

ENGINEERING A BAT GARDEN

OBJECTIVE:

The students will use the Engineering Design Process (EDP) to design a bat garden to aid in conservation efforts.

NGSS: MS-LS2-5, MS-ESS3-3, MS-ETS1-1, MS-ETS1-2, MS-ETS1-3, MS-ETS1-4

**MATERIALS:**

- Graph paper



TIME: 2-5 hours
(depending on the components the teacher chooses to do)

Teacher preparation

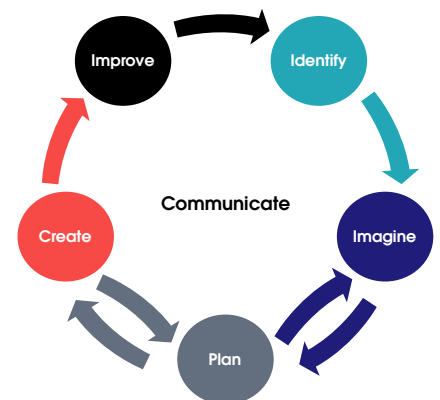
- Fill out and copy the editable Garden Budget sheet for each group or student.
- Teacher will need to display the Engineering Design Process diagram.
- Optional: Copy Student Planning Sheet for each student.

Teacher considerations

- You can shorten this lesson by providing the list of plants and pricing for students have to use in their design or you can choose to have them research plants native to your area that would attract bats and have students find prices. Note: For the activity, the cost of supplies do not have to be exact. If you are considering in creating a bat garden for your school, you would want retail prices.
- You can choose to use a budget or not with students.
- Students may need support of mathematical skills like scale and volume.

Teacher directions

1. Before class time, determine if you want students to complete this engineering challenge individually or in groups.
2. The TEA Engineering Design Process is used in the engineering lesson.
3. The student will **identify** the problem. This part of the EDP provides students with the basic information they need to move forward in the challenge. Teacher sets the expectations for the problem the students are solving by introducing the criteria and constraints.
4. The teacher will read the problem and the criteria and constraints aloud to the students.



The Problem: Design a bat garden for their schoolyard.

» Criteria and Constraints:

Your design and written description must include:

- Your plan must only use native plants to the area.
 - You must plan the method and design for watering.
 - It must fit within the overall dimensions of _____. (This is determined by the teacher.)
 - The total cost must fit within a budget of _____. (This is determined by the teacher.)
 - Teacher can decide if other features will be included such as a pathway, benches, decorative rocks, and/or fencing.
5. This part of the engineering process will require background information and research. Start with these two links from BCI to learn about what a bat garden needs to have. Students should take notes on their planning sheet.

<https://www.batcon.org/wp-content/uploads/2022/04/Guide-to-Gardening-for-Bats.pdf>

<https://www.batcon.org/wp-content/uploads/2023/09/Regional-Native-Plants.pdf>
 6. Students should research plants native to your local area. They must consider the needs of each plant such as the spacing between them and the amount of water and sunlight necessary for growth.
 7. Students will need to go out to the site to:
 - » Take measurements on the area the garden will be.
 - » Take notes on:
 - What plants are there now? What can stay or be removed?
 - What types of insects or other animals are found there now?
 - Is there more activity at certain times of day?
 - And other student observations they need to consider as they plan their bat garden.
 8. Now, students will begin the **imagine** part of the process, and brainstorm solutions to the problem/challenge. This part of the process is mainly about cooperation and communication to come up with a group design. Using graph paper, each student will sketch a quick design of their layout showing measurements and labeled items. After the students have sketched their plan, they will do a Think-Pair-Share to generate ideas from other students.
 9. After sharing their imagine, the next step is to **plan** and **create**. The team comes up with **one** plan that they will agree to try. The students will draw their final design in their notebook before they receive their materials. The final plan must have ideas from each team member's imagine. NOTE: If students are creating their own garden design, they can still share and give feedback from their peers.
 10. Students will calculate the cost to construct their garden using the Garden Shop Price List and Garden Budget sheet.
 11. If your school is going to create a bat garden, then as a class, students can share their designs and create a final plan for the school bat garden.
 12. If not, then continue through the engineering process.
 13. The next step is to **improve** their design. This stage allows students to observe and think critically about their design. Students should understand that failure is really a learning opportunity. Students should learn to expect it and accept it.

14. Throughout the engineering design process, students **communicate** with each other. A teacher will want to make time for students to share their designs either with another team or as a whole group. The other teams will provide feedback and make sure the other team included all the constraints. Remind teams they should say something they liked about the other team's design as well.
 15. Write an explanation of why the school should choose your design over the others and what led you to the name of the garden.
5. How does your bat garden support the pollinator bats as well as the bats that consume insects?
 6. How does your garden model help if you were to build an actual garden?
 7. Which material did you use the most in your final design? Why?
 8. Were there any materials you decided not to use? Why?
 9. What was most frustrating about building your design? Why?
 10. What was the most enjoyable part of this project? Why?

Reflection

As a class, discuss the questions below as a whole group.

Questions:

1. Compare your design to the other team designs. What are some similarities? What are some differences?
2. If you could have any materials in the world, what would you add to your garden model?
3. What challenges did you face working in a team?
4. Why is failure important in the engineering design process?

Elaborate

Have students make connections to how a garden for bats will contribute to the biodiversity of the ecosystem that will keep it stable and healthy.

ELPS

Check with students for understanding about what the engineering lesson is.