

ENGINEERING A BAT WING

OBJECTIVE:

The students will use the Engineering Design Process (EDP) to create a prosthetic wing for an injured bat.

NGSS: MS-PS2-2, MS-ETS1-1, MS-ETS1-2, MS-ETS1-3, MS-ETS1-4

**MATERIALS:**

- Construction paper
- Straws
- Thin string
- Scotch tape
- Scissors
- Toothpicks and popsicle sticks
- Coffee filters
- Copy paper
- wax paper
- pipe cleaners
- Paper towel rolls
- Any other materials on hand that could support student's thinking



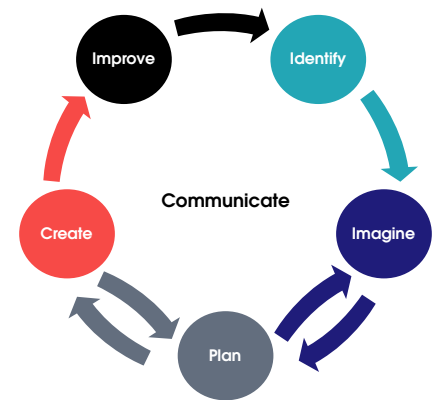
TIME: 2 hours

Teacher preparation

- Teacher will gather the materials needed.
- Teacher will need to display the Engineering Design Process diagram.

Teacher directions

1. Before class time, determine if you want students to complete this engineering challenge individually or in groups. You should gather supplies in advance so that students will know what materials are available as they plan their design.
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: A Texas Wildlife Rescue and Rehabilitation Center received a bat with an injured and unrepairable wing. The challenge is to design an artificial wing for the bat so it can fly again.

» Criteria and Constraints:

Your design and written description must include:

- the basic design of a bat wing which enables it to fly and glide.
 - the dimensions of the wing should be symmetrical to the other wing for even flight.
 - must have movable parts and structures similar to a live bat.
5. This part of the engineering process sometimes requires background information and research such as:
 - » Understanding the movements and structure of a bat wing

- » Understanding the structures and functions of the parts of a bat wing
 - » Watch a slow-motion video to see how bat wings move. <https://www.youtube.com/watch?v=JAP2I-t3FGs>
 - » Discuss the concept of a hinge using joints as examples. This can be related to human hands and other jointed limbs. Have students bend their wrists, elbows, and knees to show how they work. The videos below can give you a few ideas. <https://www.instructables.com/Mechanical-Hand-using-only-fast-food-straws-Stra/>

<https://cms5.revize.com/revize/franklinlifelong/Solutions/Solutions%202021/At%20Home%20Activities/Activities%20through%206-5/DIY%20Robot%20Hand.pdf>

<https://www.buzzfeed.com/tigersouvannakoumane/make-your-own-robotic-hand-with-this-geeky-diy>
6. Before the Imagine starts, teacher will show students the materials they are allowed to use.
 7. In the **imagine** part of the process, students brainstorm solutions to the problem/challenge. This part of the process is mainly about cooperation and communication to come up with a group design.
 8. Each student will use their imagination to come up with ideas to solve a problem on their own paper. They will draw a model of their prototype and include labels for what materials are being used to build their prototype. After the students have recorded their imagine prototype, they will do a Think-Pair-Share to generate ideas from other students
 9. After sharing their imagine, the next step is to **plan**. 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. The budget sheet must also be filled out to get approval.
 10. The **create** part of the process is where the students create their prototype, test, and re-test it. Students create their prototype based on the plan they made as the group.
 11. The next step is to **improve** their design. This stage allows students to observe and think critically about their prototype. Students should understand that failure is really a learning opportunity. Kids should learn to expect it and accept it.
 - » Students will make observations of their prototype.
 - » Students use critical thinking to identify what works well and what does not work well.
 - » Students should be given the opportunity to make improvements to their design based on observations and then re-test their prototype.
 12. Throughout the engineering design process, students **communicate** with each other. A teacher will want to make time for students to share their prototype either with another team or as a whole group. Each team will present its prototype. 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 prototype as well.

Reflection

As a class, you will want to discuss the questions below as a whole group.

Questions:

- Did your prototype meet the required criteria?
- Could your wing support the bat during multiple flights?

- What was the hardest part in building the bat wing?
- What would you change if you built another prototype?
- Tell about one thing you learned.
- Describe your teamwork. Was it positive? Negative? Both?

Elaborate

The teacher may want to students to explain what occurred with the glider by:

- Describing what forces and how those forces acted on the glider
- Explaining how this demonstrates Newton's Third Law
- Exploring balanced and unbalanced forces with Newton's First Law

ELPS

Check with students for understanding about what the engineering lesson is and what they are supposed to build.