



Dare to Be Different

Prepared by Dr. Peggy G. Lemaux (Cooperative Extension Specialist)
and Barbara Alonso (Communications Specialist)
University of California, Berkeley | <http://ucbiotech.org/dnafordinner>

WHAT WE WILL DO

- Use the characteristics of the fruits and vegetable to try to group them into related families.
- Identify a mystery fruit or vegetable based on its characteristics.
- Search for fruit and vegetable names based on characteristics in a word search puzzle (*optional*).
- Go on a food finding field trip (*optional*).

WHAT WE WILL LEARN

- All living things, **organisms**, are made up of **cells**.
- The variation in organisms reflects their **diversity**.
- The variety comes from the different **genes** and the characteristics they encode.
- Organisms with many similar traits, and thus with similar genetic information, may be **related**.

TABLE OF CONTENTS

Appetizer	1
What's in a Word?	2
Main Course	2
Activity 1.1: Who Is Related?	3
Activity 1.2: What Am I?	4
*Activity 1.3: Fruit and Vegi Hunt	4
Final Course	5
Dessert	6
Stuffed, But Hungry for More?	6
Next Time We Meet	6
SET Concepts Addressed	6
Leader Supplements for Lesson 1	7
Handout 1.1	8
Handout 1.3	9

* optional



Funding for this project was made available by the
American Society of Plant Biologists' Education Foundation.
<http://aspb.org>



This curriculum follows 4-H SET guidelines
<http://www.ca4h.org/SET>

Appetizer

One of the most fascinating aspects of life on earth is the millions of different living things, called **organisms**. There are 4,500 different species of mammals, 10,000 bird species, 1 million insect species and about 350,000 plant species. And we still haven't found them all! Scientists discover 7 to 10,000 new insect species every year. Differences in all these organisms represent their **diversity**.

We can tell the difference between one organism and another by its **characteristics**, for example, its color, its shape, its size. Often organisms have similar characteristics. The more they have in common, the more likely they are to be related.

An organism's characteristics are determined by the information in its **cells**, the individual compartments that make up the organism. That information is organized into single units, called **genes**. The genes are the recipes that make up a master cookbook and are used to create the entire meal: appetizer, main dish and a dessert. Genes contain the information for **proteins**. We get protein from the foods we eat, like cheese, meat and beans. For example, when we eat beans, our bodies break down the proteins and use them to make things our bodies need. You can think of all of an organism's genes as a cookbook of recipes. For humans and certain bacteria and plants like rice, the information in all the recipes has been determined. There are 20,000 to 25,000 genes that specify a protein in a human cell. Surprisingly plants have slightly more genes than humans, around 35,000 to 50,000.

In plants these gene-recipes are responsible for the proteins that determine the **characteristics** of the plant. Traits for animals include smooth or scaly skin, gills or lungs, fins or legs. For plants, they include fuzz on a peach, sweet taste of a strawberry, tearful smell of an onion, and color of an apple.

What's in a Word?

Words

Cell • Characteristic • Diversity • Genes • Organism • Protein

Participants will find new words in this lesson. Some may be similar to words they already know and some will not be.

Cell is the small compartment that is the basic structural unit of all organisms - often called the building brick of life. The word comes from the Latin word, *cellula*, meaning "a small room".

Characteristic is a distinguishing trait or quality and comes from the original Greek word, *character*, which originally meant "sharpen or cut". The original word referred to a stamp marking one item to make it different from another.

Diversity is being made of distinct characteristics or qualities. The word is related to other words like *verse*, *version*, *vertebra*, and *divert*. The root of the word comes from a Latin word with two parts meaning "turn" and "aside". The word *divert* means "turn in new directions".

Genes are units of information that determine particular characteristics in an organism. The word comes from the old European root *gen-* meaning "to produce". Other words from "gen-" are *genetic* and *genome*. Genes have information that make individuals different. So your genes "produce" you.

Organism is an individual form of life, such as a plant, animal, or bacterium. The Greek word for *organ* means "tool or instrument"; *ism* means "system". So an *organism*, such as the human body, is a "system of tools".

Proteins are essential components of living cells and consist of many individual chemical units called amino acids. The word comes from a Greek word meaning "of first importance", which emphasizes the important role proteins play in living organisms.

You may notice other words with these same roots. By finding the root in a word, you may be able to figure out what it means, even if you have never seen the word.

Main Course

- Lesson will introduce participants to the concept of genetic diversity.
- You will explore how this diversity occurs.
- Three activities are offered in this lesson; one is optional.
- For these activities, the fresh fruits and vegetables or pictures of them should represent whole plants, when possible, and not just their fruits. These could include vegetables with tops, like carrots, beets, green onions, or radishes. Encourage students to observe similarities in all parts of the fruits and vegetables that will lead them to think about the fact that those with similar characteristics, and thus similar genes, may be related.

ACTIVITY 1.1 Who Is Related?

In this activity participants identify different characteristics of fruits and vegetables and try to group them into families.

WHAT TO DO AHEAD OF TIME?

- Provide a variety of different produce items or ask family members to bring items.
- Provide pictures of varied produce, as an alternative.
- Encourage participants to bring different fruits or vegetables so you don't have 20 apples, although different types of apples also display diversity.

- Print copies of the fruit and vegetable Reference Guide or provide access to online version.

- Familiarize yourself with the **Reference Guide (Handout 1.1)**.

WHAT IS NEEDED?

- Varied fresh produce items or pictures of them.
- Sheets of paper, pens or pencils for each participant.

HOW MUCH TIME IS NEEDED?

20 to 30 minutes

Directions

Put fruits and vegetables in the middle of the floor. In small groups, participants can pick up individual items one at a time; in larger groups the leader can pick up the items. Then ask the group the following:

- Can you identify different characteristics of the food, like its color, shape, size, smell, taste (sweet or sour), skin thickness, texture, noticeable markings or sections?
- Does the fruit or vegetable grow above or below the ground? Based on what you know or observed about these fruits and vegetables, explain where you think they grow. On a tree, on a vine, on a plant stem? Does it grow above or below the ground?

Have each student write down the different characteristics that are identified for each food. (This list can be used in Activity 1.2 and the application activity in Dessert.) Remind the participants that the different characteristics are linked to different genes in the plant that specify what the food looks, tastes and smells like.

Once characteristics have been described, ask the participants to group the foods together that seem related, based on common characteristics. See Fruit and Vegetable Families Reference Guide, on the following page or at

<http://ucbiotech.org/dnafordinner>. Even more vegetable families are at: http://www.gardeningdata.co.uk/vegetables/vegetable_families/vegetables_families.php or <http://vegetablesonly.com/VegFamilies.pdf>

Participants will likely group fruits and vegetables in ways different from those shown in the Reference Guide. For example, tangerines and nectarines are both orange in color; onions and carrots both grow in the ground. But neither of these groups are members of the same family.

Don't discourage participants from trying to find similarities in their fruits and vegetables even if they are not related. You can explain that, if they look at other characteristics, such as seeds, a tangerine is more like an orange than a nectarine. The way the seeds look and are arranged in the fruit is specified by genes and the similarity means that likely oranges and tangerines have some genes that are alike – but also some are different since they don't taste the same. Arrange produce according to degree of similarity based on whatever characteristics the participants choose. Then use the guide in **Handout 1.1** to show the true family relationships.

ACTIVITY 1.2 What Am I?

In the second activity, participants will be divided into two groups. Each participant will use the characteristics they discovered in Activity 1.1 to describe the fruit or vegetable in their bag. Based on the characteristics the students will guess the name of the fruit or vegetable in the bag.

WHAT TO DO AHEAD OF TIME?

- Obtain various items of produce or ask family members to bring items. Encourage them to bring unusual items so you don't have repeats.
- Alternatively provide pictures of varied produce.

WHAT IS NEEDED?

- Provide a diverse array of produce or ask family members to bring items
- Alternatively provide pictures of varied produce.
- Lunch bags, pencils, scrap paper

HOW MUCH TIME IS NEEDED?

20 to 30 minutes

Directions

Leader divides participants into two groups. Before the activity begins, leader places single piece of fruit or vegetable in a brown paper bag without others seeing what it is. Leader gives each participant a bag and asks them to make a written list of the fruit's or vegetable's characteristics based on what was learned in Activity 1.1 (or they can use the list that they wrote down in Activity 1.1). Remind participants that the different characteristics are specified by its genes. Characteristics that can be included are color, size, shape, taste (sweet or sour), skin thickness and texture, and noticeable markings or sections. Does the fruit or vegetable grow above or below the ground? Does it grow on a tree or a vine? Offer as much information as possible to help others guess what it is.

One person from each group describes a single characteristic of the food item. The second group works together to guess what the item is and names it. If the guess is incorrect, another member of the first group offers another clue to the food's identity and the second group guesses again. The clues continue until the identity of the fruit or vegetable is correct. Then a member of the second group describes a characteristic of an item in their bag and the first group works together to decide what the item is and names it. If the guess is incorrect, a second member of the group offers a clue; this continues until the identify of the fruit or vegetable is correct.

ACTIVITY 1.3 Fruit and Vegi Hunt (optional)

Use characteristics to identify food in word search.

WHAT TO DO AHEAD OF TIME?

- Make enough copies of the word search for each student or check computer access and web address, so students can play online.
- Have pens or highlighters for participants to use to identify names in the word search.

WHAT IS NEEDED?

- Copies of the fruit and vegi Word Search (**Handout 1.3**)
- or-
- Access to internet to complete the word search online.
- Fruit or vegi snacks for participants who find the most names.

HOW MUCH TIME IS NEEDED?

Allow 20 minutes; some students can be doing this activity while others are doing other activities.

Directions

Remind participants that fruits and vegetables have different characteristics and also different names. Challenge them to find in the word search a fruit or vegetable that has the characteristics given in the hint. Some of the names in the search may be fruits or vegetables they identified in Activity 1.1.

Final Course

What You Will Need

- Examples of whole plant foods, such as carrots with tops, green onions, lettuce, radishes, and sprouts for participants to observe.
- Cookbook or recipes.

Discussion with Participants

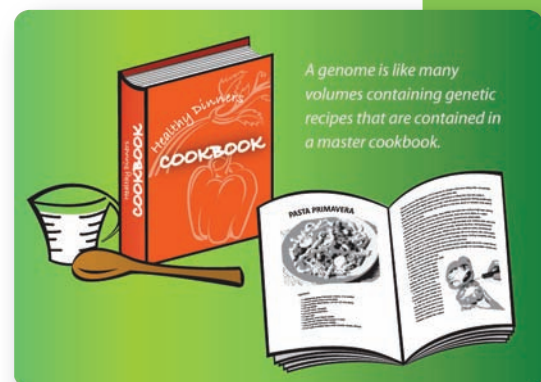
Have participants review their lists of fruit and vegetable characteristics and come up with some general conclusions about the foods we eat and their relationship with each other. Follow their lines of thinking and compare their different thoughts or views. The goal is to have participants use the new terms introduced and to come to conclusions about the concepts introduced. If needed, use the targeted questions below to stimulate discussion and bring out the important points of the lesson. Give participants time to discuss each question.

- Describe the differences you see in the various characteristics of the fruits and vegetables we have.
- Explain why some fruits and vegetables have the same shape or color but are not related.
- Explain how you think the different characteristics of the various fruits and vegetables are related to their genes.
- Explain what differences you have seen in various kinds of pets. What kinds of similarities have you seen in all dogs? All cats? What differences?
- How do you think the similarities and differences of the various kinds of pets and their characteristics are related to their genes?
- Look at the person sitting next to you. How do you think their physical features are related to their genes?

All fruits and vegetables that you saw are produced on plants or trees. Can you describe how different the plants or trees are that they grew on? Look at how different a carrot plant is from a green onion or lettuce. This variation is known as diversity. Different kinds of apples – Granny Smith, Delicious, Fuji – are members of the same family, just like your brothers and sisters, but they still have differences in taste, color and size, indicating they have differences in their genes.

- Tell me what you think it is about an apple tree that makes it produce apples and not tomatoes?
- Why do you think a tomato plant is smaller than a tree?
- Explain why cutting an onion makes you cry. Does the same thing happen when you cut a tomato?

Every organism has genetic information that dictates its characteristics – its height, its weight, its color, its smell – and it is all contained in discrete packets called genes. Genes are like recipes in a recipe box or a cookbook. In organisms, the cookbook is full of recipes called genes and you can tell how closely related two organisms are by how similar their genes are.



Dessert

Food Finding Field Trip

WHAT TO DO AHEAD OF TIME?

- Familiarize yourself with the Reference Guide (Handout 1.1).
- Contact produce manager of market to arrange for participants to visit..

WHAT IS NEEDED?

- Parental permission and transportation for participants to the venue

HOW MUCH TIME IS NEEDED?

Allow 20 to 30 minutes in the store or farmer's market plus travel time.

Directions

Participants take a field trip to the produce section of a supermarket or a farmer's market to examine the diversity among fruits and vegetables. Ask students to bring the lists of characteristics and families they identified in Activities 1.1 and 1.2. Ask them to use what they learned in those activities to group new foods they find in the market.

MATH MENU

1. If there are 3,500 species of mammals and 350,000 different species of plants, how many times more plant species are there?
2. Scientists discover around 10,000 new insect species every year. What percent of existing species does that represent?

See answers in Leader Supplements

Stuffed, But Hungry for More?

- Based on what you learned about characteristics, can you tell me what you noticed about oranges and lemons that make you think they might be related?
- Explain what characteristics humans have that are in common? Other animals like cows and monkeys? With plants? Based on those characteristics, ask the participants to speculate on whether insects or cows have more genes in common with humans and why.

See answers in Leader Supplements

NEXT TIME WE MEET

Information contained in genes (or recipes or folders) is recorded in a special alphabet called the genetic code. Next time we will explore how a code, like the genetic code, can be used to record information and give organisms their characteristics.

SET CONCEPTS ADDRESSED

Discovery-based research and scientific method

National Science Education Standards in Life Sciences
Grades 5-8, Content Standard C: Reproduction and heredity; Diversity
and adaptation of organisms

SET Process Skills Used: Categorize/order/classify; observe;
compare/contrast/hypothesize; organize/order/classify

For more information & additional lessons, please visit
<http://ucbiotech.org/dnafordinner>

Leader Supplements for Lesson 1

Key for Handout 1.3 Fruit & Vegetable Word Search



Characteristic List

CARROTS
CELERY
CUCUMBER
EGGPLANT
LIME
ONION
ORANGE
PEAR
POTATO
TOMATO

Answers to Math Menu

- 100 times 3,500 $\times 100 = 350,000$
- 1% 10,000/1,000,000

Answer to Stuffed, But Hungry for More?

We have some genes in common with all organisms, but more with other animals than with plants. For example, all animals have eyes, most have noses, fur or hair; plants don't. All animals breathe oxygen from the air (birds, mammals) or from water (fish). The processes and the genes involved in using oxygen are the same in all animals. Plants also depend on oxygen although they don't breathe oxygen like humans and most animals do. In fact plants share ~ 40 to 60% of their genes with animals.



Fruit & Vegetable Families

Peach
Apricot
Nectarine
Apple
Pear



ROSE

Cauliflower
Broccoli
Brussels sprout
Cabbage
Bok choy
Radish
Turnip
Red cabbage
Mustard greens



MUSTARD

Asparagus
Onion
Garlic
Leek
Green onion



LILY

Tomato
Potato
Sweet potato
Peppers
(Green, Red, Yellow,
Jalapeno, Anaheim)
Eggplant



POTATO OR NIGHTSHADE

Cucumber
Watermelon
Cantaloupe
Squash
Chayote



CUCUMBER

Coconut
Date



PALM

Plants are classified into groups based on similarities in, for example, their flowers & fruits. For example, the Cucurbitaceae family, squash, cucumber, melon, gourds, pumpkin, produces male & female flowers that need bees to pollinate. But some similarities, like fruit color or shape, can mislead – like the orange color of pumpkins & tangerines.

GRAPE



Grape

Swiss chard
Spinach



GOOSEFOOT

Beans
Peas
Bean sprouts
Snow pea
Lentil
Jicama



LEGUME

CITRUS



Orange
Lemon
Grapefruit
Lime
Tangerine
Tangelo

CARROT



Carrot
Parsnip
Celery
Cilantro
Coriander

SUNFLOWER

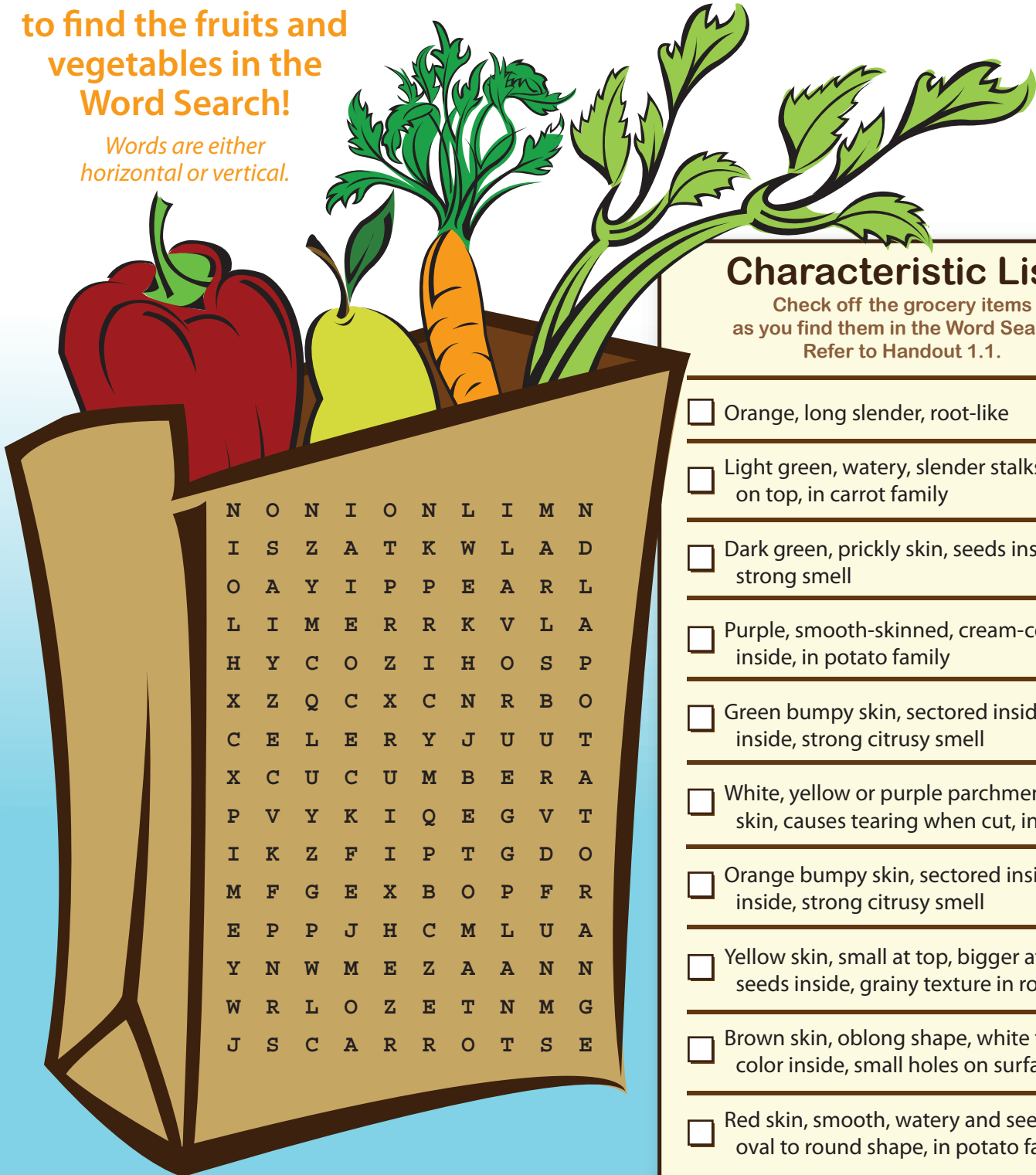


Artichoke
Lettuce
Sunflower

Fruit & Vegetable Word Search

Use the characteristics to find the fruits and vegetables in the Word Search!

Words are either horizontal or vertical.



N O N I O N L I M N
 I S Z A T K W L A D
 O A Y I P P E A R L
 L I M E R R K V L A
 H Y C O Z I H O S P
 X Z Q C X C N R B O
 C E L E R Y J U U T
 X C U C U M B E R A
 P V Y K I Q E G V T
 I K Z F I P T G D O
 M F G E X B O P F R
 E P P J H C M L U A
 Y N W M E Z A A N N
 W R L O Z E T N M G
 J S C A R R O T S E

Characteristic List

Check off the grocery items as you find them in the Word Search. Refer to Handout 1.1.

- Orange, long slender, root-like
- Light green, watery, slender stalks, leaves on top, in carrot family
- Dark green, prickly skin, seeds inside, strong smell
- Purple, smooth-skinned, cream-colored inside, in potato family
- Green bumpy skin, sectored inside, seeds inside, strong citrusy smell
- White, yellow or purple parchment-like skin, causes tearing when cut, in lily family
- Orange bumpy skin, sectored inside, seeds inside, strong citrusy smell
- Yellow skin, small at top, bigger at bottom, seeds inside, grainy texture in rose family
- Brown skin, oblong shape, white to cream color inside, small holes on surface
- Red skin, smooth, watery and seeds inside, oval to round shape, in potato family