

2019 TEACHER RESOURCES: LESSON PLANS

GRADE LEVEL 9–12 grades

LESSON TIME 4 class periods

INTRODUCTION

The modern industrial age gave way to designs that vastly improved human enterprise through technology, yet there were unintended and destructive consequences for the environment. We can no longer design against the laws of nature merely to suit our own ends. This is where designers (and you!) can help. Designers today are thinking more intentionally and considering carefully the potential ecological impacts of every design decision. Using nature as a guide, they design solutions to global problems that improve our world.

This series of lesson plans was developed to support teachers in facilitating the 2019 National High School Design Competition.

CHALLENGE

What would you design (or redesign) that is a nature-based solution to a global problem?

OBJECTIVES

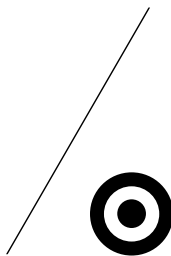
Students will be able to:

- Think critically about the natural world and identify points of inspiration
 - Develop interdisciplinary problem-solving skills
 - Design and prototype a design solution
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RESOURCES

Presentations, worksheets, and the handout for these lesson plans can be found at www.cooperhewitt.org/design-competition-teacher-and-student-resources and include:

- “What is Design” presentation
 - “Nature-Based Design” presentation
 - “Research and Brainstorming” presentation
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- “Defining the Problem” worksheet
- “Mapping” worksheet
- “Design Tactics” handout
- “Design Tactics Matrix” worksheet

Visit the Smithsonian Learning Lab for these resources and more:
<http://learninglab.si.edu/q/ll-c/f2e3DLMNFBGRYGbP>.

ENTRIES

Design Competition Website: www.cooperhewitt.org/designcompetition

Deadline to Enter: February 11, 2019, 11:59 p.m. ET

Students can enter individually or in teams of up to three.

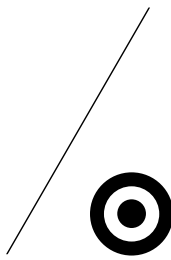
Entries will only be accepted online beginning December 14, 2018, and they must consist of a sketch and answers to the following three questions:

1. Tell us how your design (or re-design) addresses a global problem.
2. Tell us how your design is based on nature.
3. Tell us about your design idea and how it works.

Further details on entry requirements can be found in lesson 4 and on the design competition website.

VOCABULARY

Natural	Design	Process
Synthetic Biology	Designer	Survival
Empathy	Prototype	Renewal
Brainstorm	User	Discovery



LESSON 1: WHAT IS DESIGN?

RESOURCES

- “What is Design?” presentation
- “Defining the Problem” worksheet

GOALS

Students will explore the design process through an overview and case study example, and dive into the first step of the design process, defining a problem.

- Understand design is a process
- Generate potential design challenges at various scales

PRESENTATION

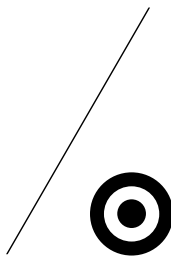
Using the “What is Design?” presentation to introduce students to the concept of design and explore the design process through a case study. Facilitate conversation regarding the ways the steps of the design process support each other and how each step might happen multiple times within a project.

Watch the video in the presentation of designer Tim Fleschner from Eone talking about the importance of defining the problem, and see how he and his team incorporated feedback to reframe their original idea.

ACTIVITY

Understanding what problem to solve is an important step in the design process. A solution to a problem or challenge is at the core of a designer’s work. Using the “Defining the Problem” worksheet, students will focus on what problem they want to solve, beginning at a large, overwhelming issue and narrowing it down to something manageable to address for the competition.

1. Distribute “Defining the Problem” worksheets to students and ask them to identify a global problem (like climate change, lack of access to food, or waste in the fashion industry).
2. Students will start with the bold circle and write in this global problem. Remind students that their challenge should be something they can design for specifically, so once students have identified a problem, they will dissect it into more specific small-scale problems.



3. Ask students to fill in the surrounding circles, identifying more and more specific challenges that relate to their larger challenge. Encourage adding additional circles to allow for more ideas. (For example, waste in the fashion industry could be divided into pollution waste caused by shipping clothes from factories and fast fashion that encourages people to throw clothes away).
4. Challenge students to continue to think about specific locations and people affected to help them identify more focused problems as needed. For many challenges, it is possible to transition from a global problem like 'waste in the fashion industry' to 'shoes that wear out too quickly and get thrown away.' Students should have at least 8 challenges of varying scales.

SUMMARY

Encourage students to think about design challenges at multiple scales considering the contributing factors and related outcomes of those challenges.

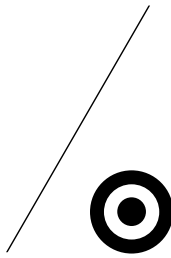
WRITING PROMPT

Reflect and prepare for next steps by asking each student to select one of the real-world challenges from their activity and explain who it affects and/or where it may occur. (Recommended word limit 50 words.)

TAKE HOME ACTIVITY

Ask students to select a smaller challenge from the "Defining the Problem" worksheets and begin conducting research to answer the following questions:

- Who does this problem affect and/or where does it exist?
- What is the primary cause of this problem? Are there additional contributing factors?
- How are designers already trying to solve this problem? Do any products or projects already exist that address this problem? If so, what are their limitations?



LESSON 2: NATURE-BASED DESIGN

RESOURCES

- “Nature-Based Design” presentation
- “Design Tactics” handout
- “Design Tactics Matrix” worksheet

GOALS

Students will explore the breadth of what nature is through examples from Cooper Hewitt’s collection and contemporary design projects. Based on the ideas and tactics that are presented, students will practice brainstorming.

- Broaden appreciating and understanding of “nature”
- Learn tactics from successful design projects
- Generate multiple design ideas employing multiple approaches to nature-based design

PRESENTATION

Begin by introducing students to nature as a guide using the “Can Namib Desert Beetles Help Us Solve Our Drought Problems?” video:

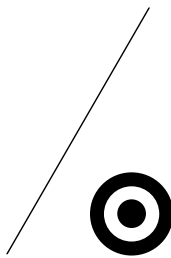
<https://youtu.be/TmyfqjXOf7M>

Next use the “Nature-Based Design” presentation to demonstrate a broad variety of ways to understand nature and be guided by nature. Examples move students from the very simple tactics related to form and material to more complex concepts related to systems and behaviors. Challenge students to stretch their understanding of what nature is and how they can use nature to design for complex challenges. For each example, consider what challenge is being solved in the particular design and how it might relate to a larger global problem.

Introduce the matrix brainstorming method by playing the “Matrix Method” video in the presentation to prepare students for their brainstorming activity.

ACTIVITY

Keeping in mind the projects and tactics presented in the “Nature-Based Design” presentation, use the “Design Tactics Matrix” worksheet to brainstorm nature-based ways to solve problems. Brainstorming works best when many students can share ideas and can be conducted as a whole class or in small groups.



1. Distribute “Design Tactics Matrix” worksheets and “Design Tactics” handouts to the class.
2. Ask students to select three aspects of nature to explore during this brainstorm. Topics can be chosen from class curriculum or from well-known sources (palm trees, spiders, water cycle, etc.). Write one element on each space in the column on the left.
3. In the remaining spaces, ask students to brainstorm ideas based on the specific tactics. Some combinations will be easier than others. If students get stuck, encourage them to move beyond the obvious or to consider a different natural element.
4. Review some of the ideas students have developed and consider how they might inspire or help solve the challenges outlined in the “Defining the Problem” worksheet.

SUMMARY

Students should develop several interesting ideas using the matrix brainstorm that can serve as a resource for developing their final project. Encourage more exploration of creative designs based on nature such as the examples below.

- Air Ink: <https://youtu.be/MqOplj2HSdE>
- Eco Machine: <https://youtu.be/McUTzdVwRHw>

WRITING PROMPT

To dive deeper into their brainstorming, ask students to choose one of the ideas from their matrix and explain what aspect of nature they have identified, what tactic they used, and what is exciting or significant about their idea? (Recommended word limit 50 words.)

TAKE HOME ACTIVITY

Ask students to explore and expand their understanding of nature by conducting additional research on an unfamiliar natural phenomenon, either one that came up in class or a topic of their choosing. Write down ways that their observations might inform their design challenge by following the tactics from class.

- How is this nature or based on nature?
- What is unique or significant about this example of nature?
- How might this have alternate applications or uses?



LESSON 3: BRAINSTORMING

RESOURCES

- “Research and Brainstorming” presentation
 - “Mapping” worksheet
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GOALS

Students will identify the global problem they want to address and potential ways nature will guide the development of their design solutions.

- Select one specific problem to focus on throughout the remainder of the project
 - Determine working groups for the remainder of the project
 - Practice brainstorming, a technique used to quickly generate multiple ideas with a non-judgmental mindset
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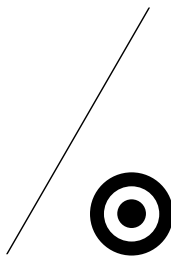
PRESENTATION

In Lesson 1, students defined problems that matter to them and in Lesson 2, students learned about how designers solve challenges with nature-based solutions. In this lesson, students will work either in teams or individually to brainstorm ways they could use nature to solve the problem they identified.

Use the “Research and Brainstorming” presentation to review the design process and Design Competition challenge. Remind students of the focus and goals of a brainstorm. Ideas may come directly from content already covered in class, previous knowledge, or be based on research conducted specifically for this challenge.

ACTIVITY

Working in teams or individually, students will identify a focused problem they would like to solve for the remainder of the unit. If students are working on individual challenges, encourage them to conduct initial brainstorms in small groups to gain a variety of perspectives and different ideas. Students will use their completed “Define the Problem” and “Design Tactics Matrix” worksheets and any associated research to select a problem.



1. Divide the class into individuals or teams who will work together for the remainder of the project. Students working in teams will select one project to work on jointly.
2. Refer to the previous worksheets and select one challenge to address and one aspect of nature, and add to the “Mapping” worksheet.
3. Set a brief time limit to begin (10 min) and ask students to map related properties, components, elements, ideas, behaviors, etc. in order to identify potential solutions to their challenge. Add additional circles to the map as needed, looking for connections and commonalities. (Note: Similar brainstorming can be done using poster paper, whiteboard, post-it notes, or other flexible work surface).
4. Once the map is complete, students will discuss which ideas and solutions they want to develop further. If no viable design solutions have been established, students can repeat the mapping exercise using different nature-based components or modified design challenges to generate more ideas.
5. After several rounds, ask students to highlight or list their top potential solutions from their brainstorming sessions and discuss with their team or individually which idea they would like to develop further.

SUMMARY

Each student should generate multiple ways they might address their challenge during the brainstorm. Mapping is only one technique for generating connections between disparate ideas. Designers might use other tools (such as the matrix method) to push past obvious ideas to unique and interesting solutions. At the end of class, each group should have identified only one main idea and one backup idea to pursue further.

For support on how to narrow down ideas, view the video “From Divergent to Convergent Thinking” in the presentation.

WRITING PROMPT

Ask students to select their top idea from the brainstorming activity and articulate what their design is and how it works. (Recommended word limit 50 words.)





TAKE HOME ACTIVITY

Students should choose between two take home activities to support the development of their design, either incorporating additional research to support their current design or re-defining their problem to allow for a more specific design solution.

1. **Research** – For those who have identified a clear challenge and a strong potential solution, additional research should be conducted in order to support various components of their idea. This may include more research on the problem by repeating the take home activity from Lesson 1 or building their understanding of the nature-based component of their design using the take home activity from Lesson 2.
2. **Reframe** – For a small group of students, they may return to the “Defining the Problem” worksheet and adjust or edit their chosen challenge to better suit the parameters of the competition or the design solutions they have developed. This activity is not starting over, but simply refining their approach to be more targeted and successful.



LESSON 4: PROTOTYPING

RESOURCES

- Cooper Hewitt National High School Design Competition Website: www.cooperhewitt.org/designcompetition
 - 8 1/2 x 11" sheets of paper
 - Prototyping materials (as needed)
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GOALS

Students will refine their design ideas, incorporating feedback from their peers, and create a final diagram or drawing of their design solution.

- Practice giving and receiving constructive criticism
 - Create a visual representation of their design solution that conveys the key ideas
 - Prepare entries for the National High School Design Competition
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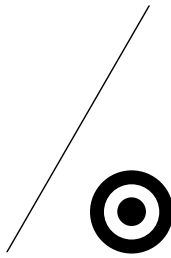
PRESENTATION

In Lesson 3, students came up with an idea of a global problem to solve that uses nature as a guide for their solution that they will now prototype. A prototype is an initial representation of a design idea that allows designers to gather feedback, test, and plan for further refinements. To enter the Design Competition, the idea will need to be expressed visually as a sketch or image of a prototype.

ACTIVITY

Students will work in 2D and 3D mediums to explore their design idea and determine how they want to represent their design solution. Before beginning prototypes, students will present their ideas to the class and receive feedback on their design ideas. Students will modify their designs based on feedback and begin prototyping.

1. Ask students to visually represent their idea in the form of a physical model, a drawing, a storyboard, a map, or other visual representation. Allow 5–10 minutes to gather or produce these initial representations.



2. Ask each student or group to share their design idea to get feedback. Input should focus on the execution of the idea and how successfully it is represented (not on drawing skills). Students should take notes and ask questions when receiving feedback so they can incorporate useful comments in their next steps. (If time will not allow the whole class to participate, feedback can be offered in smaller groups).
3. Once they have received feedback, students should determine if they want to create another drawing or a physical model of their idea using representational materials.
4. Help students strategize about how to condense their idea onto an 8 1/2 x 11" sheet of paper. Students should consider the most important aspect(s) of their idea to communicate and whether multiple perspectives or images are needed to help express their idea.

SUMMARY

Students should focus strongly on the development of their design idea and use the drawing/prototype to help them communicate how their idea works and how it addresses the global challenge they have chosen to solve. Submissions can be completed in any medium and the quality of the sketch will not be judged, but it should help illustrate the design concept.

WRITING PROMPT

Based on the presentations and feedback from their classmates ask each student to write a brief statement that clearly describes what their design is and how it works. (Recommended word limit 50 words.)

TAKE HOME ACTIVITY

Create your entry for the National High School Design Competition. Students can enter individually or in teams of up to three. Further details and resources can be found at www.cooperhewitt.org/designcompetition.

Entries will consist of the following:

- **One sketch of your design idea on an 8 1/2 x 11" sheet of paper.** Your sketch can be drawn in any medium by hand or on a computer. The quality of the sketch will not be judged, but it should help illustrate the design concept. Remember, you will have to create a .jpg file of your drawing when it's time to enter.



If you are a student with a disability, you may submit a written description of your idea as a .pdf or an audio description of your idea as an .mp3 as needed.

- **Written responses to the challenge questions.** The online entry form will include a box where you can copy and paste your statements.

If you are a student with a disability, you may submit audio files of your responses as .MP3 files as needed.

What would you design (or redesign) that is a nature-based solution to a global problem?

1. **Tell us how your design (or re-design) addresses a global problem.**
What challenge in the real-world would your design help solve and for whom? Is this something you observed or experienced? (50 words or less.)
2. **Tell us how your design is based on nature.**
What aspect of nature has guided your design? Why did you choose this? (30 words or less.)
3. **Tell us about your design idea and how it works.**
Describe your solution, its key components, and explain how and why it would work for the users you have identified. (50 words or less.)