Biodiversity Lesson 3: *The Engineer*
Student Handout

Your Challenge: You have been hired by the National Parks Service as an ecological engineer to create a design solution to preserve an ecosystem's biodiversity and ecological services.

Directions

To tackle this problem, you'll use your Student Guide Planning Organizer to:

1. Research the major threat to the ecosystem and how it impacts the area's biodiversity.
2. Design a plan or device that can preserve the biodiversity and ecosystem services of the ecosystem. Your final product will be in the form of:
    a. A physical model of the plan or device.
    OR
    b. A technical drawing of the plan or device.

Planning Organizer

Which ecosystem are you focusing on?
Think back to our PowerPoint presentation: what do you know about this ecosystem? Do you have any personal experiences in this ecosystem?

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Background Research

What ecosystem service is provided by this ecosystem?	
What is the ecosystem threat you will be focusing on?	
What is causing this threat to the ecosystem?	
How does this impact the biodiversity and ecosystem services of the ecosystem?	

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Create Your Solution

1. Plan	
1A. Restate the problem you are addressing in your own words.	
1B. What do you know about the biodiversity and ecosystem services of your ecosystem that you can use to develop your idea?	

1C. What are your solution requirements? What are some possible constraints (limitations) to consider? *For example, a requirement may be size or usability*; a *limitation may be cost or space*.	
Requirements	Limitations

1D. Brainstorm some ideas for solution designs based upon the questions and prior knowledge above. Label the dimensions and materials on any sketches you make.
1E. From your brainstorm and sketch ideas, **choose one idea** that you will develop further. This will become your final idea. On the sketch, label the function of the idea's key features as well as the dimensions and materials.

1F. Will your design/management plan be a unique design (a new invention) or will it improve upon an existing design/plan (innovation)?
1G. How does your design solution meet the needs of this problem?

1H. What are some **tradeoffs** to this solution? List the advantages and disadvantages of your solution below.	
1I. Advantages	1J. Disadvantages
1K. If you're building a model, identify materials you'll need. If you don't have access to the real-world materials, explain what you'll be using to represent these materials. For example, you might use aluminum foil to represent steel in your build. • • • • • • •	

Teacher Approval Stamp

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2. Create	
With the above plan in mind, now it is time to create your solution. Choose the format in which you'll be presenting your solution: either Option A, building a model, or Option B, creating a technical drawing. Your teacher will specify the amount of time you have.	
Option A. Build a Model Using the approved materials, and being conscientious of others' materials needs, build your device/create your plan. When you're done with your build, create a visual aid of your product that includes: ❏ Title ❏ Sketch/blueprint of device or plan showing proper dimensions ❏ An explanation of how your solution works and how it will preserve the biodiversity and ecosystem services of the ecosystem ❏ Explanations of all parts and how they contribute to the product	**Option B. Create a Technical Drawing** On poster paper, draw your technical sketch. Be sure the drawing includes: ❏ Title ❏ An explanation of how your solution works and how it will preserve the biodiversity and ecosystem services of the ecosystem ❏ Dimensions ❏ Labels and annotations of all parts ❏ Use of full color ❏ Straight lines drawn with a ruler ❏ *Optional: Include sketches showing multiple views. What would your design look like from the front, side, and top?*

3. Reflect Complete after building/drawing your device or plan.	
3A. Did you feel the need to redesign your model or technical diagram as you were building/drawing ? Give examples.	
3B. What were some of the challenges in building your model or drawing your technical diagram? Explain how you overcame your challenges.	
3C. If you were to redesign your model or technical diagram, what would you change and why?	

4. Present

You will have **3 minutes** to present your design solution along with your visual aid. In your presentation, include an explanation of:
 	
❏ The ecosystem you chose to research and the threat to the biodiversity and ecosystem services.
  ❏ Include a picture to represent the ecosystem.
  ❏ Be specific about how the threat impacts the biodiversity and ecosystem services of the ecosystem.
❏ How your device/plan works to preserve the biodiversity and ecosystem services.
  ❏ Be specific: Where will this device be located? How will this device or plan work? Why did you choose your selected materials?
❏ How you plan to measure effectiveness (for example, how will you be sure that this device or plan maintains or increases the level of biodiversity?)
 	
Optional: If approved by your teacher, include appropriate music/song to enhance your presentation (make sure it's not a distraction).

Assessment: Final Product and Presentation

You designed a solution to help preserve the biodiversity and ecosystem services of an ecosystem. Next, present your plan to an audience. Your audience may be a group of your peers, or a group of other members of your community. Use the Checklist and Science & Engineering Practices Rubric to ensure you have addressed all aspects of *The Engineer* with quality work.

Biodiversity *The Engineer* Checklist: Content Concepts and Practices

Your Challenge: Design a plan or device that can preserve the biodiversity and ecosystem services of the ecosystem

Project Completion:

- ❏ Completion of all aspects of Engineering Planning Guide including:
  - ❏ Background Research for Ecosystem and Ecosystem Threat of Choice
  - ❏ Engineering Solution Planning Template
- ❏ Option 1: Device or plan to preserve biodiversity and ecosystem services
  - ❏ Proof of model design plan (visual aid) that includes:
    - ❏ Title
    - ❏ Sketch/blueprint of device showing proper dimensions
    - ❏ Explanation of how the device works to preserve biodiversity and ecosystem services
    - ❏ Explanation of all parts and how they contribute to the device or plan
  - ❏ Model is neat, professional, and well constructed
  - ❏ Reflection of design process completion
- ❏ Option 2: Technical Drawing of Preservation Plan
  - ❏ Proof of technical drawing plan (poster) that includes:
    - ❏ Title
    - ❏ Explanation of how solution works and how it will preserve biodiversity and ecosystem services
    - ❏ Dimensions
    - ❏ Labels and annotations of all parts
    - ❏ Use of full color
    - ❏ Straight lines drawn with a ruler
    - ❏ *Optional: Include sketches showing multiple views. What would your design look like from the front, side, and top?*
  - ❏ Reflection of design process completion

DCI Standards Checklist:

- ❏ Accurate research and analysis of cause of ecosystem threat and impact of threat on the biodiversity and ecosystem services of the ecosystem
- ❏ Design solution is realistic, relevant and could be used to preserve the biodiversity and ecosystem services of an area.
- ❏ Accurate explanation of how design solution works to preserve biodiversity and ecosystem services

Science & Engineering Practices Assessed

	Emerging (1)	Developing (2)	Proficient (3)	Advanced (4)
Designing Solutions	Applies no scientific principles and/or data to design, construct, and/or test a design of an object, tool, process, or system.	Applies minimal scientific principles and/or data to design, construct, and/or test a design of an object, tool, process, or system.	Applies adequate scientific principles and/or data to design, construct, and/or test a design of an object, tool, process, or system.	Applies complete scientific principles and/or data to design, construct, and/or test a design of an object, tool, process, or system.
Developing and Using Models	Drawings, diagrams, or visual models include major misconceptions or have missing parts. Explanation of the model is minimal or not present.	Drawings, diagrams, or visual models include minor misconceptions or have missing parts. Explanation of the model is minimal.	Drawings, diagrams, or visual models are complete, but contain a minor misconception. Explanation of the model is complete but lacking complexity.	Drawings, diagrams, or visual models have no misconceptions and contain all details. Explanation of the model is complete and complex.
Communicating Findings/Design (Oral Presentation)	Findings/design are incompletely and inaccurately communicated. Or no evidence of using appropriate eye contact, adequate volume, or clear pronunciation.	Findings/design are completely communicated with some misconceptions. Or uses minimal eye contact, inappropriate volume, or inconsistent pronunciation.	Findings/design are completely communicated but lacking depth and complexity. Or often uses eye contact and engaging and appropriate volume and pronunciation, but is inconsistent.	Findings/design are completely communicated with depth and complexity. Or mostly uses eye contact and engaging and appropriate volume and pronunciation.