DISCOVER ENGINEERING

Reimagining Public Space Challenge

Grades: 7 to 12

Topics: Green & Climate, Design Challenge

Engineering Disciplines: Project Management, Civil Engineering

Photo: Mieke Campbell

Reimagining Public Space Challenge

Design an innovative, multiuse public space that improves the community for its visitors and residents.

In this module, students practice project management skills as they plan to develop a unique public space and learn about urban planning. Students discover the many types of public spaces in their community—parks, libraries, shopping areas, restaurants, museums, and more—as well as the benefits that they bring to their residents and visitors. They meet with a client who describes an existing public space, and students make a plan to renovate it. Teams implement the engineering design process to build, test, and redesign, and present their final solution at a community event.

Photo: Yoav Aziz

Learning Goals

In this module, students will:

- Learn how engineers and landscape architects (among others) design public spaces that the community can enjoy
- Use project management tools and the engineering design process to develop a solution to a community problem
- Learn about urban planning and redevelopment

Module Overview

This module consists of five topics arranged in the order in which they should be taught, guiding students through the project management and engineering design processes. The amount of time you spend per topic will vary depending on how you structure the unit. However, minimum time estimates for each topic are listed below.

The table below shows how the topics are organized, estimated session lengths, and the accompanying handouts.

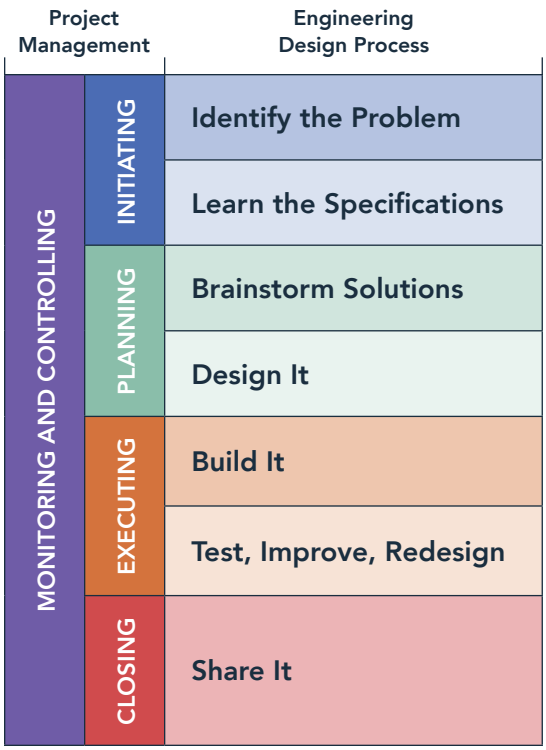
Topic	Length	Student Handouts
Topic One: Introducing the Challenge	One 45–60-minute session	• Designing a Public Space
Topic Two: Initiating • Identify the Problem • Learn the Specifications	Two or more 45–60-minute sessions	• Define the Project • Stakeholder Register • Project Roles • Project Schedule • Glossary of Project Management Terms
Topic Three: Planning • Brainstorm Solutions • Design It	Two or more 45–60-minute sessions	• Research Resources • Project Roles
Topic Four: Executing • Build It • Test, Improve, Redesign	Three or more 45–60-minute sessions	
Topic Five: Closing • Share It	Two or more 45–60-minute sessions	• Lessons Learned • Project Rubric

Background Information

These modules embed the engineering design process within a project management framework. Students will work as a team and manage their own projects, from start to finish, as they design solutions.

Engineering Design Process

The engineering design process is a series of steps that engineers use to solve problems. First, they identify an important problem, issue, or need that they want to address. They meet with their client to learn the project specifications: who they're designing for, what's the budget and timeline, and whether there are any project constraints. Then they research and brainstorm solutions. They enter an iterative cycle where they build a prototype, test it, and improve their design. Finally, they share their solution with the client, stakeholders, and community.



Project Management

Project management involves planning, organizing, and managing a large project, breaking it into smaller, achievable parts in order to deliver a final result. When managing a project, it's important to meet with the client in order to define the project's scope, stakeholders, and risk factors. Staying on schedule and within budget is also critical—students will use a variety of tools that can be used to track progress.

Prerequisites

Before starting the Public Spaces Challenge, students and leaders should read the Introduction to Project Management module to become familiar with project management and key tools that will be used throughout.

Students should already be familiar with the engineering design process. If not, set aside 20–30 minutes and lead the DiscoverE Making Toast activity with students.

Academic Standards

This challenge aligns well with numerous NCSS and ISTE standards. Learn how on page 35.

Preparation

The Public Spaces Challenge is an open-ended module where local needs and conditions will inform students' solutions. There are a variety of problems that students might investigate and countless solutions for them to consider. With this in mind, determine the parameters of the project before students get started.

Project Definition and Scope

A well-defined project, deliverables, and outcomes are key to your students' success. Before beginning the unit, consider potential public spaces within the community that could be used for students' projects. Projects on the school grounds will be the easiest to manage; however, there might be others in the community that are accessible to students. Talk to teachers, staff, parents, store owners, elected officials, the town's parks and recreation department, or anyone else who might have project ideas or become clients for your students' projects. Pick one public space for which the class will create solutions and gather everything you'll need to present the problem in detail (see the Preparation section in Topic One: Introducing the Challenge on page 8).

Next, consider how students will present their solution to their clients, stakeholders, and the community at the end of the module. Students can present their solution in a variety of ways—a proposal, design showcase, scale model, or something else. You can decide the final presentation format that all students will follow or let teams choose. Some options include:

- Build a prototype or model
- Produce drawings, videos, a slideshow, or a multimedia presentation
- Publish their proposal in an online publication
- Submit their proposal to a relevant local organization for consideration
- A combination of these ideas

Photo: Viktor Forgacs

The Client

A project's scope is determined by the client, who sets the deliverables, deadline, constraints, and resources. This challenge assumes the educator, STEM leader, or school principal will serve as the client, particularly if the public space to be renovated is on school property.

However, you can also ask a member of the community, local City Planning Commission, a landscape architect who specializes in public spaces, a civil engineer, or urban designer to be the client. Contact the client in advance and ask if they can provide photos of the space, share information about its history, ideas for renovation, key stakeholders, success criteria and resource constraints, as well as a timeline for the project. Find a date for the client to visit the class, either in person or virtually (see Topic Two: Initiating on page 13).

Constraints and Resources

Engineering **constraints** are limitations on a design. **Resources** are things needed to plan and build an engineering project, such as materials or people's work efforts. Consider the following questions to determine the constraints and resources for students' projects:

- What project constraints should students be aware of?
- What is the time frame for the project?
- Are there permissions that need to be secured, either by the school, town, or property owner before the students begin?
- What resources are available? Do students have a budget for purchasing materials or creating a project proposal and presentation?
- Are there subject matter experts (SMEs) who can help students research or serve as advisors?

Project Teams

Consider how to group students as well as the size of the teams. Also take into account individual students' strengths when balancing the teams. Finally, think about how students will gain practice with the various project management roles: project manager, scheduler, builder, note taker, researcher, designer, tester, and presenter. (See the *Project Roles* handout for additional information.)

Photo: Gabriel Sollmann

Materials

Students will need access to different materials over the course of the module. These include:

- Computers or laptops with internet access
- Copies of handouts (print and/or electronic)
- Google slides (via a Google account) or another presentation software
- Prototyping materials (see Topic Four: Executing on page 28)
- Writing and drawing materials

Assessment

Consider how you will assess the work pieces, processes, and final product and presentation. The module includes an assessment rubric that you can customize and use to evaluate students (see the Project Rubric on pages 33–34).

Leader Notes

Topic One: Introducing the Challenge

In this session, students will be introduced to the challenge. First, they will read about public spaces—what they are, where they exist, and how they're used. Then students will discuss existing spaces in their neighborhoods and brainstorm strengths and weaknesses for each. Finally, one space will be selected as the focus for the challenge.

Challenge: Design an innovative, multiuse public space that improves the community for its visitors and residents.

Estimated Time

One 45–60-minute session

Materials

For each student:

- *Designing a Public Space* handout

Preparation

1. Read the Leader Notes and gather the materials. Make copies of the handout.
2. Prepare to lead a discussion about public spaces in the students' community. Find photos of public spaces in the students' community to make the project more concrete. These could be parks, shopping malls or plazas, the library, recreation facilities, walking trails, playgrounds, parks or open spaces, music venues, etc.
3. Obtain a photo of the public space that students will be using for the challenge. If working with a client from the community, reach out to see if they can share a photo that shows the current condition of the space.
4. If the public space is within walking distance, consider planning a field trip to the site at the end of the session or before moving on to Topic Two: Initiating.

Instructions

1. Tell students that they will be looking at public spaces in their community. If needed, define **public space** and give two or three examples. Show any photos that you collected.
2. Distribute the handout *Designing a Public Space*. After students have had a chance to read it, give them five minutes or so to discuss the questions at the bottom of the handout with their partner or group.
3. Next, lead a brainstorming session about public spaces in the community. Use the board or a projector and ask students to list some public spaces. Be sure to include any examples you've collected and any spaces the students may be focusing on during the module. Talk about each space, their strengths and/or weaknesses, and how they are currently being used. Then ask the students to rank the spaces as great public spaces or public spaces that could be great. Have the students share their reasons for their rankings.
4. It's now time to introduce the unit challenge: **Design an innovative, multiuse public space that improves the community for its visitors and residents.** Explain that over the next several sessions, students will work in groups to design a public space and present it to the community.
5. Return to the list of brainstormed public spaces and mark a star next to the space that the group will be using for the challenge. Explain that all teams will be designing solutions for this public space. Show photos of the space to inspire thinking, or if the public space is within walking distance, take a field trip to the site. Encourage students to take photos and notes about the site's current condition.

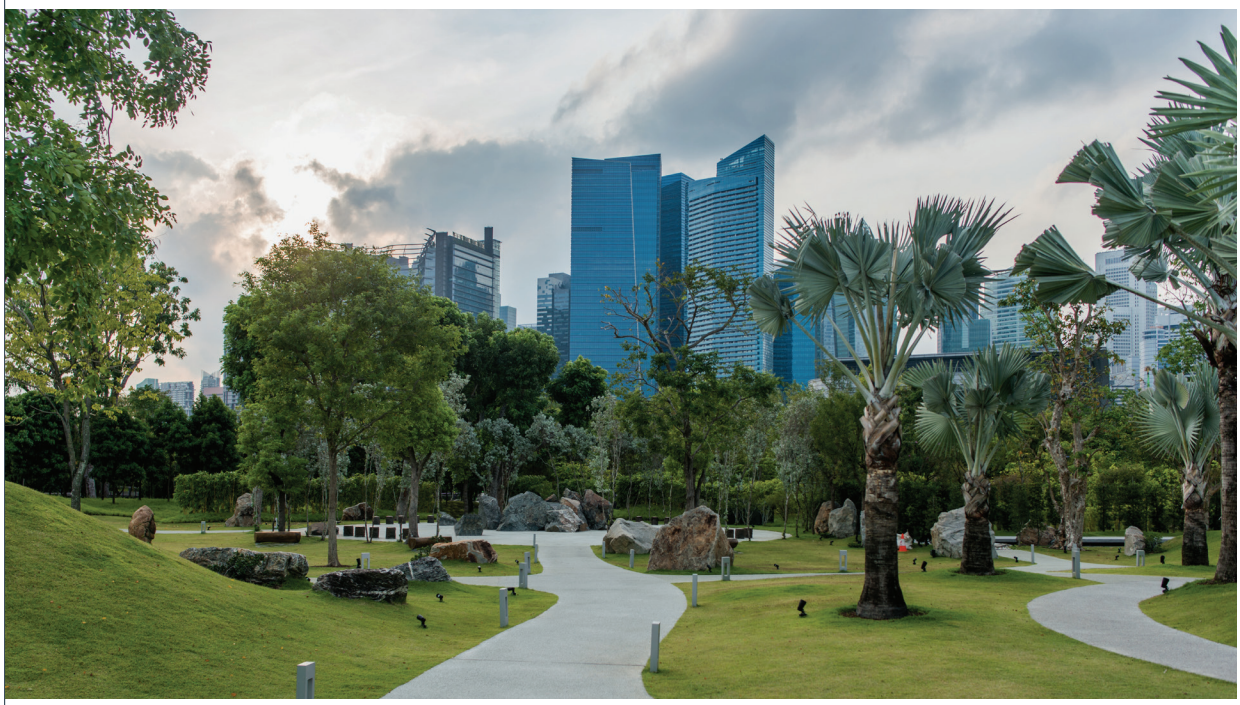


Photo: Undrey

Student Handout

Designing a Public Space

What is a public space?

A public space is broadly defined as an area or place that is accessible and inclusive toward all people, regardless of their age, race, ethnicity, or socioeconomic level. In public spaces, people can gather, speak freely, or act in any lawful manner they choose. They include libraries, shopping areas, restaurants, playgrounds, parks, museums, music venues, publicly owned streets, pathways, open spaces, and civic buildings. They can also encompass privately owned property as long as it is open to the public (either free-of-charge or inexpensive). Chances are, you pass through public spaces every day!

Why are they needed?

Boston Public Garden. Ethan Long, CC BY-SA 2.0, via Wikimedia Commons.

Public spaces, both small and large, indoors and outdoors, not only make an area more attractive and livable but also provide benefits to towns and cities. Residents need a variety of public spaces throughout their community—where they can meet, relax, play, learn, connect, share cultures, and build civic identity. Many public space projects improve a city's economy by introducing new businesses and bringing in visitors or tourists. Other public space projects can help reduce crime, ease traffic congestion, increase pedestrian safety, promote healthy living, improve the environment, and enhance civic engagement. Studies have shown that cities that devoted half or more of their space to public use are more prosperous and its residents have a better quality of life.

Dining out in New York. Jim.henderson, CC BY 4.0, via Wikimedia Commons

What spaces can be used?

When city planners and engineers develop new public spaces, they consider more than open fields or existing parks and plazas. They look at sites such as abandoned buildings, old railway lines, waterways (rivers, lakes, ponds), former industrial areas, and the single largest land asset in any city—the streets and sidewalks.

Streets and Sidewalks as Public Spaces

During the COVID pandemic, many cities found creative ways to turn their most plentiful public spaces—streets and sidewalks—into places where people could gather and socialize. Cities closed streets to traffic and turned them into pedestrian thoroughfares, where people could walk with plenty of space between them. Sidewalks were turned into parklets so restaurants could serve patrons outside. This unexpected use caused city planners to reconsider how they might design streets and sidewalks differently in the long term. Think about streets, sidewalks, and roadways in your community. How do they provide public space for people and the activities they enjoy?

Unusual Public Spaces

Abandoned Gas Station. Photo by Strange Happenings on Pexels

Few cities have pristine open space waiting to be developed. But they do have underused properties, such as abandoned railroads, old gas stations, alleys, highway underpasses, polluted rivers, and former warehouses or manufacturing plants. Some of these sites are *greyfields*, areas with abandoned buildings or shopping sites that are now obsolete, vacant, or falling into disrepair. Others are *brownfields*, properties once used for industrial or commercial purposes that may now be contaminated with hazardous waste or polluted soil or water. Brownfields and greyfields require more time and money to develop, particularly if there are contaminates that need to be removed. However, spaces that have fallen into disrepair can be unsafe and enable criminal activity. Converting greyfields and brownfields into usable public spaces not only enhances the community but also reduces crime and makes neighborhoods safer.

How do we get started?

The first step is to think about the public spaces in your community. Your ideas could be helpful to town planners, civil engineers, or urban designers who are trying to incorporate more public spaces into the landscape. Talk with a neighbor and discuss:

- Which public spaces do you enjoy spending time at? Why? What makes them great?
- Which public spaces need to be renovated? What could make them better?
- Are there any unusual public spaces in your community? Where are they? What makes them unusual?

- Identify greyfields and brownfields in your community. How could they be reimaged and developed into a new public space?
- What ideas do you have for a public space that can be enjoyed by all people in your community?

References

Local Government Commission. (n.d.). Livable Places Update | Reimagining Our Streets in the Era of COVID-19. Retrieved from Civic Well: https://www.legacy.civicwell.org/newsletter/livable-places-update-reimagining-our-streets-in-the-era-of-covid-19/

Project for Public Spaces. (2009, January 1). 10 Benefits of Creating Good Public Spaces. Retrieved from Project for Public Spaces: https://www.pps.org/article/10benefits

Reimagining the Civic Commons. (2022, August 2). 5 Ways Investing in Public Space Reduces Violence and Crime. Retrieved from Medium: https://medium.com/reimagining-the-civic-commons/5-ways-investing-in-public-space-reduces-violent-crime-3f984ab8c759

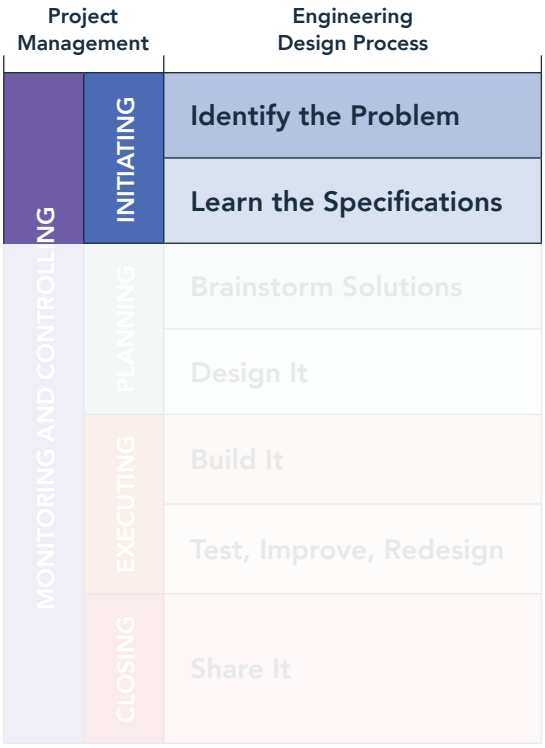
Rose, H. W. (n.d.). The Value of Public Space. University of Sheffield and the Bartlett School of Planning, University College London. https://www.designcouncil.org.uk/fileadmin/uploads/dc/Documents/the-value-of-public-space1.pdf: CABE Space.

Tupponce, J. I. (2021, June 7). Cities worldwide took space for cars and gave it to people during the pandemic. Will it stick? Retrieved from Virginia Commonwealth University News: https://news.vcu.edu/article/cities_worldwide_took_space_for_cars_and_gave_it_to_people_during

UN-HABITAT. (n.d.). Public Space. Retrieved from UN-HABITAT: https://www.bigjeducationalconsulting.com/resources

Leader Notes

Topic Two: Initiating



In this phase, students will define the scope of their project. Working in teams, they will investigate a specific public space problem that exists within their community and identify key stakeholders. Finally, they will meet with the client to learn the project specifications while using project management tools to keep their team organized.

Estimated Time

Two or more 45–60-minute sessions

Materials

For each student:

- *Project Management* graphic
- *Define the Project* handout
- *Stakeholder Register* handout
- *Project Roles* handout
- *Project Schedule* handout
- Optional: *Glossary of Project Management Terms* handout

Preparation

1. Review "The Initiating Process" in the Introduction to Project Management module (pages 6–10). It walks through an example project and shows how to use a set of project management tools that can be used with any project.
2. Read the Leader Notes and gather the materials. Make copies of the handouts.
3. Prepare to introduce the client to students.

a. If bringing in a client from the community, set up a time for them to speak to students either in person or virtually. The client should be prepared to share photos of the space, information about its history, ideas for renovation, key stakeholders, success criteria and resource constraints, as well as a timeline for the project.

b. If playing the role of the client, do some local research to determine the problems with the public space you've selected and what actions have been completed to date. After doing research, you might find historic or city planning documents, photos, town meeting notes, or other important pieces of information to share with students. You can determine a budget (imaginary or real) and define the success criteria and engineering constraints.

4. Establish the project's success criteria and constraints. We recommend identifying two or three criteria for success and one or two constraints. Engineers and project managers use these criteria to evaluate the progress of their project and its final success. There are multiple options when establishing the criteria: develop it yourself, ask the outside client for their input, and/or brainstorm with the students.

Instructions

1. Remind students that in the last session, they learned about public spaces and brainstormed a list of public spaces. In this session, they will begin the work of designing an innovative, multiuse public space in their community.
2. Begin by showing the Project Management graphic (page 4) and explain that during the Initiating phase, students will:
   a. Define the scope of their project
   b. Identify key stakeholders
   c. Meet their client
   d. Learn the project's success criteria and constraints
   e. Determine team roles and responsibilities
   f. Establish their project schedule
3. The Introduction to Project Management module (pages 6 to 10) is a great resource to introduce your students to the steps involved in the Initiating phase.
4. Once you feel your students understand what's involved in initiating a project, distribute the *Define the Project* and *Stakeholder Registry* handouts. Tell the teams they will need to discuss each question, write what information they know, and pose any additional questions.

5. After they have reviewed the handouts, share with them that conducting interviews with project stakeholders and the client is an effective way to inform and define the project's parameters.

    a. If you're meeting with an external client or stakeholders, remind students that it is an opportunity to get more information about the public space, learn about its history, hear stakeholders' visions for its future, and have their questions answered. Encourage students to take notes during the meeting.

    b. If you're playing the role of client, present the public space and share the photos you've collected. Explain the problems and goals that you want to achieve. Be sure to include information about stakeholders, success criteria and constraints, and timeline for the work.

6. Review the success criteria and project constraints with the teams.

7. Before concluding the initiating phase, work with your teams to begin filling out the *Project Roles* and *Project Schedule* handouts.

8. Explain that one way to complete a large project is to break it up into manageable tasks. Tell students that they will naturally gravitate toward roles that they are good at, but encourage them to try all roles by the end of the project. Also explain that multiple people can do the same role, depending on what's needed. For example, all team members will be researchers during this session.

Direct students to the *Project Roles* handout at the beginning of each session. Have them spend a few minutes determining each team member's role. Encourage them to try every role, even ones that may feel difficult or uncomfortable. Remind teams that multiple students can have the same role in any given session.

Photo: Josef Kubes

Student Handout

Define the Project

The first step in project management is to define the project. You can do this through research, interviews with different project stakeholders, and your project's client. Discuss with your team what you already know, jot notes, and add any additional questions you have. Then, start your research, and meet with your client and other project stakeholders to discuss and define the parameters of your project.

Review pages 6–10 in the Introduction to Project Management module. It walks through an example project and shows how to use the set of project management tools.

1. **Where** is the public space? Are there any special features or issues to be aware of?

2. **What** problems or issues does this public space currently have? Describe.

3. **Who** uses the public space currently? Is it well used or sparsely used? Is a goal to increase usage?

4. **How** is the public space currently used? Are there other activities or new features that the stakeholders want or need? Are there any conflicting opinions about desired improvements and features among the various stakeholders?

5. **Who** will benefit from your proposed changes or improvements? Will any existing users be negatively impacted?

6. Discuss with your client:
   a. How would they like you to present your solution (a model? Design plans? A presentation?)
   b. What is the budget?
   c. What resources do you have to complete the project? Also ask if you can request additional resources.
   d. What success criteria or project constraints do you need to be aware of?
   e. When is your proposed solution due? What is the timeline for the project?

Student Handout

Stakeholder Register

Stakeholders are the people or organizations that have an interest in the project or the project's outcome. In the initiating process, project teams will often create a stakeholder register, which includes the individuals involved and/or impacted by the project, their role in the project (customer, sponsor, team member, or public), and their contact information.

Name	Role in Project	Contact Information

Student Handout

Project Roles

Dividing up the work means that nobody carries the whole load and gives everyone an important part to play in the project. Your team can determine which roles are needed for your project, as well as any other roles that would be useful. Sometimes, team members might need to take on multiple roles. Over the course of the project, give every role a try, even those that feel challenging.

Here is a list of typical project roles, and feel free to add additional roles your project might need:

- **Project Manager**—communicates with client, updates schedule, gives status reports, assesses risk, creates budget, makes sure the team is on task
- **Researcher**—reads articles, learns history of the project, summarizes the research
- **Note Taker**—takes notes during meetings, lists team decisions
- **Designer**—responsible for the design of the product; creates sketches and materials list
- **Builder**—creates prototypes, incorporates feedback from testing into new versions
- **Tester**—tests prototypes, gathers information to help redesign
- **Presenter**—creates presentation; presents to client, stakeholders, and community

Student Handout

Project Roles

	Person				
Activity/Role					

Student Handout

Project Schedule

Use this schedule to list the tasks that need to be completed, the time estimated to get them done, and the deadlines. Tasks are usually listed in the order in which they should be started, and often, one task is dependent on the previous task. For example, if your role is to create a drawing, you need to make your deadline so that the builders can then create a prototype. Your schedule must also be flexible. Some parts of the project might take longer than anticipated, so be prepared to adjust as needed.

Review pages 12–14 in the Introduction to Project Management module to review how to create a schedule.

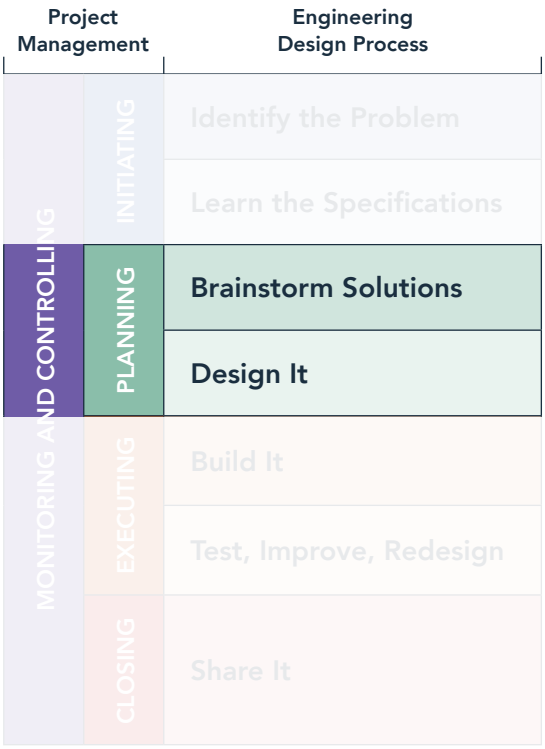
Project Schedule

Team:

Tasks	Due Date	Estimated Work Time					

Leader Notes

Topic Three: Planning



In the planning phase, students will hone their project management skills as they research and learn about designing public spaces broadly and within the structure of their own community. Students will identify and read several articles, brainstorm ideas to renovate a new public space, and select their ideas to pursue. Then they will design it—specifying and sketching the features of their public space.

Estimated Time

Two or more 45–60-minute sessions

Materials

For each student:

- Access to a computer, laptop, or tablet (one per pair)
- Colored pencils (1 set per group)
- Paper, large (11" x 17" printer paper or similar)
- *Project Management* graphic
- *Research Resources* handout
- *Project Roles* handout (one per group)
- (Optional) *Plan for Acquiring Resources* handout*
- (Optional) *Create a Budget* handout*

*Both optional handouts are available for download at https://discovere.org/engineering-activities/introduction-to-project-management/

Preparation

1. Review "The Planning Process" in the Introduction to Project Management module (pages 11–18). Decide which tools your students will use as they manage their projects. The tools you select will depend on the particular project, the prior experience of your students, and the amount of time allotted to complete the module.
2. Read the Leader Notes and gather the materials. Make copies of the handouts. [Note: The *Planning a Public Space* handout has embedded links. You can download a Word version of the handout so students click the links directly and type their notes.]
3. Acquire devices for students to use to do their research. Each pair will need a computer, laptop, or tablet with internet access.
4. If you've identified a subject matter expert (SME), reach out to see if they're available and determine the best way for students to contact them.

Instructions

1. Show the Project Management graphic, pointing out what has already been accomplished. Then explain that during the Planning phase, students will:
   - Research successfully reimaged public spaces
   - Brainstorm solutions
   - Design their public space.
2. Explain that to brainstorm possible solutions, students will need to research and learn about public spaces that have been successfully reimagined, designed, and created. They will learn about project histories, goals, design principles that were followed, and how success was measured.
3. Remind students to complete the *Project Roles* handout for today's session.
4. Share the *Research Resources* handout. Explain that the handout has a short list of articles and websites to review and point out that there is space to take notes about any ideas that might be useful for their project. Remind them that this is not a complete list and they are expected to explore links within each article and do a search to find additional articles to spark ideas.
5. At this point, teams have spoken to their client, potentially interviewed stakeholders, and researched successful public spaces. It's time to brainstorm ideas for their public space!

6. As they brainstorm ideas, remind them to refer to their *Defining the Project* handout as well as the project's success criteria and constraints. You can also ask them to consider:
   - What problem are you trying to solve?
   - What need will your public space address?
   - What are all the different ways your public space will be used?
   - What features are most important to include in the space?
   - Who will use the space and when? (time of day and/or season)
   - How have you made your space accessible, easy to use, and safe?
   - How is the space eco-friendly or climate aware?
7. Encourage them to generate as many ideas as possible. Once they have a long list, ask them to narrow in on the most important features to include in their public space. Consensus among the group should be reached.
8. It's time to design their public space. We recommend sketching out their ideas and space. Their drawing should include all the features and details a builder would need to actually build it, such as labels, dimensions, lists, and/or materials. Distribute the large sheets of blank white paper and colored pencils. As teams sketch their spaces, check in with them about their designs.

Photo: Boudhayan Bardhan

Student Handout

Research Resources

Divide the articles and websites among your team, but make sure each is read by at least two team members. You'll also need to find two or more articles and add them to the table. As you read, take notes in this document. Jot down anything that sparks an idea or is important to remember as you're designing your public space.

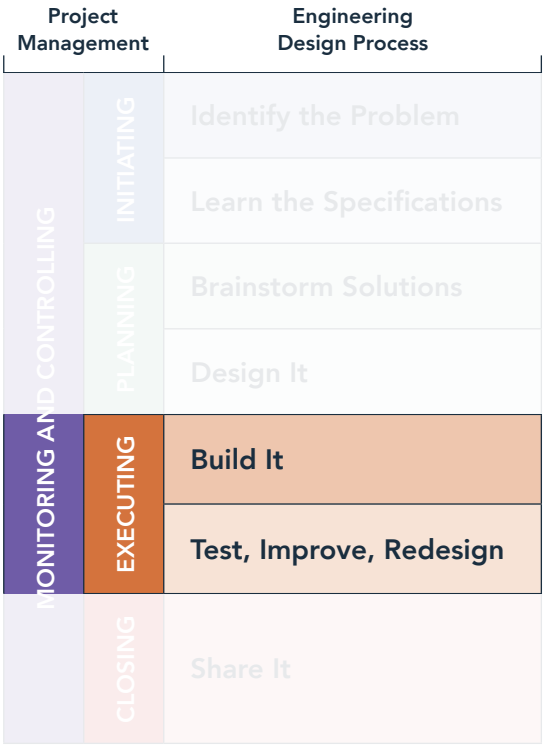
Articles & Website	Notes
Arch 20: 10 Tips for Designing Successful Public Spaces https://www.arch2o.com/tips-design-successful-public-spaces/	
Science News Explores: Stores and malls buy into ponds and rain gardens for flood control https://www.snexplores.org/article/stores-and-malls-buy-into-ponds-and-rain-gardens-for-flood-control	
Arch Daily: Transforming Public Spaces Through Art: An Interview with Antonio Ton https://www.archdaily.com/1013814/transforming-public-spaces-through-art-an-interview-with-antonio-ton	
U.S. Environmental Protection Agency: Heat Islands (Explore the subtopics) https://www.epa.gov/heatislands	

Science News Explores: Making yards more diverse can reap big environmental benefits https://www.snexplores.org/article/diverse-plantlife-lawns-yards-environmental-benefits	
University City District: Transforming Public Spaces (Explore the subtopics) https://www.universitycity.org/transforming-public-spaces	
(Add another article)	
(Add another article)	

Important features to include in our design:

Leader Notes

Topic Four: Executing



In the executing phase, students use their ideas and sketch to create a deliverable to share with their client. Teams can create a prototype or model, poster, illustrations, photographs, or something else that will enable the client and stakeholders to envision teams' public space solutions. Using the engineering design process, teams will test their design and make improvements if needed. Finally, they will develop a presentation to share their solution with the client and stakeholders.

Estimated Time

Three or more 45–60-minute sessions

Preparation

1. Review "The Executing Process" in the Introduction to Project Management module (pages 19–22).
2. Read the Leader Notes and gather materials that students might use to develop their prototypes.
3. Procure devices for students to use to create their presentations. Each team will need one or two computers, laptops, or tablets with internet access. They might also need to access Google slides (via a Google account) or another presentation software.
4. Note that this topic may take several sessions to complete, depending on the level of detail and complexity of teams' prototypes and presentations. Students may need one to two sessions to design, test, and iterate and another couple of sessions to plan their presentation, create slides, and rehearse. Consider whether there are parts of the process that students can complete outside of class or at home.

Materials

For each student:

- Access to a computer, laptop, or tablet (one or two per team)
- Google Slides or other presentation software
- Poster paper
- Markers
- Rulers

In addition, provide a variety of prototyping materials for students to explore. You can also have them bring materials from home. Feel free to use what you have on hand, but some possibilities include:

- Aluminum foil
- Cardboard, variety of thicknesses
- Construction paper
- Cotton balls
- Craft sticks, variety of sizes and colors
- Fabric scraps
- Markers
- Modeling clay
- Paint and paint brushes
- Pipe cleaners
- Recyclables (plastic containers, cups, egg cartons, packing peanuts, etc.)
- Straws
- String or yarn
- Styrofoam™
- Tape

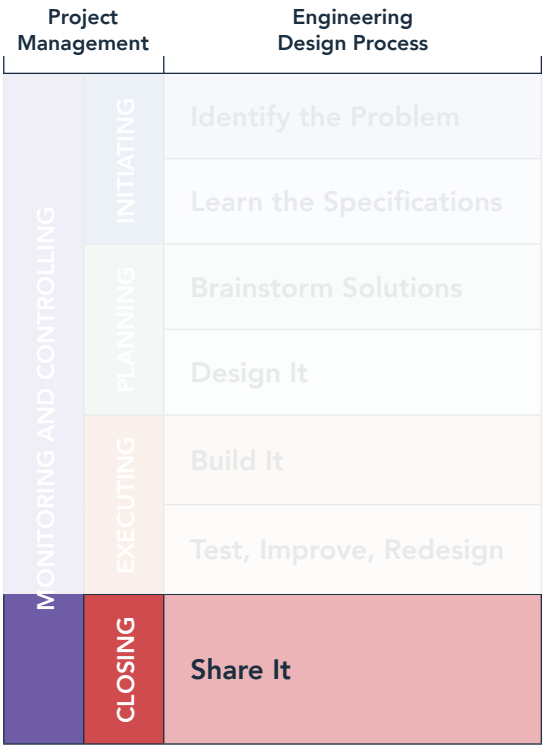
Instructions

1. Show the Project Management graphic and introduce the executing phase. Explain that engineers build an initial *prototype*, or model, of their solution. Then they test to see if it's working the way they thought it would. They re-design, make improvements, and test it again.
2. Tell students that they will create something to demonstrate their solution to their client or stakeholders. If the client has selected the final format, explain it to students. If students are choosing a format, remind them of options. They might make a prototype or model, poster board containing detailed illustrations and descriptions, a photo collage, or something else that shows their ideas.

3. Point out the materials that are available to inspire creativity. Have them discuss and agree on a plan for their prototype—what do they want to make and how will they make it? Also have teams take a few minutes to determine each member's role for the session and update their *Project Roles* handout.
4. As teams are building, circulate and check in by asking questions to reinforce the engineering design process:
    - Is your design working the way you thought it would? Which parts have been easy to make? Which have been difficult?
    - What problems have come up that were unexpected? How did you resolve them?
    - Have you made changes to your initial design? What did you change? How is it working?
    - Review your client meeting notes. Does your design address all of their ideas and concerns?
5. Provide a session for qualitative testing and redesign. One way to test solutions is to pair teams up and have them take turns walking through their public space solutions. Each team should develop a list of open-ended questions that they seek answers to, such as:
    - What are your first impressions about our design?
    - Who do you think would enjoy using the space?
    - How do you think our space would be used?
    - What can we do to make our space more safe or comfortable for users?
    - What about our design is visually or aesthetically pleasing?
    - Which aspects of our public space stand out to you the most?
    - What part of our design can be improved?
6. Teams take turns walking through their public space solutions, explaining each feature of their design, and soliciting feedback for improvement. If teams feel they need more feedback, pair them up with second team or find a different group at school (or home) to ask for feedback.
7. Give teams time to redesign and make improvements to their prototypes. Remind them to return to their brainstormed ideas and sketches to see whether they want to revisit early ideas.
8. After designs are finalized, teams create presentations to share their solutions with the client and stakeholders. They might write talking points to accompany their prototype or poster, or create a slideshow to incorporate photos and other media. Ensure every student has a role in the presentation and provide ample time for practice.

Leader Notes

Topic Five: Closing



Students will learn about the Closing Process as they present their solutions to stakeholders and reflect upon the project. They will use the *Lessons Learned* handout to review their project management process and accomplishments.

Estimated Time

Two or more 45–60-minute sessions

Materials

For each team:

- Access to one or two computers, laptops, or tablets
- Google Slides or other presentation software
- *Lessons Learned* handout
- *Project Rubric* handout

Preparation

1. Review "The Closing Process" in the Introduction to Project Management module (pages 23–24).
2. Plan the final client meeting. Select a date, making sure that students have enough time to complete their presentations beforehand. If needed, reserve an auditorium, library, or other space on site where students can present their work. Check with the administration and custodial staff to let them know what you need, which may include a PA system and additional seating depending on the size of the anticipated audience. If using audio/visual equipment, test it beforehand so you know how it works.

3. If there's money in the budget, consider planning a small celebration at the end of the presentations. You could serve light refreshments and give students, clients, and community members time to interact. (Be aware of the site's food policies and allergens.)
4. Read the Leader Notes and make copies of the handout.
5. Procure devices for students for their presentations.

Instructions

1. Show the Project Management graphic and explain that the final step is to share their solutions with the client, stakeholders, and interested community members. As teams wrap up, they will also reflect on the project and consider lessons learned.
2. Share the presentation date with students. Lead a short brainstorming discussion to help students determine what needs to happen in preparation. Ask students to consider:
   - Who should be invited to attend the presentation?
   - How will your team advertise the event to clients, stakeholders, parents, and other interested community members?
   - How will you share your solution?
   - What questions might your client and the audience ask? How will you be prepared to answer them?
   - Will you include handouts for the audience members?
   - What roles will your team members play during the presentation?
3. Give teams time to do last minute prep for their presentations and a final rehearsal in the venue with the audio/visual equipment that they will be using. Ensure that teams invite their clients and publicize the event in the community.
4. When presentation day arrives, give students a pep talk, particularly if they're nervous about presenting. Remind them that they have learned a lot about project management, teamwork, designing public spaces, and the engineering design process. It's their time to shine!
5. After the presentations are finished, bring teams together to complete the *Lessons Learned* handout. This wrap-up enables students to reflect on their project and process so that they can make improvements in the future. After teams have completed the handout, lead a discussion so they can share.
6. If students decide they want to proceed further and go beyond prototyping, they should set up another meeting with the client to discuss how to move their design to the next phase. Who will they need to talk to? What materials will they need to create a more detailed prototype?
7. Congratulate teams on completing the Public Spaces Challenge! Encourage them to share their project results at Social@DiscoverE.org or tag @DiscoverEorg.

Project Rubric

Student Names:_____ Date:_____

Project Title:_____

	Exemplary	Solid	Developing	Needs Attention
Comprehension of Subject Matter	All content is accurate and complete and communicates a full understanding of the topic.	Most of the content is accurate and shows mastery of the topic.	Content shows some flaws and omissions and illustrates only partial knowledge of the topic.	Much of the content is inaccurate and confusing and communicates very little understanding of the topic.
Quality of Research	Research includes multiple, varied sources that are cited at appropriate points and that contribute valuable information to the project.	Research includes several sources that are cited at some point in the project and that contribute relevant information.	Research includes at least a few sources that are cited, but the information contributed is only partially relevant and useful.	Research is inadequate or does not contribute relevant information to the project. Research sources cannot be checked.
EDP & Engineering-based Solutions	The Engineering Design Process has been followed and engineers could implement the solutions.	Most elements of the Engineering Design Process have been followed and engineers could implement the solutions.	Only some elements of the Engineering Design Process have been followed and not all solutions are engineering-based.	The Engineering Design Process was not followed and the solutions are not engineering-based.
Problem/ Solution	The problem has been clearly defined and the proposed solution is innovative and well considered.	The problem has been adequately defined and the proposed solution is sensible.	The problem has not been well defined and the solution is not necessarily actionable.	The problem is defined confusingly and the solution does not make sense.
Project Management Implementation	The team makes effective use of all appropriate project management principles and tools.	The team makes use of most appropriate project management principles and tools.	The team makes use of some appropriate project management principles and tools.	The team does not make good use of appropriate project management principles or tools.

	Exemplary	Solid	Developing	Needs Attention
Group Work	All of the group members participated completely and enthusiastically, exceeding expectations for the assignment tasks.	All of the group members participated completely, meeting all of the requirements for the assignment tasks.	Most of the group members participated, completing most of the requirements for the assignment tasks.	Some of the group members did not participate, causing the group to miss some of the requirements for the assignment tasks.
Risk Management	The team's response to problems or setbacks demonstrated flexibility, resourcefulness, and practicality.	The team's response to problems or setbacks demonstrated flexibility and willingness to ask for help when needed.	The team's response to problems or setbacks was somewhat disorganized or the team did not ask for help when needed.	The team's response to problems or setbacks was chaotic or inappropriate.
Presentation Characteristics (if applicable)	Presentation is logically organized, complete, and persuasive.	Presentation is logically organized and complete.	Presentation is not well organized or is missing a few important elements.	Presentation is disorganized and obviously incomplete.

Additional Comments:

Academic Standards

This challenge aligns well with numerous NCSS and ISTE standards.

Next Gen Science Standards

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.
MS-ETS1-2	Evaluate competing design solutions using a systematic process to determine how well they meet the criteria and constraints of the problem.
HS-ETS1-2	Design a solution to a complex real-world problem by breaking it down into smaller, more manageable problems that can be solved through engineering.
HS-ETS1-3	Evaluate a solution to a complex real-world problem based on prioritized criteria and trade-offs that account for a range of constraints, including cost, safety, reliability, and aesthetics as well as possible social, cultural, and environmental impacts.

ISTE Standards

1.3.a	Students use effective research strategies to find resources that support their learning needs, personal interests, and creative pursuits.
1.3.d	Students build knowledge by actively exploring real-world issues and problems, developing ideas and theories, and pursuing answers and solutions.
1.4.a	Students know and use a deliberate design process for generating ideas, testing theories, creating innovative artifacts, or solving authentic problems.
1.4.b	Students select and use digital tools to plan and manage a design process that considers design constraints and calculated risks.
1.4.c	Students develop, test, and refine prototypes as part of a cyclical design process.
1.4.d	Students exhibit perseverance, a tolerance for ambiguity, and the capacity to work with open-ended problems.
1.6.a	Students choose the appropriate platforms and digital tools for meeting the desired objectives of their creation or communication.
1.6.d	Students publish or present content that customizes the message and medium for their intended audiences.