

Form Drag 2022 UF Lesson Plan Template

Summary

Students will learn about the concept of form drag as it relates to wind engineering through an interactive activity where students will construct “sails” of different shapes and sizes and investigate how their effectiveness differs.

Engineering Connection

The ability to understand and apply concepts of wind engineering to the design process is a great introduction to engineering methods. Learning about this topic will grow the students' basic knowledge of wind and how it impacts the structures it interacts with.

Audience

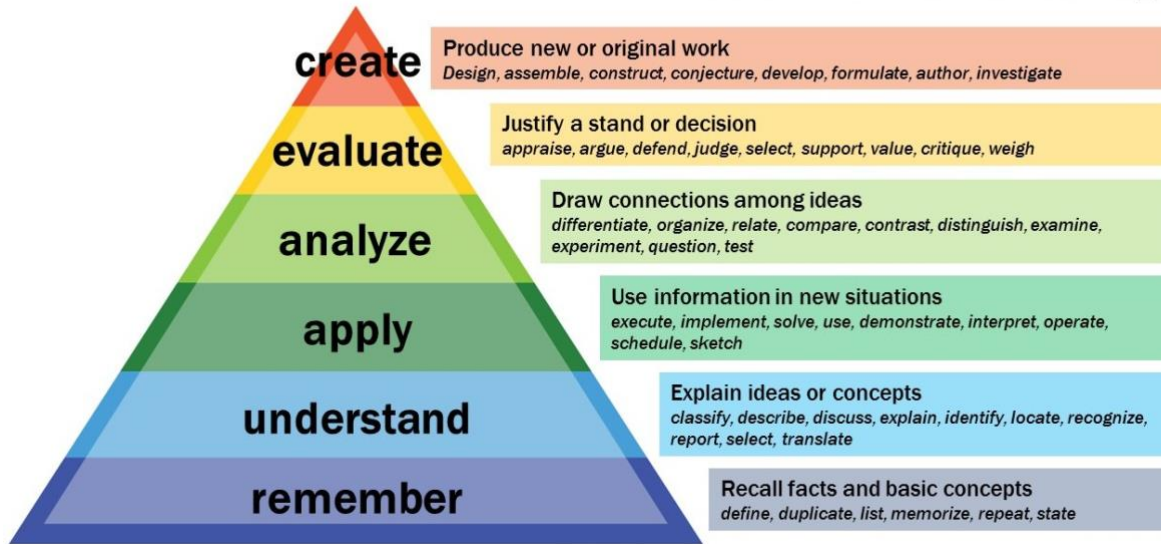
6-8th grade (middle school)

Lesson Objectives

- **Remember:** Recall everyday experiences with the wind to make wind engineering more familiar to students and not jargony. Ask students for examples in their everyday life. This will prompt students to explore a STEM field since it applies to our everyday life.
- **Understand:** Define **basic wind engineering** and **scientific method** concepts so students understand the applications in wind engineering. Explain how the shape of an object affects the forces applied to it by wind so students can analyze this concept as they construct their car-sail.
 - **Scientific Method:** Observe, Hypothesis, Experiment, Results, Analysis, Accept or Reject, Share, Repeat
 - **Basic Wind Engineering Concepts:**
 - What is a prototype? What is its purpose?
 - What is an experiment and/or test? Why do engineers do them?
 - Define aerodynamic. What does it mean for an object to be aerodynamic? Show different shapes and have students guess which is aerodynamic and which is not. Discuss shapes.
 - Define drag. What does it mean for an object to have drag? How does this connect to an object being aerodynamic?
- **Apply:** Demonstrate how aerodynamics and drag forces apply to boat sails. Describe possible experiments and prototypes that can be done to explore the aerodynamics and drag forces of a sail. Explain to students the experiment that they will perform.
- **Create:** Students will design and construct a car-sail out of popsicle sticks/straws and cardboard/construction paper and use it on a toy car placed in front of a fan. It will allow students to creatively explore and synthesize the concepts and applications taught.
- **Evaluate:** Evaluate which car-sail was the most aerodynamic. Order each car-sail from the most aerodynamic to the least aerodynamic.

- **Analyze:** Discuss car-sail results. Differentiate which shapes experience more/less force in the same wind. Implement knowledge about drag to explain why some sail shapes were more effective than others.

Bloom's Taxonomy



Educational Standards

NGSS MS-PS2-1: "Apply Newton's Third Law to design a solution to a problem involving the motion of two colliding objects."

NGSS MS-ETS1-2: "Evaluate competing design solutions using a systematic process to determine how well they meet the criteria and constraints of the problem."

NGSS MS-ETS1-3: "Analyze data from tests to determine similarities and differences among several design solutions to identify the best characteristics of each that can be combined into a new solution to better meet the criteria for success."

Material List

- Toy cars
- Popsicle sticks or straws
- Plastic cups (solo cups)
- Construction paper or cardboard
- Tape
- Fan

Introduction

A force is created by pushing or pulling something with mass that changes its speed. You can apply a force to something next to you simply by putting your hand on it and pushing. But how else can forces be created? Wind and water also create forces, even though they

may not always be seen. This lesson will demonstrate the effect of wind on the structures that students design, so they are able to get an initial understanding of how forces over a certain area (pressure) cause a change in speed, and possibly direction, of a vehicle such as a toy car.

Procedure

Explain how someone else can implement your lesson plan by creating a list of instructions separated by the secondary titles below.

Background knowledge

- Discuss aerodynamics in simple terms, showing different figures and asking which seems like it would be more aerodynamic. Explain what a force is and have students.

Before the activity

- Discuss and demonstrate how things like boat sails experience a lot of drag, while things like airplanes and race cars experience much less. Discuss what factors cause this.

During the activity

- Each student will have access to the materials listed above and will be asked to construct a car sail they believe will travel the fastest/furthest when put in front of the fan. They can make any changes they wish throughout the process if they think it will improve their design.

After the activity

- Explore why some students' sails worked better than others, and possibly how even the best sail designs could be improved upon.

Assessment

Students will have mastered the objectives when they are able to predict which sail shapes will be most effective.

Wrap-up

Ask students to find an image of a car/boat that resembles their design. This will show how even though they used basic concepts, this same procedure is used in more complex engineering design.