Engineering Design Challenge – Straw Glider II

Students will have a basic understanding of the engineering process as they build, evaluate and modify a simple straw glider while learning about variables.

LESSON PLAN

Lesson Objective

The students will:

- Be introduced to the engineering design process as they build, evaluate and modify a straw glider.
- Learn to collect and analyze data as they modify the design.
- Learn about the three types of variables and how they are used in the engineering design process.

Goal

In this lesson, students will work in teams and gain a basic understanding of the engineering process. They will apply their understanding to design and build a straw glider.

The Engineering Design Process

This lesson plan uses the Engineering Design Process created by "Engineering is Elementary" which in turn was developed for the Museum of Science, Boston. No federal endorsement is implied. This Engineering Design Process has five steps and uses terms elementary students can understand.

WHAT IS THE GOAL?

ASK: What is the problem? How have others approached it? What are your constraints or limits?
IMAGINE: What are some solutions? Brainstorm ideas. Choose the best one.
PLAN: Draw a diagram. Make list of materials you will need.
CREATE: Follow your plan and create something. Test it out!
IMPROVE: What works? What doesn't? What could work better? Test it out!

It is important to note that the Engineering Design Process (EDP) is flexible. There are as many variations of the model as there are engineers and engineering teams. Since this is a cycle, there is no official starting or ending point. You can focus on one step, move back and forth between steps, work on one of two steps, then pass the project to another team or begin again to refine the glider.

Grade Level: 6-8

Ohio Learning Standards/Technology (2017)
Design and Technology
6-8.DT.1.c.: Define and categorize the requirements of a design as either criteria or constraints.
6-8.DT.2.a.: Apply a complete design process to solve a problem
6-8.DT.2.d.: Consider multiple factors, including criteria and constraints, (e.g., research, cost, time, materials, feedback, safety) to justify decisions when developing products and systems to solve problems.
6-8.DT.3.a.: Collaborate to solve a problem as an interdisciplinary team modeling different roles and functions.
6-8.DT.3.d.: Give examples of how changes in one part of a system can impact other parts of that system.

Ohio Learning Standards/Science (2018)
Expectations for Learning
Nature of Science

Physical Science
8.PS.1 Objects can experience a force due to an external field such as gravitational fields.
8.PS.2 Forces can act to change the motion of objects.

Ohio Learning Standards/Mathematics (2017)
Statistics and Probability
6.SP.4: Display numerical data
6.SP.5: Summarize numerical data sets
6.SP.5.c.: Find the quantitative measures of center (median and/or mean)

Materials Required:

- Paper
- Card Stock
- Drinking straws—various sizes
- Tape
- Caution tape, string or some method to create a "fly zone"
- Safety glasses/Eye Protection
- Measuring Tape—tape down or secure in the designated fly zone

Step 1: Create a straw glider. Let the students conduct test flights in a designated "fly zone." Follow recommendations for safety in the classroom.

Step 2: Introduce the Engineering Design Process:
- **ASK:** What is the problem? How have others approached it? What are your constraints or limits?
- **IMAGINE:** What are some solutions? Brainstorm ideas. Choose the best one.
- **PLAN:** Draw a diagram. Make list of materials you will need.
- **CREATE:** Follow your plan and create something. Test it out!
- **IMPROVE:** What works? What doesn't? What could work better? Test it out!

Step 3: Organize the students into teams.

Step 4: ASK: What is the problem? Make a straw glider that can go farther.
How have others approached it?
What are your constraints? May only use the materials provided. (You may also want to include other materials not listed on page one—such as paper clips, different weight papers, etc.)

Step 5: IMAGINE: What are some solutions? Brainstorm ideas. Choose the best one.
Encourage students to think "outside the box."

Step 6: PLAN: Draw a diagram. Make list of materials you will need.

Step 7: CREATE: Follow your plan and create something. Test it out!
Follow recommendations for safety in the classroom: create a designated fly zone, no one retrieves glider from the fly zone until the "Control Tower" (usually the teacher) gives an "all clear" and wear safety glasses.

Step 8: IMPROVE: What works? What doesn't? What could work better? Test it out!
Give students the option of three or more refinements to the design before a "fly-off" to determine the best design.

Step 9: Explain variables. A variable is any factor, trait, or condition that can exist in differing amounts or types. An experiment usually has three kinds of variables: independent, dependent, and controlled.
The **independent variable** is the one that is changed by the engineer or scientist. To ensure a fair test, a good experiment has only one independent variable. As the engineer or scientist changes the independent variable, he or she **observes** what happens.

The engineer or scientist focuses his or her observations on the **dependent variable** to see how it responds to the change made to the independent variable. The new value of the dependent variable is caused by and depends on the value of the independent variable.

Experiments also have **controlled variables**. Controlled variables are quantities that an engineer or scientist wants to remain constant, and he or she must observe them as carefully as the dependent variables. For example, how can you ensure that the launch angle of the glider is always the same and the amount of power used in the "throw" or "toss" is always the same? Most experiments have more than one controlled variable. Some people refer to controlled variables as "constant variables."

The engineer or scientist must be able to **measure** the values for each variable. Distance, weight or mass are examples of variables that are easy to measure.

See student worksheet.

Resources:

Information on the Engineering Design Process:
https://stemactivitiesforkids.com/2016/02/22/the-engineering-design-process/
https://www.engineergirl.org/128119/engineering-design
https://www.nasa.gov/audience/foreducators/best/edp.html
https://www.teachengineering.org/k12engineering/designprocess
https://www.eie.org/overview/engineering-design-process
https://www.eie.org/engineering-adventures/engineering-design-process

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Engineering Design Challenge – Straw Glider II

STUDENT /TEAM WORKSHEET

Glider—Design 1

Design 1	Trial 1	Trial 2	Trial 3	Mean
Distance				

How will you change the straw glider to increase the distance flown?

What is the independent variable?

What is the dependent variable?

What are the controlled variables?

Glider—Design 2

Design 2	Trial 1	Trial 2	Trial 3	Mean
Distance				

Did the change improve the distance flown? Yes or No

How will you change the straw glider to increase the distance flown?

What is the independent variable?

What is the dependent variable?

What are the controlled variables?

Glider—Design 3

Design 3	Trial 1	Trial 2	Trial 3	Mean
Distance				

Did the change improve the distance flown? Yes or No

How could you change the straw glider to increase the distance flown?

What is the independent variable?

What is the dependent variable?

What are the controlled variables?

Which of the three designs flew the greatest average distance?