

Connecting with Climate

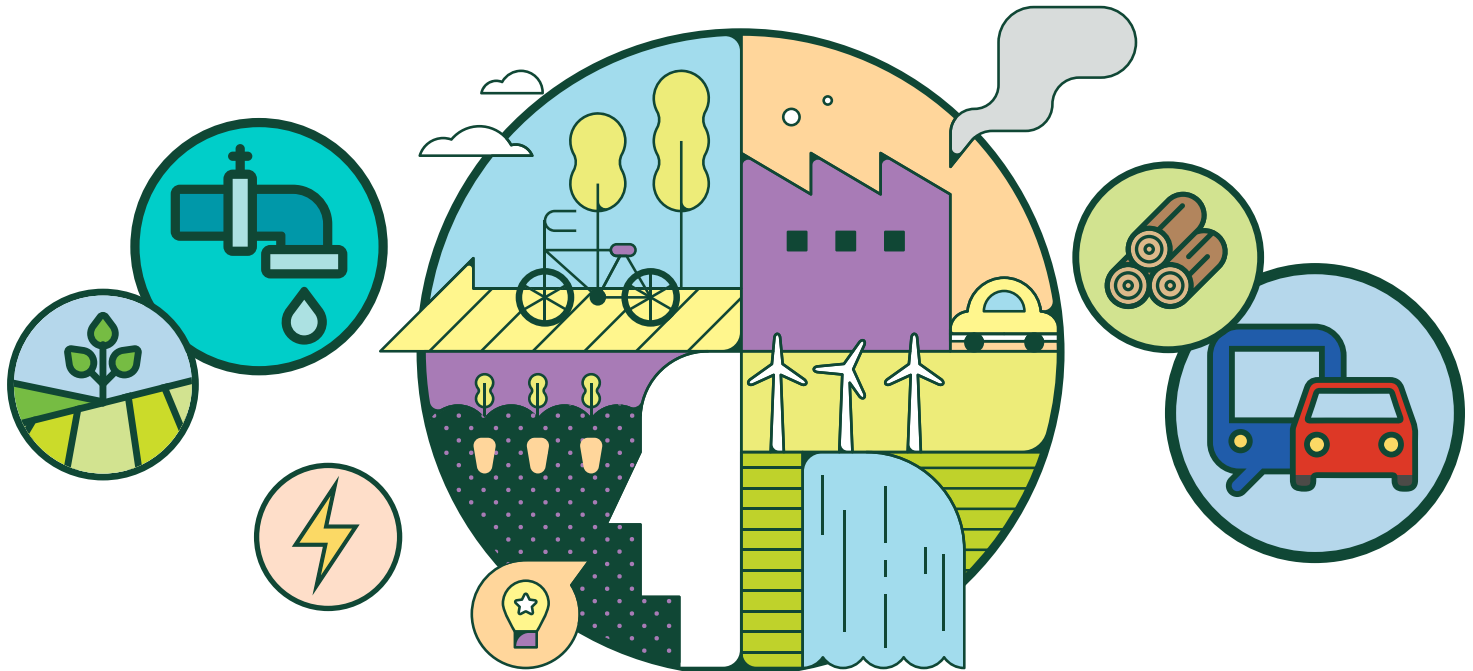
Grade Levels: 6-12

Duration: 90 min

PRESENTED BY



In this systems design activity, learners will explore how to problem-solve when approaching large-scale, multidimensional issues like climate change.



Outline

Frame the Activity	10 min total
Activate Prior Knowledge	5 min
Introduce the Activity	5 min
Activity	80 min total
Digital Collage	20 min
Ripple Effects: Find Connections	15 min
Brainstorm Solutions	20 min
Share and Reflect	15 min
Debrief	10 min

Grade Levels: 6-12

Duration: 90 min

Concepts/Skills

Brainstorming, problem-solving, sustainability, communication, organization

Objectives

Students will:

- Explore the complexities of multidimensional environmental issues by creating digital collages.
- Engage in a systems design challenge by exploring how environmental issues are interconnected and can result in ripple effects.
- Brainstorm, develop and share innovative solutions while also exploring the potential effects they can have on other environmental issues.



Lab Connections:

[Down the Drain](#)
[Sustainable Cities](#)

Materials and Preparation

Materials

- [Connecting with Climate MURAL Template](#)
- Projector (to share digital collages)
- Whiteboard or chart paper and markers
- Computers/tablets for creating digital collage (1 per group of 3-4 learners)
- Scratch paper (6-8 pages per group of 3-4 learners)
- Pens or pencils (1 per learner)
- *Optional:* Magazines, sticky notes, scrap paper, chart paper and other supplies for physical collage



Preparation

1. Post the five categories of environmental issues where learners can see them: water management, food production, energy generation, transportation, and material reuse.
2. Load the digital collage tool onto each of the devices.
3. Have scratch paper (and writing utensils, if necessary) available to pass out.
4. Try out the activity yourself, with other educators or kids you know. This will give you practice with the resources so you can anticipate student questions.



Adaptations

Digital Collage Options:

- Use The Tech's [Connecting with Climate Template in MURAL](#) for this activity, or design your own template in the tool of your choice. Google Slides, Jamboard, Padlet, etc. all provide options for a collaborative workspace.
- Note that you will need one workspace for the five categories as well as a Collective Workspace section for teams to note the ripple effects between categories. In addition, you will need space for each team to brainstorm their solutions.

Distance Learning:

- Have learners individually contribute ideas to the shared digital space. Host shared video calls and break-out rooms if possible for learners to share ideas and collaborate virtually.
- For more tips on adapting Design Challenges to a virtual setting, see our [Educator Tips for Remote STEM Learning](#).

Physical Collage:






- Not enough devices? Have learners create physical collages by cutting and sorting images, or even by drawing images on small pieces of paper.
- Provide space for teams to post or display their collages later in the lesson when they are looking for connections between the categories.

Background Information

The [Solve For Earth](#) exhibition at The Tech Interactive explores the connections between technology and living sustainably on Earth, examining human impacts on our Earth systems. The Connections Wall installation, which inspired this activity, highlights the interconnectedness of all aspects of our environment. **Environmental issues** are not a series of problems that need to be addressed individually. They are a part of a vast system of interrelated problems that deeply affect one another. This lesson empowers learners to consider the complexities of large-scale, multidimensional problems, as well as how solutions for one aspect of the problem could positively or negatively affect another.



This lesson will examine five categories of environmental issues and their connections:

 <p>Water Management</p>	 <p>Agriculture and Food Production</p>	 <p>Energy Generation</p>	 <p>Transportation</p>	 <p>Material Reuse</p>
<p><i>Managing the optimum use of water resources.</i></p>	<p><i>Growing our food and processing the raw ingredients into food products.</i></p>	<p><i>Generating electric power from primary energy sources.</i></p>	<p><i>Movement of people, animals and things from one location to another.</i></p>	<p><i>Use of a product or material for another purpose.</i></p>

Systems Design Challenges

Systems Design Challenges present learners with a real-world problem that is part of a complex system. Learners examine the intricate parts of that problem as they design potential solutions. In this introduction to systems design, learners will focus on deconstructing a complicated problem and begin to explore their own role as problem-solvers and the impact they can create. These problem-solving approaches can be applied to a range of problems and professional careers in addition to the environmental issues used in this lesson.

Frame the Activity

Activate Prior Knowledge (5 min)

1. Begin this lesson by tapping into learners' own experiences and knowledge of complex problems.
2. Ask them what they think of when they hear multidimensional problem, complex issue, or even systemic problem.
 - Learners may provide a range of examples of large-scale problems facing the world today: social justice issues, poverty, homelessness, the environment. etc.
3. Let learners know that during this lesson they are going to try a **systems design challenge**. They will use this problem-solving technique to approach complex problems, try to break them down, understand them, and develop innovative solutions.

4. Tell learners that the complex problem they are going to explore in this systems design challenge is the environmental issues facing our world today.
5. Use these **Guiding Questions** to activate their prior knowledge about this topic:
 - *What are some examples of environmental challenges we currently face in the world?*
 - *What are some of the effects of these environmental issues on the world, your community, your daily life?*
6. Invite learner responses and lead a short discussion about the term **environmental issues** and different ways they affect our world.
 - If learners are unfamiliar with the term, define environmental issues as the harmful effects human activity has on the environment.
 - During the discussion, point out that global problems like environmental issues are *multidimensional*, meaning there will be many aspects to the problem that need to be considered. *For example:* a lack of water may make it harder to grow food as well. They will have a chance to examine that idea more throughout the lesson.

Introduce the Design Challenge (5 min)

1. Introduce learners to the **five categories** of environmental issues and provide a brief definition for each one.
 - Make connections to any issues that learners brought up during the initial discussion.
 - These categories represent some of the biggest environmental issues affecting the world. People all over the world are trying to develop sustainable solutions to issues within these categories.
 - Each of these categories is also a part of the complex system of environmental issues. In other words, any changes to these categories can potentially affect others, leading to unexpected results or consequences.
2. Let learners know they will be doing a **design sprint**. This means they will use a number of creative brainstorming techniques to develop initial ideas for a sustainable solution.
3. Introduce the activity with a design problem, criteria and constraints.

Design Problem	Start designing a solution to a problem in one of five categories of environmental issues.
Criteria	<ul style="list-style-type: none"> • Solution addresses smaller parts of the larger problem. • Solution shows consideration for its effects (positive or negative) on other parts of the problem or another environmental issue. • <i>Bonus:</i> Your solution is also interconnected and creates positive change in more than one category.
Constraints	There's a time limit!

4. Organize learners into teams of 3-4. Assign each team one of the five categories of environmental issues.
 - Repeating the categories is fine if there are more teams than categories.
 - The teams will be pairing up to share solutions at the end of the activity, so make sure there are an even number of teams.
5. Assign each team a device with the **MURAL Template (Step 1)** or your alternative digital collage tool already loaded.

Activity



Create a Digital Collage (20 min)

1. Let learners know that the first step to solving a complex problem is deconstructing it, understanding its components and defining a specific problem. So, learners will first need to understand the category they have been assigned and problems within it.
 - Acknowledge that, because these environmental issues are expansive and multidimensional, there can be an overwhelming amount of information to consider. They don't need to try to know everything about these topics.
 - Let them know they will start by organizing what their team already knows about the issue and related problems.
2. To help visualize and define the problem, learners will create a digital collage ([MURAL Step 2](#)).
 - Their collage will communicate quickly what their team knows about their category.
 - The goal is to be able to see many aspects of the issue at once.
3. Project the digital collage tool and walk learners through the process.
 - Teams will have a short time limit to encourage rapid ideas.
 - Let teams know they can also include questions and things they want to learn in addition to what they know.
 - Encourage teams to add images and ideas that are meaningful to them rather than choosing the first thing they see during an internet search.
4. Teams should use the remaining time to work on their collage (*approx 18 min*).

Digital Collage Prompts:

- *What do you already know about how your environmental issue is affecting the planet?*
 - *Do you see the effects or consequences of this environmental issue in your own lives?*
 - *What images or emotions come to mind when you think about your environmental issue?*
5. Provide a five-minute and one-minute warning. Bring the class back together when the time is up.



Tips for Digital Collage

- Encourage teams to use a variety of media to build their collage, including copy-paste images, links to videos or articles or even text and emojis 😊
- Resources for images include:
 - [Environmental Photographer of the Year](#)
 - Pixabay, Unsplash and other free image websites
- Provide a workspace (section of a mural, slide, Padlet, Jamboard etc.) for each category.
 - If there are multiple teams per category, divide the workspace so they can work separately in the same area, but later coordinate and combine their ideas.
- If you are not using the [MURAL template](#), make sure to provide a Collective Workspace where all the groups can copy and paste their collages. This will allow them to label interconnected problems while exploring ripple effects in the next section.



Ripple Effects: Find Connections (15 min)


1. Tell learners that, now that they've developed an understanding of the complexities of their team's environmental issue, they will next need to consider how the problems from these five categories are interconnected.
2. Introduce learners to the term **ripple effect**, when an event causes other situations or events to occur indirectly.
 - *For example:* A ripple effect of the Arctic sea ice melting due to climate change is a smaller supply of food sources all the way through the food chain.
 - These ripple effects can be positive, negative or even a combination.

Examples of Ripple Effects

Students may notice other positive and negative ripple effects related to these examples.

Event/Situation	Positive Ripple Effects	Negative Ripple Effects
Plastic waste not properly recycled		Microplastics ingested by sea life end up in our food and bodies.
Wolves reintroduced into Yellowstone	Trophic cascade: Biodiversity improved. Trees flourished and the course of the river changed!	
COVID-19 pandemic	Fewer people were traveling, so CO ₂ emissions improved.	
Reduced use of coal to generate electricity	Reduced mercury pollution.	
Clean renewable energy	Less CO ₂ emissions.	Chemicals used to create solar panels can harm the environment.
An increase in electric vehicles	Lower CO ₂ emissions.	Lithium mining causes localized pollution of water and health issues for miners.

3. Project each collage for 30 seconds and have students start noting or calling out connections they are seeing
4. Project the Collective Workspace ([MURAL Step 3](#)). Demonstrate how teams can draw lines, add comments, or copy and paste ripple effects and connections between the categories.

 **Tip:** Copy team collages over to the Collective Workspace prior to this step so teams can see all of their ideas together.

5. Give teams 5 minutes to work individually and take notes in the Collective Workspace where they think different categories could potentially affect each other.
 - *Where do they see connections from the information on the collages?*
 - *Can they think of other potential connections from their real-world knowledge?*
6. At the end of the time, review the ideas generated as a class.

Notes:

- This activity serves as a brief introduction to the complexity of environmental issues and the ways in which our actions, problems and solutions are all interconnected. Focus on this larger goal and the idea that becoming aware of these connections can help us develop more informed and effective solutions.
- When considering large-scale, multidimensional issues like the environment, students can become overwhelmed and focused on the "doom and gloom" or negative effects. It can help to include stories of positive change to motivate student engagement.

Extension

Before they start brainstorming ideas, have teams conduct research on their environmental issue category. Ask them to consider the following as they look up information.

- *Currently, what are the biggest concerns in this category?*
- *Which practices in this category appear to be sustainable? Which do not?*
- *What do experts recommend must happen in order for the environmental issues to improve?*

For resources and suggested websites by category, see the [Appendix](#).

Tech Tips

For more tips on facilitating a brainstorm and suggestions of alternative techniques, see our [Brainstorming Tech Tip \(PDF and Video\)](#) and explore more about Design Challenge Learning.

Check out thetech.org/resources for more design challenge facilitation tools and techniques.

Brainstorm Solutions (20 min)

1. Now that they have explored both the interconnectedness of the environmental issues, it is time to think about sustainable solutions.
2. Inform learners that they will do a **design sprint** as a team to brainstorm innovative solutions to their environmental issue.
 - Remind learners that the goal of a design sprint is to get lots of quick ideas. They do not need polished, realistic solutions by the end of this activity.
 - Let them know that their ideas can be wild and can include technology that isn't necessarily accessible today. Electric cars and the cell phone were once considered wild ideas, too!
3. Teams can brainstorm in a digital workspace ([MURAL Step 4](#)) or using sticky notes, pencil and paper. Make sure they have the materials needed and lead them through the timed Round Robin brainstorming exercise.

Round Robin Brainstorm example

	Column A	Column B	Column C	Column D	Column E
Round 1					
Round 2					
Round 3					

4. Pick a Problem (2 min)

- Each team will need to choose one problem from their category that they want to develop a solution for.
- Each learner can star/circle their top three choices to help the team select their favorite idea.
- They should write this problem at the top of their brainstorming space.

5. Round Robin Brainstorm Chain (10 min)

Next, tell teams they will have a Round Robin Brainstorm. Let them know you will facilitate the process and move them on through each step. Direct each team to the digital brainstorming workspace ([MURAL Step 4](#)).

(**Note:** Use sticky notes or note cards for a physical adaptation.)

- (3 min) Each learner should come up with at least three ideas that they place in their column in their team's brainstorm space.
- (3 min) Have learners move down and to the right in the workspace. They should look at the ideas of the person in the column above them. In the space below, they will either add on to the idea or create a new idea inspired by the others. Ideally they will have generated at least three ideas by the end of the time limit.
- (3 min) Have learners move down and to the right again. They should repeat the same process, looking at the two previous sets of ideas in that column and generating their own.
- The goal of the short time limit is to encourage rapid brainstorming and limit judgment. Remind them that, during brainstorming, ideas can be wild and random. They do not need to create a workable solution.

6. Select a Solution (8 min)

- When the time is up, teams stop where they are. Celebrate the volume of ideas they generated, and have them choose their team's favorite solution to share with the rest of the class.
- Again, learners can star/circle three ideas to help the team narrow down their selection.
- In addition, encourage teams to consider which solutions might be connected to other categories.
 - Which solution(s) would have the most positive impact on your issue?
 - Which solutions(s) can potentially impact other categories positively?
 - Which solutions(s) can potentially impact other categories negatively?

7. Make sure teams write down their final solution so they are ready to share in the next section. Encourage them to capture:

- Basic details of their solution.
- Their category (environmental issue).
- The problem they were trying to solve.
- How the solution addresses this category of environmental issues.

Real-World Examples

Looking for some inspiration for taking on the world's biggest environmental challenges? Check out the [Solve For Earth](#) exhibition page, which includes resources on exploring how to think about and solve problems to build a sustainable future. Watch our [Emerging Tech](#) videos to see how today's innovators are using technology to problem-solve environmental



Adaptation for Advanced Engineers:

Have teams compare and contrast their ideas to solutions in use today. What advantages and disadvantages do their solutions have?



Share and Reflect (15 min)

1. Next, teams will share their solutions with a team working on a different category. Their goal is to share their ideas and examine the potential connections between their solutions and environmental issue categories.
2. Assign teams to pair up.
3. Give teams about 8 minutes to share their solutions and look for ways their ideas might be interconnected. See the **Sample Sharing Schedule** for details.
4. **Sharing Questions** include:
 - *What was your category (your environmental issue)?*
 - *What was the problem you were trying to solve?*
 - *How does your solution(s) address this environmental issue?*
 - *What is new or novel about your solution(s) that excites you the most?*
 - *What would you want to know more about to develop your idea further?*
5. **Reflection Questions** for both teams to consider as they look for connections include:
 - *What connections do you notice between your solutions or your categories?*
 - *What ripple effects (positive and negative) might come out of your solutions?*
 - *How might your solutions affect other environmental issues?*
6. Remind the learners that this exercise is not meant as a critique of each other's solutions, but rather a way to explore how these categories are interconnected and the broader impact our choices can make.
7. Provide reminders on time and leave a few minutes at the end of the sharing for a few teams to volunteer to share out their solutions and interconnections.
8. **Tip:** Have teams take notes on the connections they notice in the shared digital workspace so that they review and reflect on them as a class at the end of the sharing. This can be done by adding to the ripple effects Collective Workspace they used earlier in the lesson ([MURAL Step 3](#)).

Sample Sharing Schedule

2 min	Team A shares
2 min	Team B shares
4 min	Teams A & B reflect on connections



Debrief (10 min)

1. Lead a short debrief with learners that focuses on the complexity of large-scale problems, the connections between sustainable solutions, and how they approached their target issue.
 - Help students recognize other places in their day-to-day life or even professional careers where they might use the skills they applied in this activity.
2. Possible **Debrief Questions** include:
 - *What aspects surprised you/the team as being interconnected?*
 - *Besides environmental issues, what are other examples of multidimensional issues that could be broken down using systems design thinking?*
 - *What other methods, other than collaging, could you use to analyze the many aspects of a problem or find connections?*
 - *How valuable do you think this approach to problem solving is?*
 - *How do/could you use some of the problem-solving skills you used in this activity in other parts of your life? In careers?*



Extension: Design Solutions

- Have learners continue to develop their solution by creating a sketch or building a model and conducting additional research.
- They can continue the design process by sharing their solutions with others and receiving feedback. If possible they can even present their solutions to environmental groups and community stakeholders.

Standards Connections

Next Generation Science Standards

Grades	Standard	Description	3-Dimensional Focus
6-8	MS-ESS3-5	Ask questions to clarify evidence of the factors that have caused the rise in global temperatures over the past century.	Stability and Change Stability might be disturbed either by sudden events or gradual changes that accumulate over time.
6-8	MS-ETS1-1	Define the criteria and constraints of a design problem with sufficient precision to ensure a successful solution, taking into account relevant scientific principles and potential impacts on people and the natural environment that may limit possible solutions.	Influence of Science, Engineering, and Technology on Society and the Natural World All human activity draws on natural resources and has both short and long-term consequences, positive as well as negative, for the health of people and the natural environment.
9-12	HS-ESS3-1	Construct an explanation based on evidence for how the availability of natural resources, occurrence of natural hazards, and changes in climate have influenced human activity.	Cause and Effect Empirical evidence is required to differentiate between cause and correlation and make claims about specific causes and effects.
9-12	HS-ETS1-1	Analyze a major global challenge to specify qualitative and quantitative criteria and constraints for solutions that account for societal needs and wants.	Influence of Science, Engineering, and Technology on Society and the Natural World New technologies can have deep impacts on society and the environment, including some that were not anticipated. Analysis of costs and benefits is a critical aspect of decisions about technology.

Vocabulary

Design sprint: A process used by designers and businesses to quickly come up with ideas, prototype, test and improve them. They have a quick time frame and use a lot of creative brainstorming techniques.

Environmental issues: The harmful effects human activity has on the environment.

Ripple effect: A secondary effect, or when an event causes other situations or events to occur indirectly.

Multidimensional: Having or involving several aspects.

Sustainability: Meeting the needs of the present without compromising the ability of future generations to meet their own needs.

Systems Design Challenge: A design challenge that presents learners with a real-world problem that is part of a complex system and that encourages them to consider the intricate parts of that problem as they design potential solutions.



Lab Connection

Visiting the Tech on a Field Trip? Sign up for one of our Science or Innovation Labs. This activity works well before or after our Down the Drain and Sustainable Cities Labs. Learn more at thetech.org/sciencelabs or thetech.org/innovationlabs.

Resources and References

 <p>Water Management</p>	<ul style="list-style-type: none"> • “Water Scarcity Threats WWF.” World Wildlife Fund, 2021. • “Water.” Explore Topics, UN Environment Programme, 2021. • “What We Do.” CA Department of Water Resources, water.ca.gov, 2021.
 <p>Agriculture and Food Production</p>	<ul style="list-style-type: none"> • Food and Agriculture Organization of the United Nations, 2020. • “Enteric Fermentation.” Climate & Clean Air Coalition, UN Environment Programme. • “Methane.” Climate & Clean Air Coalition, UN Environment Programme, 6 May 2021. • Ritchie, Hannah, and Max Roser. “Environmental Impacts of Food Production.” Our World in Data, 15 Jan. 2020. • “Plant-Based and Cultivated Meat Innovation,” Good Food Institute, 2021.
 <p>Energy Generation</p>	<ul style="list-style-type: none"> • “Energy.” Explore Topics, UN Environment Programme, 2021. • “Electricity Explained- How Electricity Is Generated.” U.S. Energy Information Administration, November 2020. • “Renewable Energy Explained.” U.S. Energy Information Administration, November 2020. • Ritchie, Hannah, and Max Roser. “Energy.” Our World in Data, 15 Jan. 2021.
 <p>Transportation</p>	<ul style="list-style-type: none"> • “Transportation and Climate Change,” National Geographic Resource Library, National Geographic Society, 1 Mar. 2021. • “Sustainable Transportation.” Office of Energy Efficiency and Renewable Energy, Energy.gov, 2021. • “Transportation.” Project Drawdown, 2021.
 <p>Material Reuse</p>	<ul style="list-style-type: none"> • “All about the Circular Economy.” National Geographic Kids, 7 June 2020. • “Recycling and Climate Change.” Environmental Center, University of Boulder Colorado, 19 Mar. 2021. • Renee Cho, “Recycling in the U.S. Is Broken. How Do We Fix It?” State of the Planet, Columbia Climate School, 13 Mar. 2020.
 <p>Additional Resources</p>	<ul style="list-style-type: none"> • Project Drawdown, 2021, drawdown.org. • “The Biggest Environmental Problems of 2021.” Earth.org, 14 Sept. 2020. • “THE 17 GOALS Sustainable Development.” United Nations, Department of Economic and Social Affairs, Sustainable Development, 2021. • “Teaching Collections, Climate Solutions.” Solutions U, 2021.