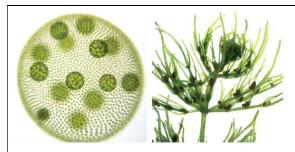# Supplemental Material

CBE—Life Sciences Education

Zambrano *et al.*

Textbook Chapter Manipulations by Condition

Prosocial Utility Value	General Utility Value	Neutral
Located in Text		
This knowledge about the diversity of plant life and the evolutionary relationships between plants is an essential part of helping communities of people. Some examples of how this is accomplished is through healthy foods, medicines, and low-cost clean energy.	This knowledge about the diversity of plant life and the evolutionary relationships between plants is an essential part of human daily life. Some examples of how this is accomplished is through manufactured products and household necessities.	This knowledge about the diversity of plant life and the evolutionary relationships between plants is essential to understand how and why plants colonized land. For example, all land plants emerged from one common ancestor.
Because of their different structures, vascular plants store their own food and water while nonvascular plants do not. This allows vascular plants to survive during changes in the environment, like during a drought. Knowing which types of plants, like certain vascular plants, will survive during drought can provide a greater supply of food to communities that have food shortages during extreme conditions.	Because of their different structures, vascular plants have two different types of vascular tissues, while nonvascular plants do not. The fibers found inside the vascular tissues in certain vascular plants (e.g. the flax plants and cotton) are valuable raw materials used in the paper industry. Knowing which types of plants contain high fiber vascular tissues has allowed manufacturers to develop paper that is stronger and of a higher quality.	Because of their different structures, vascular plants store their own food and water while nonvascular plants do not. Therefore, there is a wider variety of plant groups that belong to vascular plants because nonvascular plants are restricted to growing in or around water.
Located in Sidebar		
Exploring Mosses *Mosses, in particular, can be helpful for people. For example, certain types of moss can be used as an alternative fuel that is clean-burning, efficient, and cost-effective. When it is harvested and dried, its energy potential is similar to that of wood and coal. While it is not a major potential energy source, it can be used in communities to heat homes during the winter at lowered cost.*	**Exploring Mosses** *Mosses, in particular, can be useful for people. For example, certain types of moss are often used as a soil amendment or potting soil ingredient. Since moss can hold onto moisture and nutrients that would otherwise not be retained, adding moss to the soil helps roots absorb more water and nutrients. Therefore, moss can be used for a prosperous indoor plant or outdoor garden.*	**Exploring Mosses** *Mosses, in particular, are soft and leafy. The individual plants are usually composed of simple leaves that are generally only one cell thick, attached to a stem that may be branched or unbranched, and has only a limited role in conducting water and nutrients.*

▲ **Figure 29.2 Chlorophytes (left) and a charophyte (right)** *Heavy metals (including lead and mercury) are persistent in the environment and have serious health consequences for people. Green algae has the ability to bind to these heavy metal toxins, allowing them to be safely excreted from the body and improving health.*

▲ **Figure 29.2 Chlorophytes (left) and a charophyte (right)** *Green algae have chloroplasts that contain chlorophyll, giving them a bright green color, as well as the accessory pigment beta carotene. The green pigment is often used as a food coloring.*

▲ **Figure 29.2 Chlorophytes (left) and a charophyte (right)** *Green algae have chloroplasts that contain chlorophyll a and b, giving them a bright green color, as well as the accessory pigment beta carotene. They store carbohydrates in the form of starch.*
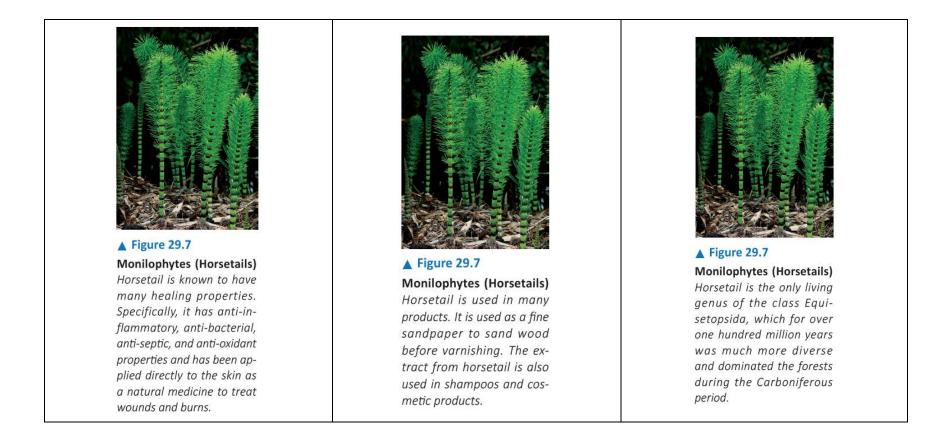

▲ **Figure 29.5 Sphagnum (Peat moss)**

Peat moss is slightly antiseptic and possess superior absorptive power. Their cell walls can lower the pH of their environment to inhibit the growth of bacteria. Since the pH of human blood is close to being the optimum for most pathogenic bacteria, people can use peat moss on wounds to lower their pH in order to inhibit bacterial growth. On account of these properties, they were used for filling absorbent bandages in place of cotton during World War I.

▲ **Figure 29.5 Sphagnum (Peat moss)**

Peat moss has many uses, including being used as soil conditioner to improve the soil's physical qualities. It is also used as a packing material for fine objects. After being dried, peat mosses are broken down into peat-dust (also called peat mould). It is then composted into a finer material and packed in around fragile objects, like furniture, glass objects, and books.

▲ **Figure 29.5 Sphagnum (Peat moss)**

Individual peat moss plants consist of a main stem, with tightly arranged clusters of branch fascicles usually consisting of two or three spreading branches and two to four hanging branches. The top of the plant, or capitulum, has compact clusters of young branches. Along the stem are scattered leaves of various shapes, named stem leaves; the shape varies according to species.

▲ Figure 29.7

Monilophytes (Horsetails)

Horsetail is known to have many healing properties. Specifically, it has anti-inflammatory, anti-bacterial, anti-septic, and anti-oxidant properties and has been applied directly to the skin as a natural medicine to treat wounds and burns.

▲ Figure 29.7

Monilophytes (Horsetails)

Horsetail is used in many products. It is used as a fine sandpaper to sand wood before varnishing. The extract from horsetail is also used in shampoos and cosmetic products.

▲ Figure 29.7

Monilophytes (Horsetails)

Horsetail is the only living genus of the class Equisetopsida, which for over one hundred million years was much more diverse and dominated the forests during the Carboniferous period.

Study 1 Measures

Prior to Experiment

Baseline Prosocial Affordance Beliefs

Instruction: One topic covered in biology is plant diversity. For each statement below, please indicate how much you disagree or agree by selecting an option.

1	2	3	4	5	6	7
Strongly Disagree	Disagree	Somewhat Disagree	Neither Agree nor Disagree	Somewhat Agree	Agree	Strongly Agree

___ I think I can apply knowledge of plant diversity to helping others.
___ I think knowledge of plant diversity can be used to give back to my community.
___ I think knowledge of plant diversity is useful for helping other people like me.
___ I think knowledge of plant diversity can be used to attend to others' needs.

Baseline Topic Interest

___ I think plant diversity is interesting.

During Experiment

Prosocial Affordance Beliefs

Instruction: For each statement below, please indicate how much you disagree or agree by selecting an option.

1	2	3	4	5	6	7
Strongly Disagree	Disagree	Somewhat Disagree	Neither Agree nor Disagree	Somewhat Agree	Agree	Strongly Agree

___I think I can apply knowledge of plant diversity to helping others.
___I think knowledge of plant diversity can be used to give back to my community.
___I think knowledge of plant diversity is useful for helping other people like me.
___I think knowledge of plant diversity can be used to attend to others' needs.

Topic Interest

Instruction: For each statement below, please indicate how much you disagree or agree by selecting an option.

1	2	3	4	5	6	7
Strongly Disagree	Disagree	Somewhat Disagree	Neither Agree nor Disagree	Somewhat Agree	Agree	Strongly Agree

_____ Plant diversity is interesting.
_____ It is a waste of time to learn about plant diversity. [reverse-scored]
_____ Plant diversity fascinates me.
_____ I become very absorbed when reading about plant diversity.
_____ Plant diversity does not hold my attention at all. [reverse-scored]

Perceived Competence

How well do you expect to perform on the quiz today?

O Extremely well
O Very well
O Moderately well
O Slightly well
O Not well at all

Quiz [correct answers are bolded]

1. What are the closest relatives of land plants?
   a. **Green algae**
   b. Red algae
   c. Fungi
   d. Rhizarians

2. Mosses are considered to be a type of:
   a. Vascular plant
   b. **Nonvascular plant**
   c. Ground plant
   d. None of the above

3. How is a plant classified as a vascular or nonvascular plant?
   a. Whether or not the plant has enclosed chambers where seeds can mature
   b. Whether or not the plant has rings of cellulose-synthesizing proteins

c. Whether or not the plant evolved from charophytes
d. Whether or not the plant has a transport system that can transport water and nutrients throughout the plant body

4. What is the classification of these leaves? [For image see Reece et al., 2014, 10th edition, page 625, image of Tunbridge filmy fern].
   a. Acicular leaves
   b. Sporophyll leaves
   c. Microphyll leaves
   d. Megaphyll leaves

5. Seed plants can be divided into two groups: gymnosperms and angiosperms. How are these two groups different?
   a. Angiosperms have enclosed chambers where seeds can mature, while gymnosperms do not
   b. Gymnosperms have extensive vascular structures, while angiosperms do not
   c. Angiosperms have roots that anchor them, while gymnoperms sperms do not
   d. None of the above

6. Which of the following was a benefit that enabled plants to move from water to land?
   a. Bright sunlight that was unfiltered by water and plankton
   b. Atmosphere offered more plentiful carbon dioxide than did water
   c. Soil by the water's edge was rich in some mineral nutrients
   d. All of the above

7. Fill in the blank: Competition for _____ may have stimiluated more evolution in vascular plants that eventually lead to the formation of the first forests.
   a. Carbon dioxide and water
   b. Space and sunlight
   c. Xylem and phloem
   d. Seeds and nutrients

8. In the anatomy of a plant, what is the purpose of the **cuticle**?
   a. It helps release seeds into the air gradually via periodic gusts of wind
   b. It forms extensive networks of filaments through the soil and transfers nutrients
   c. It acts as waterproofing, helping prevent excessive water loss
   d. All of the above

9. Which of the following plant species are the most ancient group of vascular plants?
   a. Bryophytes
   b. Lycophytes
   c. Hornworts
   d. Liverworts

Descriptive Statistics of Variables by Textbook Condition and Ethnic Group.

Variable	Prosocial Textbook			Control Textbooks		
	URM $n = 29$	Asian $n = 14$	White $n = 35$	URM $n = 36$	Asian $n = 35$	White $n = 45$
Before Reading Textbook						
Baseline Prosocial Affordance Beliefs	4.31 (1.15)	4.70 (1.03)	4.23 (1.23)	4.29 (1.21)	4.24 (.96)	3.96 (1.48)
Baseline Topic Interest	3.93 (1.36)	4.14 (1.56)	4.17 (1.56)	4.25 (1.59)	4.11 (1.62)	3.76 (1.65)
After Reading Textbook						
Prosocial Affordance Beliefs	5.26 (1.44)	4.95 (1.10)	4.41 (1.05)	4.08 (1.30)	4.44 (1.11)	3.93 (1.41)
Topic Interest	4.52 (1.42)	4.39 (1.23)	3.90 (1.15)	3.80 (1.36)	4.03 (1.21)	3.80 (1.38)
Perceived Competence	2.45 (.91)	2.43 (.65)	2.49 (.92)	2.67 (.83)	2.60 (.88)	2.67 (.80)
Quiz Score	4.97 (1.84)	5.93 (1.73)	5.89 (1.71)	5.39 (1.89)	5.57 (1.65)	5.87 (1.59)

Notes. Values outside parentheses are means. Values inside parentheses are standard deviations. $N = 194$. One participant was excluded from analyses because they did not fall into the URM, Asian, or White categories.

Prosocial Utility Value

Textbook Coding Scheme & Manual

Prosocial Utility Value (PUV):
Any value or relevant connection that an individual finds that enables them to complete a potential, present, or future goal that is related to helping a community or a group of people.

Coding Scheme

Variable Name on Excel Sheet		Description	Code
Book		Title of textbook	
Chapter		Title of chapter	
Chapter location		Section of the chapter you are reading	1 = Introduction 2 = Body 3 = Conclusion
Page #		Page number you are reading	
RA Initials		Insert your initials here	
#PUV		How many PUV connections?	0 = None 1 = One 2 = Two… etc.
If #PUV ≥ 1	Page Location	Where was the content located on the page?	1 = In-text 2 = Sidebar 3 = Figures/tables/other box
	Text Density	What was the page comprised of?	1 = Mostly text 2 = Mostly non-text
	Text	Insert the actual text here. If the content is an image or other content (not text) describe it here.	
	Question	Is this connection part of a question?	0 = No 1 = Yes

Note: If there you have more than one prosocial connection in on a page (i.e., #PUV > 1), insert another row for each additional prosocial connection that you find. We will code for **each** prosocial connection.

Coding Rubric

Only <u>explicit</u> PUV statements will be coded. In other words, we are only looking for a passage that <u>explicitly</u> states why this information is useful for other humans. There must be no inference required for the statement to be considered PUV. It has to specifically talk about how it can help humans, in statements like ("helps humans" "treat people.")

Example PUV Statements

Example 1.
"Using this new technology, we can establish the innocence of people who have been wrongly convicted of murder and other capital crimes."

Example 2.
"Heavy metals (including lead and mercury) are persistent in the environment and have serious health consequences for people. Green algae have the ability to bind to these heavy metal toxins, allowing them to be safely excreted from the body and improving health."

[REMEMBER!]

❖ **Implicit PUV is NOT PUV**
Passages containing statements that **<u>implicitly</u>** link to PUV **<u>WILL NOT count</u>** as PUV material.

The following example, therefore, is NOT PUV that we are looking for:
"Phosphorous-32 or a phosphate compound incorporating another radioactive isotope such as tc-99m causes tumors to concentrate the radioactive substance and become sources of radioactivity that can be detected."

The statement is missing information about people (e.g. patients), a group of people (e.g. people with a disease), or a community of people.

❖ **Mentioning treatments for diseases itself does not imply PUV**
Remember, the statement must **<u>explicitly</u>** convey a potential, present, or future goal that is related to **<u>helping a community or a group of people</u>**.