

# Destination 2018: Sustainability Lesson Plan

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DISCIPLINE: SCIENCE (BIOLOGY & ENVIRONMENTAL SCIENCE)

The goal of this lesson plan is to help you decide why and where you will infuse sustainability to improve student learning. Remember that sustainability is not an "add-on" content area; rather, sustainability can be integrated into already existing lessons as in-class examples of concepts and as a context for activities and problem sets that promote critical thinking.

## Week 1: Needs Assessment

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This week you will write a needs assessment for your lesson, learn about SDG goals, and identify 3 goals that could align with your course and topic.

### Needs Assessment

1. Write your Needs Assessment:

*(examples)*

*I feel that it could be of benefit to link the concepts of environmental systems and dynamics to more real world examples, and why they should care about the topic.*

2. Explain why you think infusing sustainability will help this need:

*(examples)*

*I think infusing sustainability will help increase student learning and outcomes directly by allowing them to understand how their own personal choices is interconnected with environmental science concepts covered in class.*

3. State where (course or area) you are infusing sustainability and the topic:

*(examples)*

*Intro to Environmental Science– I would like to incorporate sustainability around the learning outcome below.*

*Describe the structure and function of significant environmental systems*

### Research SDGs

Visit the [Sustainable Development Knowledge Platform](#) to research the Sustainable Development Goals.

4. Choose at least 3 of the SDGs of interest that could align with your topic and share why:

*(examples)*

*#6 Clean Water and Sanitation – Students can examine how poor water quality may affect their daily lives.*

*#15 Life on Land – Student can examine how forests contribute to providing food, combating climate change and protecting biodiversity.*

*#13 Climate Action – Students can examine how forests combat climate change, and learn how to take action to combat climate change in their daily lives.*

## Week 1 Reflection

5. Now that you have completed this week's portion of the template, reflect on the following:

- a. I'm excited about...including sustainability into my courses.
- b. I have questions about...how to actually do this....well.

## Week 2: Learning Outcomes/Research

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This week you will write the student learning outcome for your lesson, explore lesson plan examples, look at a variety of classroom assessment techniques, and consider how you could incorporate the 3 Pillars of sustainability with a learning activity.

### Student Learning Outcome(s)

The Student Learning Outcome is a statement of what the student will learn or be able to do because of this lesson. For more information on how to write a measurable learning outcome, review the following resources:

[How to write a Student Learning Outcome \(Slides 1 to 5\)](#) | Bloom's Taxonomy Resources - [Bloom's Taxonomy Action Verbs](#), [Bloom's Interactive Graphic](#), [Bloom's Taxonomy of Learning Domains](#)

6. Write your Learning Outcome:  
([examples](#))

*The student will be able to create visual data highlighting their direct experience with common plant species and communities found in Florida and the importance of biodiversity as it relates to conservation and life on land.*

*The student will also gain exposure to sampling techniques and experimental design.*

## Sustainability Lesson Plan Samples

Explore the following resources for lesson plan ideas:

- [Sustainability teaching activities across the disciplines](#) (Repository developed by Carleton College)
- Lesson plans organized according to conceptual Sustainability Systems: [Water](#), [Energy](#), [Food](#), [Waste](#), [Landscape & Ecosystem](#), [Supply Chain](#), and [Quality of Life](#) (Developed by ASU faculty)
- [AASHE Curriculum Resources Hub](#) (requires login)

7. Of the lesson plans you've explored, pick 3 and share why you selected those:  
([examples](#))

*Riparian Plant Lab - In this field exercise for an introductory environmental science course, students investigate plant cover and type in a riparian area using transects. The final assignment is a lab report that includes a summary data table, a graph of cover types along their transect and an analysis of riparian health.*

*Plant People - This integrated outdoor-learning, research and reflection exercise gives students a first-hand familiarity with local native plants and their significance in local native societies, and engages them in a reflective writing exercise on the value of urban parks. In doing so, they acquire an appreciation for Traditional Ecological Knowledge (TEK) and the importance of combining knowledge and direct experience in order to cultivate sustainable behavior and stewardship.*

*Is the Water Safe for Aquatic Life? - In this field activity students visit local water bodies and measure water quality factors and observe the surrounding habitats. Follow-up questions ask students to apply their data to basic chemistry principles, the scientific method, and graphing. They also ponder sustainability issues such as point and non-point sources of pollution (including personal contributions), impacts of pollution, and potential mitigations. A preliminary worksheet about some major water quality factors is included.*

## Classroom Assessment Techniques

Explore the following resource for Classroom Assessment Techniques:

- [101 Strategies to Demonstrate the Essential Competencies](#) – a college of classroom assessment techniques aligned to the essential competencies of a Valencia educator prepared by Valencia faculty Donna Colwell and Kevin Colwell
- [50 CATs by Angelo and Cross](#)
- [Classroom Assessment Techniques](#) by Northwest Evaluation Association

8. Of the CATs you've explored, pick 3 and share why you selected those:  
([examples](#))

### *Mock Tests*

*Ask students to write test questions as they review the material, which could be done collaboratively in class, where students discuss one another's test questions and the answers. Students will identify key concepts and relationships in a body of material, providing an opportunity for corrections and reinforcing what they do know.*

### *Muddiest Point*

*Ask students to write on an index card anonymously what is clear and unclear about a concept presented in class to ensure comprehension, clarify misunderstandings, and receive feedback on your instruction. This not only encourages self-assessment but also formative assessment.*

### *Group Investigation*

*Students demonstrate their ability to synthesize course content by creating a final project that highlights the relationships between several topics within the course using primary and secondary sources. Students determine the format for presenting their project, which could be a film, slide show, website, etc.*

## 3 Pillars Activity Idea

Review the 3 Pillars Worksheet.

9. Describe an activity that incorporates the 3 pillars:  
([examples](#))

*One of the cornerstones of ecological research is measuring and monitoring biodiversity. These measures can be relatively simple to calculate, but often require many hours spent in the field to collect the data. These measures are vital, considering that such information helps to determine the current state of an ecosystem and allows informed management decisions to be made regarding future conservation efforts.*

*The students will measure species richness (S), which is defined as the number of different species in a given area. To calculate species richness, they will identify and count trees and plants along a transect within the Valencia "arboretum". From this information they will calculate the Jost Diversity Index (D), which provides an estimate of biodiversity for that habitat. This index is based on both number and abundance of different species present.*

## Week 2 Reflection

10. Now that you have completed this week's portion of the template, reflect on the following:

- a. I'm excited about...using a CAT to evaluate the activity above.
- b. I have questions about...which CAT would be suitable one to use.

## Week 3: Putting it All Together

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The goal for this week is to create an activity that incorporates the SDG, CAT, and connection to the 3 Pillars of sustainability.

## SDG Selection

11. Choose the SDG that aligns best with your Needs Assessment/Student Learning outcome and explain why:  
([examples](#))

*#15 Life on Land – Student can examine how forests contribute to providing food, combating climate change and protecting biodiversity. I feel that this SDG deals directly with terrestrial systems / land use topics covered in class.*

## CAT Selection

12. Choose the CAT that aligns best with your Needs Assessment/Student Learning outcome and explain why:  
([examples](#))

*Group Investigation/Data Visualization*

*After returning from field work, students will summarize their biodiversity data on some form of visual medium (ex: bar chart, line graph, etc.) Perhaps there may be a low-stakes summative quiz also that re-enforces the learning outcome.*

## 3 Pillars Activity

13. Describe how you will incorporate the 3 Pillars into your activity:  
([examples](#))

*The environmental pillar is well engrained into this activity. Perhaps I can elaborate in a post activity discussion the social and economic implications as well.*

## Activity Draft

14. Create a draft of the activity using the SDG, CAT, and 3 Pillars:  
([examples](#))

*One of the cornerstones of ecological research is measuring and monitoring biodiversity. These measures can be relatively simple to calculate, but often require many hours spent in the field to collect the data. These measures are vital, considering that such information helps to determine the current state of an ecosystem and allows informed management decisions to be made regarding future conservation efforts.*

*The students will measure species richness ( $S$ ), which is defined as the number of different species in a given area. To calculate species richness, they will identify and count trees and plants along a transect within the Valencia "arboretum". From this information they will calculate the Jost Diversity Index ( $D$ ), which provides an estimate of biodiversity for that habitat. This index is based on both number and abundance of different species present.*

*Remember to wear protective clothing and appropriate footwear for working in dense brush.*

*Objectives*

- *To become familiar with common plant species and communities found in Florida*
- *To gain exposure to sampling techniques and experiment design*
- *To make measures of biodiversity, including species richness and the Jost diversity index*

## *Materials*

*The Valencia Arboretum*

*Dichotomous key for vascular plants [Note: Pictures (as well as underlined names in the dichotomous key) are provided for the plants that you are most likely to encounter in the Arboretum during your lab]*

## *Background*

*Within the Valencia arboretum there are many plant communities represented. We will explore two of the following communities:*

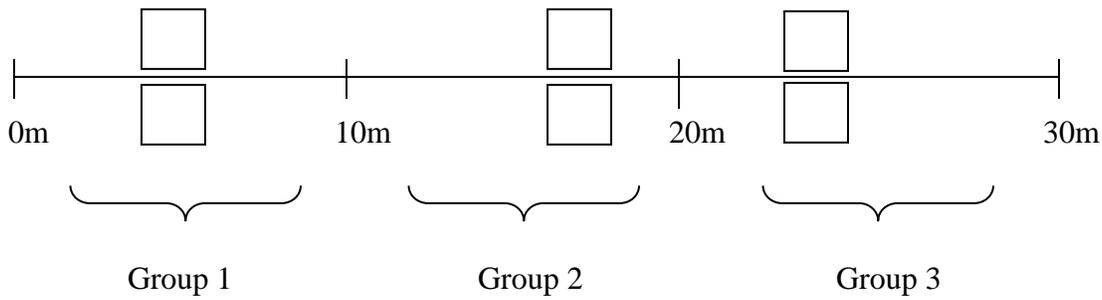
*Pine Flatwoods – once the most dominant plant community in the southeast, this habitat is recognized by the presence of longleaf and slash pines forming a relatively open canopy with saw palmettos and wiregrass in the understory.*

*Freshwater swamps – these are low-lying wet areas that are dominated by cypress, gum, or bay trees. Red maple will often be found here with ferns and willows in the understory.*

*Scrub – this community is recognizable by its deep, extensive fine sand soils. Sand pine, myrtle oak, Chapman oak, rosemary, saw palmetto, and rusty lyonia are commonly found here.*

## *Methods*

*Using the attached picture guide and dichotomous key, you will identify and count the number of species present in a 2m x 2m quadrat. Each quadrat will be set along one of four transects established by your instructor prior to the lab. Site selection is one of many key elements that must be carefully addressed in any scientific study. Thus, randomness must be integrated into quadrat placement to avoid any unintended biases. To this end, each 30m transect will be divided into three 10m sections. Students will work in groups of 4. There will be three groups per transect; the first group will begin at the 0m mark, the second group at the 10m mark, the third group at the 20m mark. Each group will roll a die and place their quadrat that many meters from the endpoint (a die roll of 4 means the quadrat will be placed 4 meters from the endpoint of). Two quadrats will be placed on either side of the transect.*



Within each transect, identify each plant species and its abundance and record your data on the worksheet provided. Once you have made your observations, return to the building and determine the plant species richness and species diversity for each ecological community that was sampled (e.g. scrub, pine flatwood, etc).

To calculate the Jost diversity index ( $D$ ), use the following formula:

$$D = e^{(\sum p_i \ln(p_i))}$$

	A	B
1	<b>Plant Species</b>	<b># of plants</b>
2	Saw Palmetto	25
3	Shiny Lyonia	8
4	Smilax	3
5	Reindeer Lichen	18

1. Calculate the total number of plants found. For our example above the sum is 44.
2. For each species, calculate the proportion ( $p_i$ ) of the total (from 1 above). For species 1 in the example above,  $p_1 = 25/44 = 0.56818$ .
3. For each species, calculate the natural logarithm of  $p_i$  (from 2 above). For species 1 in the example above,  $\ln(p_1) = -5.6531$ .
4. For each species, multiply  $p_i$  by  $\ln(p_i)$ . For species 1 in our example above, this is the same as  $0.56818 * -5.6531 = -0.3212$ .
5. Calculate the sum of the  $p_i * \ln(p_i)$  values. This should be a negative number. For our example data set above, this is  $-1.17992$ .
6. Multiply the result obtained in 5 above by  $-1$  to make it a positive number.
7. Calculate  $e$  raised to your answer in 6 above. For our example data set above, this is  $3.2541$ . Therefore, the Jost Diversity Index ( $D$ ) for this community is:  $3.25$ . This indicates that, although we found 5 different species within this ecosystem, if we take their relative richness into account, there are effectively only 3.25 species within this community.

Which community exhibited the highest species diversity and/or richness?

Would you expect the community with the highest species richness to also exhibit the highest diversity? Why?

15. Explain how the activity aligns with your Needs Assessment/Student Learning Outcome  
([examples](#))

*The student will be able to create visual data highlighting their direct experience with common plant species and communities found in Florida and the importance of biodiversity as it relates to conservation and life on land.*

*The student will also gain exposure to sampling techniques and experimental design.*

## Week 3 Reflection

16. Now that you have completed this week's portion of the template, reflect on the following:

- a. I'm excited about...finalizing the lesson plan! 😊
- b. I have questions about...how to better incorporate the social and economic pillars into the activity.

## Week 4: Lesson Plan Draft

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This week you will finalize your activity and create directions for students.

17. Prepare a set of instructions on how to facilitate this activity.  
([examples](#))

*Answer the following questions:*

What prior knowledge will students need to be successful with this activity?

*They will be given background population and community ecology information the class prior to the activity.*

What needs to be setup prior to delivering the lesson?

*Line transects, field flags, pvc quadrats*

What resources and materials will you need?

*Student lab handouts, dichotomous keys, plant id images, dice*

How do you plan to introduce the topic?

*The topic will be introduced the class before the activity, along with the activity instructions so as to use the entire activity day time.*

How will you keep students engaged?

*They will be responsible for creating a visual summary. Periodically providing background biological/ecological/ethnobotanical stories on economically important plant species and other native/non-native wildlife.*

Step-by-step run of the activity

*Now that you have addressed the questions above, include directions in the draft of your activity*

*Please see the directions in week 3 above—they have remained the same.*

## Week 4 Reflection

18. Now that you have completed this week's portion of the template, reflect on the following:

- a. I'm excited about...implementing the lesson plan, along with a follow-up activity dealing with construction of a bike-path through the "arboretum" and looking through the lenses of various stakeholders.
- b. I have questions about...how best to integrate the bike-path activity so as to include the economic and social pillars of sustainability.