2, ***The Periodic Table*** ;
Master 1.4, ***Essential Plant Nutrients*** ;
Master 1.5, ***Essential Human Nutrients ;***
Master 1.6, ***Sources of Essential Nutrients***

One photocopy per student:

Master 1.2, ***The Periodic Table;***
Master 1.3, ***Chemical Symbols of the Elements;***
Master 1.6, ***Sources of Essential Nutrients***

Background Information: There are more than 100 known elements that combine in a multitude of ways to produce compounds, which account for the living and nonliving substances we encounter. Out of that list of 100 elements, plants require 17 essential nutrients to complete their life cycles; germinate, grow, build tissue, flower, pollinate, produce seed or vegetative structures to reproduce (runners, tubers, bulbs, rhizomes, etc.) and/or survive cold or dry periods. A nutrient is considered essential if it is required by the plant to complete its life cycle, cannot be replaced by another nutrient, is directly involved in the plant's metabolism, and is required by

many different plants. These nutrients are identified on Master 1-4. Plants that grow on land obtain these nutrients from air, water and soil.

Cells carry on the many functions needed to sustain life. This requires that they take in nutrients, which they use to provide energy for the work that cells do and to make the materials that a cell or organism needs. Plants and humans require similar sets of essential nutrients. The essential nutrients needed by humans are identified on Master 1-05.

In the context of plant requirements, carbon, oxygen, and hydrogen are called the non-mineral nutrients. Some essential nutrients are obtained from more than one source. For the purpose of this activity, you want students to realize that plants obtain their nonmineral nutrients (carbon, hydrogen, and oxygen) from the air and water, while the rest come from the soil.

Activity One: Essential Nutrients

1. Begin the lesson by explaining that scientists who are interested in studying human health must understand the specific needs of the body. Ask:

   "What do humans need to live?"*(Answers will vary.)* Accept all answers.

2. Write student responses on the board, on an overhead transparency, or using an electronic board.
3. Direct the discussion to elicit air (oxygen), water, and food. Some students may realize that sleep is also required for survival. Other students may suggest environmental conditions such as temperature and pressure or material things such as clothing and shelter.
4. Remind students that life requires energy for its existence. Ask students:

   "What do people take into their bodies from their environment to help them survive?" *(Students should recognize from their previous answers that air, water, and food are obtained from the environment.)*

   "What do we need from the air?" *(It is the oxygen in the air that we require.)*

   "Why do we need water? (*Students should be able to explain that our cells are mostly made of water. Water is the medium in which life has evolved. It is required for the chemistry of life.)*

   "Why do we need food to survive?" (*Students should recognize that we derive chemical energy from food and that food supplies the chemical building blocks needed by our cells.)*
5. Remind students that humans (and animals) eat plants and other animals to obtain chemical energy and provide them with the building blocks needed by their cells. Ask:

   "Do plants need food?" *(No, not in the sense that humans or other animals eat food. Plants do not eat. Plants make food from minerals, water, and gasses. Plants do need*

nutrients. What may be commonly be called "plant food" is actually fertilizer.) Make sure students realize that PLANTS DO NOT EAT! Plants absorb nutrients from soil as they take in water. Plants absorb carbon dioxide through their leaves from the atmosphere during photosynthesis.

6. Explain that they will now investigate the chemical elements that are essential for plant growth.
   a. Display an image of Master 1.1, ***Essential Nutrients***.
   b. Ask different students to read aloud the criteria that describe an essential element.
7. Pass out a copy of Master 1.2, ***The Periodic Table*** and a copy of Master 1.3, ***Chemical Symbols of the Elements*** to each student.
8. Instruct the class to think about the definition of "essential element" and use a colored pencil to shade those elements on the periodic table that they think are essential for healthy plant growth based on the information they have learned in the past.
   a. If possible, students should think of an example of how a given element is used by the plant (such as nitrogen being used to make protein).
   b. Give students about 5 minutes to complete this task. This step gives you an opportunity to assess how well students can relate their knowledge of chemistry to biology. For example, students may respond that carbon is used to make sugar. Students likely will not be able to suggest a function for elements needed in trace amounts. Usually, such elements are needed as cofactors for enzymes. It is not important to discuss the uses of each element, but it is important that students understand that these elements are needed to build cell structures and to carry out the cell's chemistry through enzymatic reactions.
9. Display an image of Master 1.2, ***The Periodic Table***.
   a. Ask a student volunteer to read aloud the elements shaded on his or her periodic table.
   b. Have the volunteer explain why he or she selected those particular elements.
   c. Have additional students add to the list with their predictions.
   d. As the elements are read off, circle them on the image.
   e. Students are not expected to identify the complete list of essential elements. Their responses, however, will reflect their relative knowledge about the biology of plants.
10. Explain that you are now going to reveal which elements have been shown to be essential for plant growth and compare them with students' predictions. Display an image of Master 1.4, ***Essential Plant Nutrients***.
    a. Students likely will be surprised that so many elements are essential for plant growth.
    b. The comparison between the elements predicted by the students and the accepted ones should show some overlap, especially among the most abundant elements: carbon (C), hydrogen (H), nitrogen (N), oxygen (O), phosphorus (P), and sulfur (S).
    c. If not already mentioned, ask students to name an important molecule in the cell that requires the element phosphorus. If not mentioned, you can explain that the most important energy molecule in the cell is adenosine triphosphate (ATP) and it includes the element phosphorus.
11. Ask:
    "Do you think that humans require the same essential elements as plants?" *(Responses will vary. Some students may think that since humans and plants are very different from each other, they will need different sets of elements. Others may reason that since plants and humans are each made of cells, the essential elements needed by both will be similar.*

Still others may think that since all of the food humans consume ultimately begins with plants that the nutrients may be similar or exactly the same.)

12. Display an image of Master 1.5, ***Essential Human Nutrients.***
    a. Ask students to comment on how similar or dissimilar the pattern of elements is compared with that shown previously for plants.
    b. Students should notice that the two patterns are more alike than different. If using transparencies, you can align and overlap the transparencies of Masters 1.4, ***Essential Plant Nutrients*** and 1.5, ***Essential Human Nutrients*** to make this point clearer. If using other technology circle the similarities.
13. Referring to the box of cereal and candy bar nutrition labels, ask students what types of nutrients they think humans need and how different foods can provide those nutrients. Have the students look at the labels on the two boxes to see how they compare. Ask:

    "Which nutrients from both labels are the same?"

    a. Have students share with another student in their proximity the ingredients listed on the labels.
    b. Have students refer back to the periodic table of elements. Which of the nutrients from the nutrition label can students find on the periodic table?
    c. Which of the nutrients on the labels are also nutrients that plants need?
    d. Ask students to compare some of the common nutrients that plants and humans both need, such as calcium, copper, iron, magnesium, phosphorus, potassium and zinc.
    e. Based on cereal nutrition label, have five students share which of their foods seem to provide the most nutrients for humans and create a visual list.
14. Summarize the concept that nutrients plants require to grow are the same nutrients humans need to grow; humans receive these nutrients from plants.

Evaluation Options:

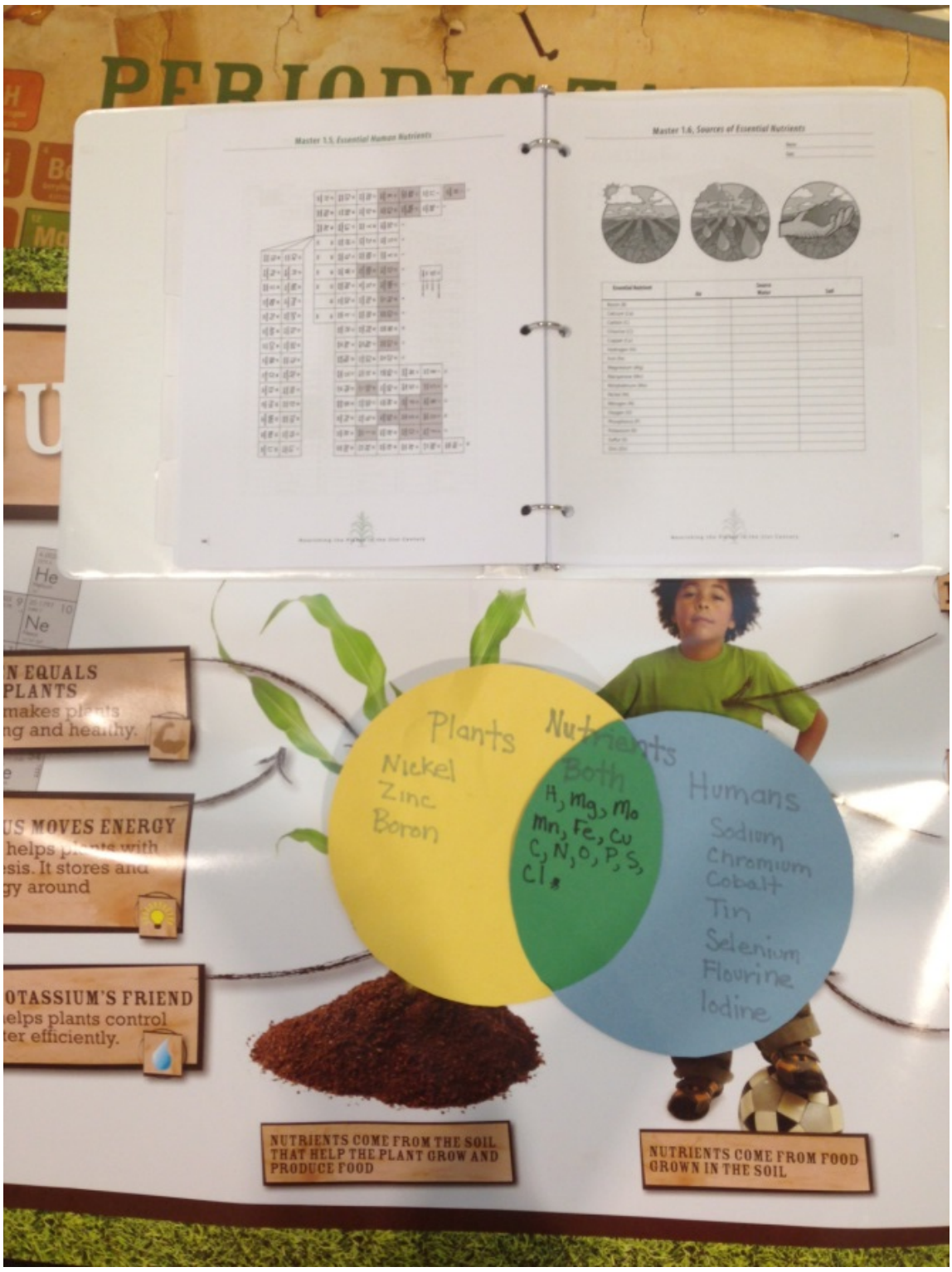
1. Assess student completion and accuracy of ***Sources of Essential Nutrients***.
2. Evaluate student participation in discussion and activities.
3. Have students select one of the nutrients discussed that is essential to both humans and plants, research the nutrient and write how the nutrient is used in plants and in humans, what deficiencies are and sources for both plants and humans.
4. Have students research nutrients that cycle and create a diagram of that cycle (nitrogen, carbon, water).

Sample Pre- and Post-Assessment

1. What is an essential element?

2. Do plants and animals have the same essential elements? If so name three.

3. How do plants obtain essential elements?


Master 1.5, Essential Human Nutrients
Master 1.6, Sources of Essential Nutrients
Plants
Nickel
Zinc
Boron
Both
H, Mg, Mo
Mn, Fe, Cu
C, N, O, P, S,
Cl
Humans
Sodium
Chromium
Cobalt
Tin
Selenium
Flourine
Iodine
NUTRIENTS COME FROM THE SOIL THAT HELP THE PLANT GROW AND PRODUCE FOOD
NUTRIENTS COME FROM FOOD GROWN IN THE SOIL

Serving size 1 Bar (60 g)

Amount per serving	
Calories 220	Calories from Fat 35
	%daily value
Total Fat 4g	6%
Saturated Fat 1g	4%
Trans Fat 0g	
Polyunsaturated Fat 1g	
Monounsaturated Fat 1g	
Cholesterol 15mg	6%
Sodium 230mg	10%
Potassium 135mg	4%
Total Carbohydrate 43g	14%
Dietary Fiber 5g	19%
Soluble Fiber 1g	
Sugars 19g	
Protein 4g	

Vitamin A 20%	• Calcium 20%
Iron 20%	• Vitamin E 10%
Thiamin 20%	• Riboflavin 20%
Niacin 20%	• Vitamin B6 20%
Folic Acid 20%	• Phosphorus 10%

Not a significant source of Cholesterol, Vitamin A, Vitamin C.

*Percent Daily Values are based on a 2,000 calorie diet. Your daily values may be higher or lower depending on your calorie needs.

	Calories	2,000	3,000
Total Fat	less than	65g	80g
Sat. Fat	less than	20g	25g
Cholesterol	less than	300mg	300mg
Sodium	less than	2,400mg	2,400mg
Total Carbohydrate		300g	375g
Dietary Fiber		25g	30g

Ingredients

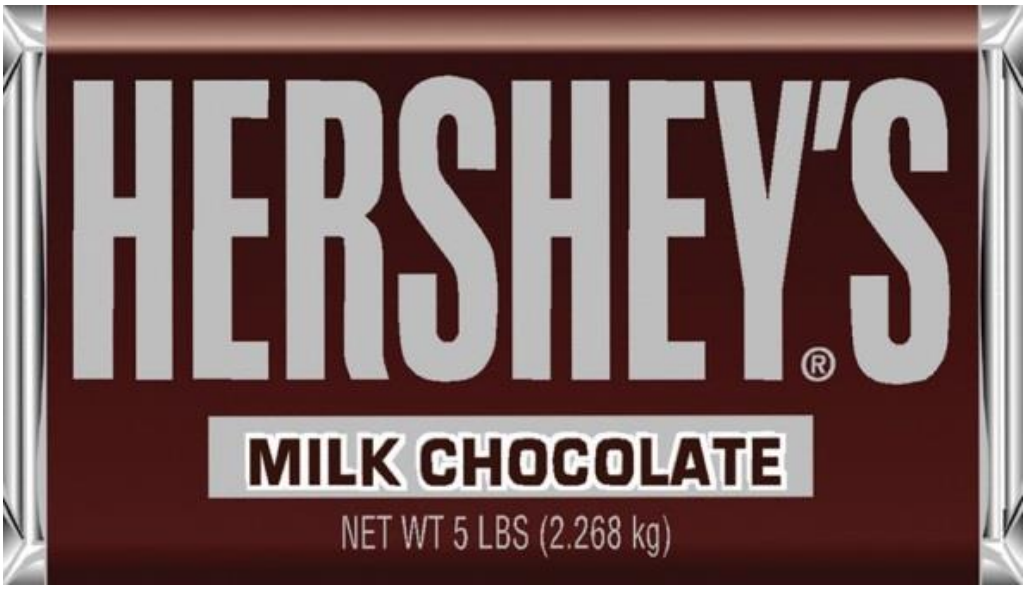
WHOLE GRAIN ROLLED OATS, HIGH FRUCTOSE CORN SYRUP, BROWN SUGAR, OAT BRAN CONCENTRATE, RICE FLOUR, OAT FLOUR, SUGAR, MARGARINE (PARTIALLY HYDROGENATED SOYBEAN OIL**, SOYBEAN OIL, WATER, PARTIALLY HYDROGENATED COTTONSEED OIL**, SALT, MONO AND DIGLYCERIDES, SOY LECITHIN, CALCIUM DISODIUM EDTA [A PRESERVATIVE], ANNATTO COLOR, ARTIFICIAL FLAVOR, VITAMIN A PALMITATE), MALTODEXTRIN, MODIFIED FOOD STARCH, GLYCERIN, CORN SYRUP, DRIED WHOLE EGGS, MALTED BARLEY EXTRACT, CALCIUM CARBONATE, SALT, WATER, SORBITOL, CINNAMON, SODIUM BICARBONATE, MALT (CONTAINS BARLEY, SOY, AND WHEAT COMPONENTS), CORN FLOUR, MALIC ACID, SODIUM ALGINATE, ENZYME MODIFIED SOY PROTEIN, NATURAL MIXED TOCOPHEROLS, CALCIUM PHOSPHATE, SODIUM HEXAMETAPHOSPHATE, POTASSIUM SORBATE AND BHT (PRESERVATIVES), ARTIFICIAL COLOR, NATURAL AND ARTIFICIAL FLAVORS, NIACINAMIDE*, VITAMIN A PALMITATE, REDUCED IRON, SODIUM PHOSPHATE, PYRIDOXINE HYDROCHLORIDE*, RIBOFLAVIN*, THIAMIN MONONITRATE*, FOLIC ACID*

*ONE OF THE B VITAMINS

**ADDS A DIETARILY INSIGNIFICANT AMOUNT OF TRANS FAT

CONTAINS SOY, EGG AND WHEAT INGREDIENTS.
MAY CONTAIN TRACES OF PEANUT AND TREE NUTS.

Quaker® Oatmeal to Go: Brown Sugar and Cinnamon



Nutrition Facts

Serving Size 1 Bar (45g)
Servings Per Package 1
Calories 190
Calories from Fat 63

*Percent Daily Value (DV) are based on a 2000 calorie diet.

Amount/serving	%DV*	Amount/serving	%DV*
Total Fat 7g	**11%**	**Total Carb.** 21g	**7%**
Saturated Fat 4g	**20%**	Dietary Fiber 1g	4%
Trans Fat 0g		Sugars 7g	
Cholesterol 10mg	**3%**	**Protein** 12g	**24%**
Sodium 170mg	**7%**		
Vitamin A	2%	• Calcium	4%
Vitamin C	1%	• Iron	6%

INGREDIENTS: PROTEIN BLEND (WHEY ISOLATE, WHEY CONCENTRATE, SOY ISOLATE, WHEAT ISOLATE), HERSHEY'S* SEMI-SWEET CHOCOLATE CHIPS (SEMI-SWEET CHOCOLATE [SUGAR, CHOCOLATE, COCOA BUTTER, MILK FAT, SOY LECITHIN AND VANILLIN, ARTIFICIAL FLAVOR] AND MILK), CHOCOLATE COMPOUND COATING (WHEY ISOLATE, MALTITOL, PALM KERNEL OIL AND PALM OILS, SUGAR, COCOA PROCESSED WITH ALKALI, SOY LECITHIN, NATURAL & ARTIFICIAL FLAVORS, SUCRALOSE), CORN SYRUP, MALTITOL, MARGARINE (PALM OIL, WATER, SALT, WHEY, VEGETABLE MONOGLYCERIDES, SOY LECITHIN, NATURAL BUTTER FLAVOR, CITRIC ACID [ACIDULANT], BETA CAROTENE [COLOR], VITAMIN A PALMITATE ADDED), SORBITOL, WHEAT FLOUR, DARK COCOA, HERSHEY'S DUTCH PROCESSED COCOA, SUGAR, BAKING SODA, SALT, POTASSIUM SORBATE AND GUAR GUM. **CONTAINS MILK, WHEAT, PEANUTS, AND SOY PRODUCTS. MANUFACTURED IN A PLANT THAT PROCESSES PEANUT, TREE NUT, WHEAT, SOY, MILK, AND EGG PRODUCTS.**

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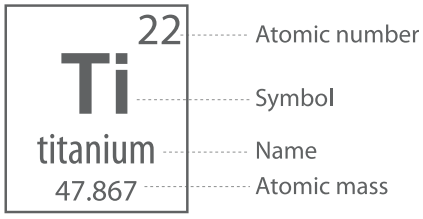
NAME

DATE

MASTER 1.2

THE PERIODIC TABLE



1 H hydrogen 1.0079																	2 He helium 4.0026
3 Li lithium 6.941	4 Be beryllium 9.0122											5 B boron 10.811	6 C carbon 12.011	7 N nitrogen 14.007	8 O oxygen 15.999	9 F fluorine 18.998	10 Ne neon 20.180
11 Na sodium 22.990	12 Mg magnesium 24.305											13 Al aluminium 26.982	14 Si silicon 28.086	15 P phosphorus 30.974	16 S sulfur 32.065	17 Cl chlorine 35.453	18 Ar argon 39.948
19 K potassium 39.098	20 Ca calcium 40.078	21 Sc scandium 44.956	22 Ti titanium 47.867	23 V vanadium 50.942	24 Cr chromium 51.996	25 Mn manganese 54.938	26 Fe iron 55.845	27 Co cobalt 58.933	28 Ni nickel 58.693	29 Cu copper 63.546	30 Zn zinc 65.39	31 Ga gallium 69.723	32 Ge germanium 72.61	33 As arsenic 74.922	34 Se selenium 78.96	35 Br bromine 79.904	36 Kr krypton 83.80
37 Rb rubidium 85.468	38 Sr strontium 87.62	39 Y yttrium 88.906	40 Zr zirconium 91.224	41 Nb niobium 92.906	42 Mo molybdenum 95.94	43 Tc technetium [98]	44 Ru ruthenium 101.07	45 Rh rhodium 102.91	46 Pd palladium 106.42	47 Ag silver 107.87	48 Cd cadmium 112.41	49 In indium 114.82	50 Sn tin 118.71	51 Sb antimony 121.76	52 Te tellurium 127.60	53 I iodine 126.90	54 Xe xenon 131.29
55 Cs caesium 132.91	56 Ba barium 137.33	57-70 ✸	71 Lu lutetium 174.97	72 Hf hafnium 178.49	73 Ta tantalum 180.95	74 W tungsten 183.84	75 Re rhenium 186.21	76 Os osmium 190.23	77 Ir iridium 192.22	78 Pt platinum 195.08	79 Au gold 196.97	80 Hg mercury 200.59	81 Tl thallium 204.38	82 Pb lead 207.2	83 Bi bismuth 208.98	84 Po polonium [209]	85 At astatine [210]	86 Rn radon [222]
87 Fr francium [223]	88 Ra radium [226]	88-102 ✸ ✸	103 Lr lawrencium [262]	104 Rf rutherfordium [261]	105 Db dubnium [262]	106 Sg seaborgium [266]	107 Bh bohrium [264]	108 Hs hassium [269]	109 Mt meitnerium [268]	110 Uun ununnilium [271]	111 Uuu ununnunium [272]	112 Uub ununbium [277]		114 Uuq ununquadium [289]			

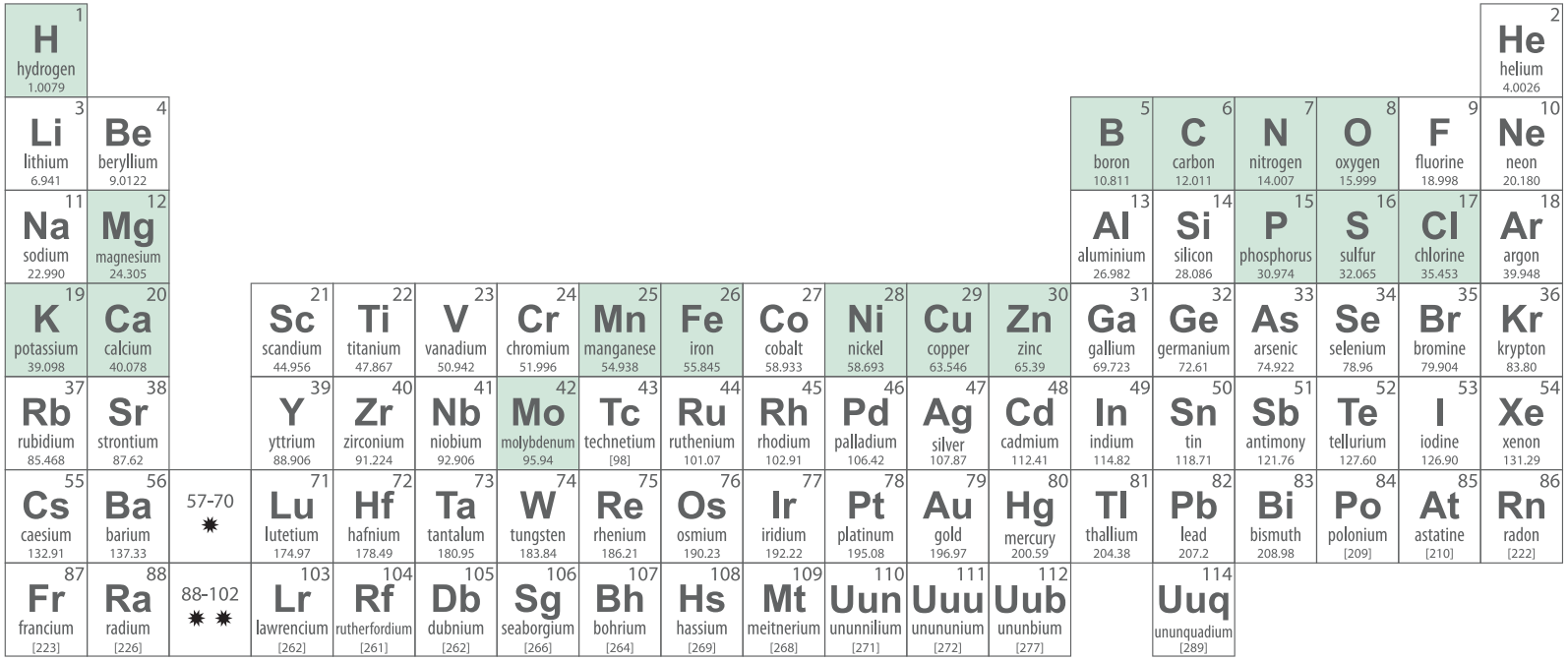
✸ Lanthanide series	57 La lanthanum 138.91	58 Ce cerium 140.12	59 Pr praseodymium 140.91	60 Nd neodymium 144.24	61 Pm promethium [145]	62 Sm samarium 150.36	63 Eu europium 151.96	64 Gd gadolinium 157.25	65 Tb terbium 158.93	66 Dy dysprosium 162.50	67 Ho holmium 164.93	68 Er erbium 167.26	69 Tm thulium 168.93	70 Yb ytterbium 173.04
✸ ✸ Actinide series	89 Ac actinium [227]	90 Th thorium 232.04	91 Pa protactinium 231.04	92 U uranium 238.03	93 Np neptunium [237]	94 Pu plutonium [244]	95 Am americium [243]	96 Cm curium [247]	97 Bk berkelium [247]	98 Cf californium [251]	99 Es einsteinium [252]	100 Fm fermium [257]	101 Md mendelevium [258]	102 No nobelium [259]

NAME

DATE

MASTER 1.3

ESSENTIAL ELEMENTS FOR PLANTS



✸ Lanthanide series

✸ ✸ Actinide series

57	58	59	60	61	62	63	64	65	66	67	68	69	70
La lanthanum 138.91	Ce cerium 140.12	Pr praseodymium 140.91	Nd neodymium 144.24	Pm promethium [145]	Sm samarium 150.36	Eu europium 151.96	Gd gadolinium 157.25	Tb terbium 158.93	Dy dysprosium 162.50	Ho holmium 164.93	Er erbium 167.26	Tm thulium 168.93	Yb ytterbium 173.04
89	90	91	92	93	94	95	96	97	98	99	100	101	102
Ac actinium [227]	Th thorium 232.04	Pa protactinium 231.04	U uranium 238.03	Np neptunium [237]	Pu plutonium [244]	Am americium [243]	Cm curium [247]	Bk berkelium [247]	Cf californium [251]	Es einsteinium [252]	Fm fermium [257]	Md mendelevium [258]	No nobelium [259]

NAME

DATE

MASTER 1.4

ESSENTIAL ELEMENTS FOR HUMANS

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3 Li lithium 6.941	4 Be beryllium 9.0122											5 B boron 10.811	6 C carbon 12.011	7 N nitrogen 14.007	8 O oxygen 15.999	9 F fluorine 18.998	10 Ne neon 20.180
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19 K potassium 39.098	20 Ca calcium 40.078	21 Sc scandium 44.956	22 Ti titanium 47.867	23 V vanadium 50.942	24 Cr chromium 51.996	25 Mn manganese 54.938	26 Fe iron 55.845	27 Co cobalt 58.933	28 Ni nickel 58.693	29 Cu copper 63.546	30 Zn zinc 65.39	31 Ga gallium 69.723	32 Ge germanium 72.61	33 As arsenic 74.922	34 Se selenium 78.96	35 Br bromine 79.904	36 Kr krypton 83.80
37 Rb rubidium 85.468	38 Sr strontium 87.62	39 Y yttrium 88.906	40 Zr zirconium 91.224	41 Nb niobium 92.906	42 Mo molybdenum 95.94	43 Tc technetium [98]	44 Ru ruthenium 101.07	45 Rh rhodium 102.91	46 Pd palladium 106.42	47 Ag silver 107.87	48 Cd cadmium 112.41	49 In indium 114.82	50 Sn tin 118.71	51 Sb antimony 121.76	52 Te tellurium 127.60	53 I iodine 126.90	54 Xe xenon 131.29
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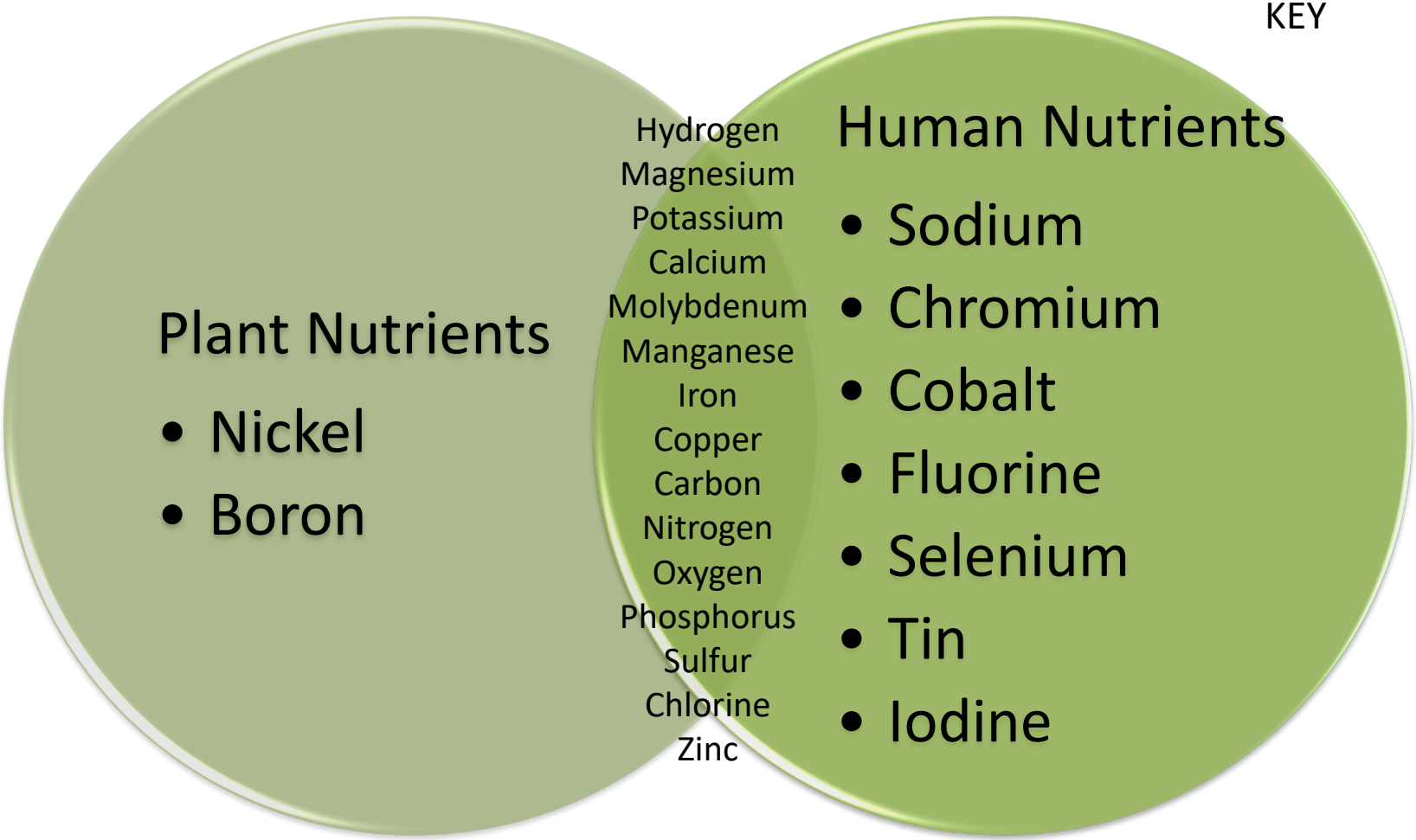
Venn Diagram – Essential Nutrients

ANSWER KEY



Venn Diagram – Essential Nutrients