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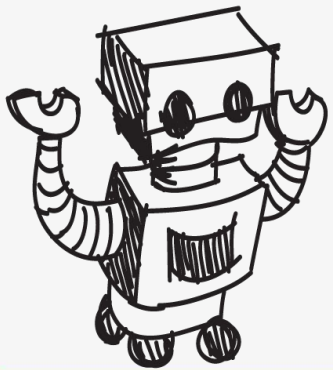
TRY Engineering

Lesson Plan:

Take Flight

IEEE

Real-World Application



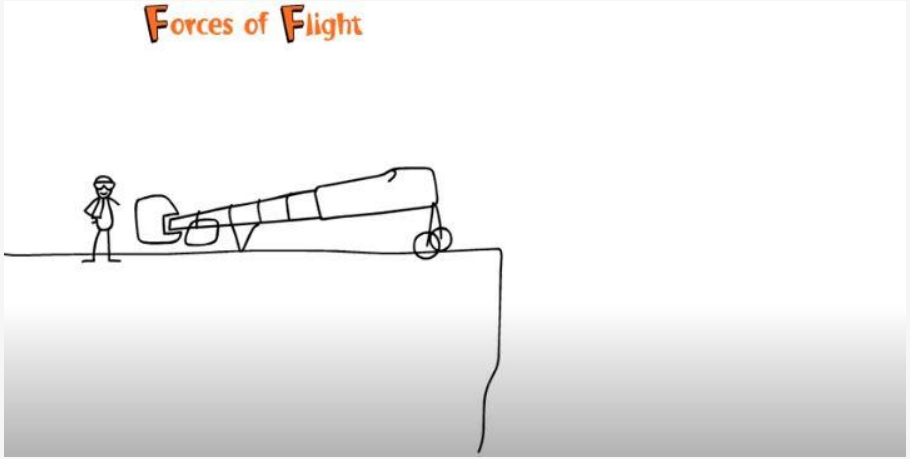
How Does a Glider Work?

- Learn the basics of how a glider works. *(Video 1:00)*

Source: PBS Learning Media website – Design Squad Nation:
https://nj.pbslearningmedia.org/resource/arct14.sci.dsattack/how-does-a-glider-work/

How Do Things Fly?

- There are 4 forces that impact how things fly (weight, lift, drag, and thrust). See how they work together to produce flight. *(Video 1:12)*



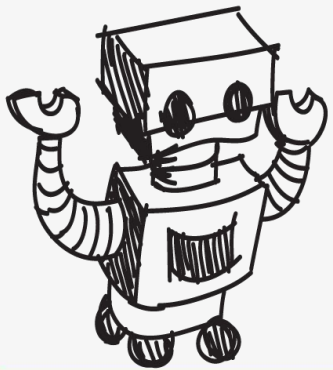
Source: Smithsonian Education YouTube Channel: https://www.youtube.com/watch?v=CKrvYCOSbf8

Did you Know?

- Did you know there is a World Paper Airplane Championship? It's true! Red Bull sponsors the Championship each year. Maybe you could be one of the next competitors. *(Video 3:49)*

Source: Red Bull YouTube Channel: https://www.youtube.com/watch?v=SUyqakRMrxo

The Design Challenge



The Design Challenge

- You are a team of engineers given the challenge of creating a glider out of simple materials that can fly as straight as possible toward a target that is fifteen feet away.

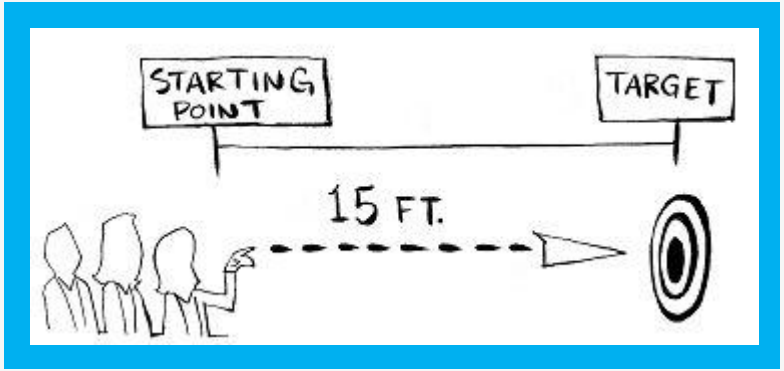
Defining the Challenge: Criteria & Constraints

Criteria

- Glider must fly as straight as possible toward a target that is fifteen feet away.

Constraints

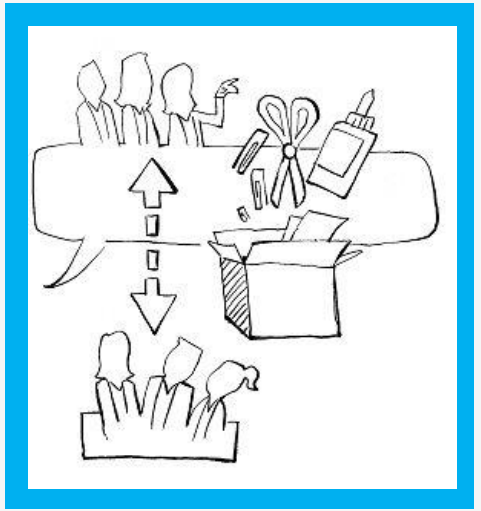
- Can use only the materials provided.
- Unused materials may be shared with other teams or materials may be traded.



Material

Optional for Build – Trading/Table of Possibilities

- Cardboard/Cardstock
- Cardboard tubes (paper towel, toilet paper)
- Popsicle sticks/Balsa wood/Paint stirrers
- Craft foam sheets/Foam trays
- Paperclips/Rubber bands
- Foil



Weight

- Coins/Rocks/Clay/putty

Testing Materials and Process

Testing Materials

- Measuring tape
- Box, goal, or bench for target
- A gym or nice day – to test outdoors!

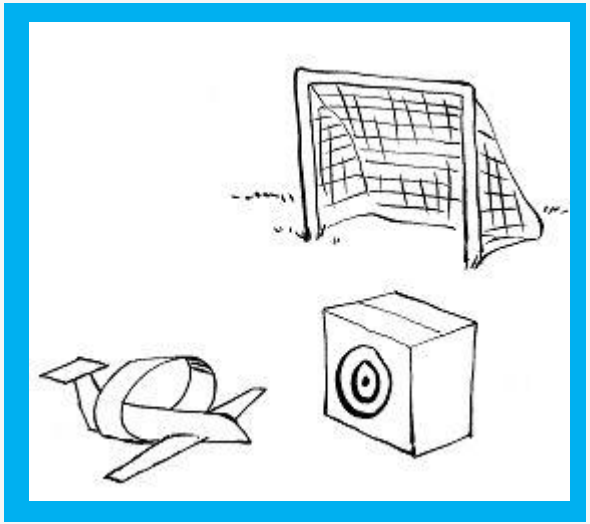
Testing Process

- Each team will test their design by flying their glider from a starting point to a target fifteen feet away. Measure and record the distance that each glider successfully flies.

Testing Materials and Process

Testing Process, continued

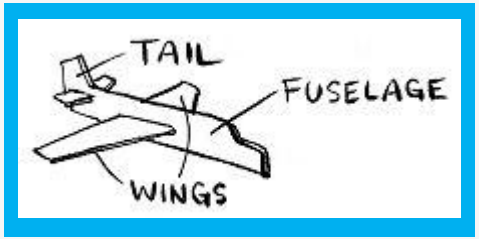
- To flight test, identify a large target such as a box, goal or bench so that gliders fly away from students. An objective person should “fly” each glider so the strength of the launch is consistent. Each plane will be tested three times with the furthest distance of the three used to determine the winning team.
- Document the distance flown and draw the flight path of each test.

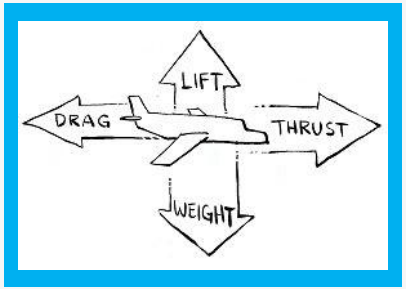


Consider...

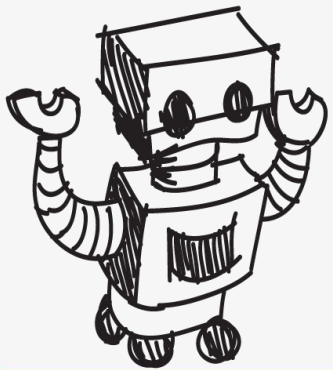
Before you get started brainstorming and sketching your design...consider the following...

- Three main parts of a glider: the wings, the body (or fusilage), and the tail
- Balancing the 4 forces that impact flight: thrust, weight, lift, and drag
- How the “weight” of your design is offset by the “lift”
- If a stabilizer on the tail or extra weight in the front is needed to improve stability



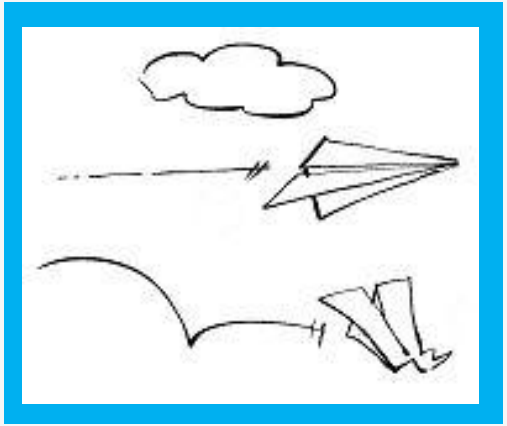


Reflect & Debrief

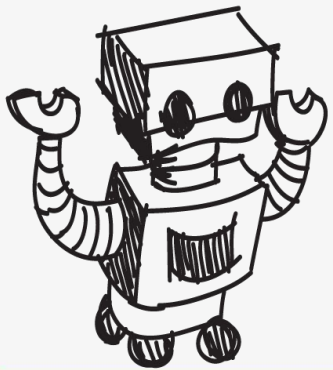


Reflection

- How did you decide on the shape of the parts of your glider?
- What was it about the shape of each part that you thought might help your glider fly?
- What aspect(s) of the design led to the success of the glider that flew the straightest and furthest?
- If you could have selected some building materials which were not made available to you, what would you have selected? Why?



Engineering Design Process



The Engineering Design Process

Learn about the engineering design process (EDP). The process engineers use to solve problems.

(Video 1:47)

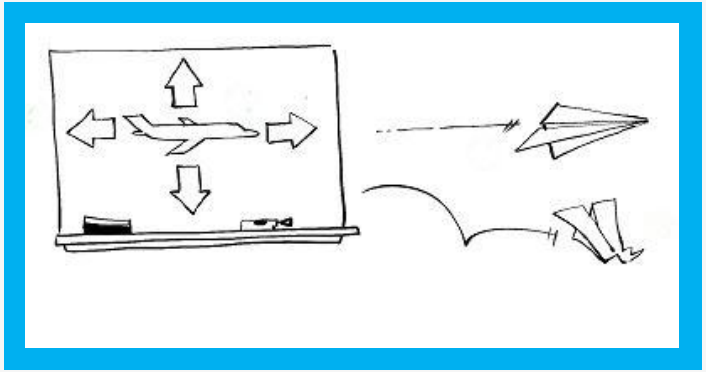
Source: TeachEngineering YouTube Channel http://www.youtube.com/watch?v=b0ISWaNoz-c

Engineering Design Process

- Divide into teams of two or three
- Review the challenge and criteria & constraints
- Brainstorm possible solutions (sketch while you brainstorm!)
- Choose best solution and build a prototype
- Test then redesign until solution is optimized
- Reflect as a team and debrief as a class

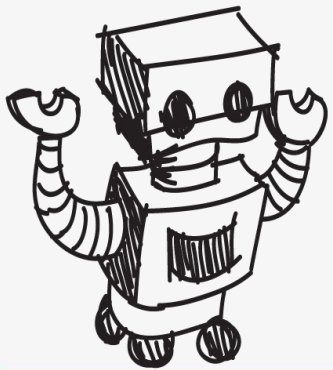
Productive Failure

- The engineering design process involves productive failure: test, fail, redesign. Iterate again and again until you have the best possible solution.
- It is important to document iterations to keep track of each redesign. Use the engineering notebook to sketch ideas, document iterations and any measurement and/or calculations.



- It's also important to showcase the fact that there can be multiple solutions to the same problem. There's no one "right" solution.

Vocabulary



Vocabulary

- Aerodynamic: The qualities of an object that affect how easily it is able to move through the air.
- Constraints: Limitations with material, time, size of team, etc.
- Criteria: Conditions that the design must satisfy like its overall size, etc.
- Drag: A force that acts opposite to the relative motion of any object moving with respect to surrounding air.
- Engineers: Inventors and problem-solvers of the world. Twenty-five major specialties are recognized in engineering (see infographic).
- Engineering Design Process: Process engineers use to solve problems.

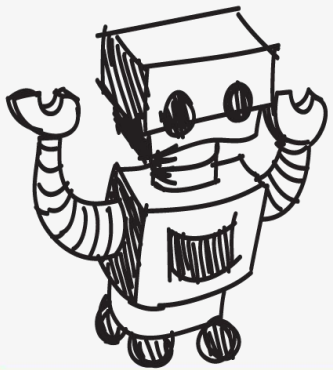
Vocabulary

- Engineering Habits of Mind (EHM): Six unique ways that engineers think.
- Iteration: Test & redesign is one iteration. Repeat (multiple iterations).
- Lift: An aerodynamic force that helps to counteract weight. The heavier an object is, the harder it is for lift to work against it and achieve flight.
- Pressure: The application of force to something by something else in direct contact with it.
- Prototype: A working model of the solution to be tested.
- Thrust: The forward motion (velocity) or thrust of an aircraft through the air along with the shape of the aircraft and its parts.

Vocabulary

- Velocity: How fast an object is moving in a particular direction.
- Weight: Everything has weight, which is a result of gravitational forces. The materials selected for a glider design will have a weight that will need to be offset by “lift” in order to fly.
- Wright Brothers: Two brothers and aviation pioneers who are generally credited with inventing, building, and flying the world's first successful airplane.

Dig Deeper



Dig Deeper into the Topic

Internet Connections

- NASA: Wright Brothers Invention Process
- NASA: Re-Living The Wright Way

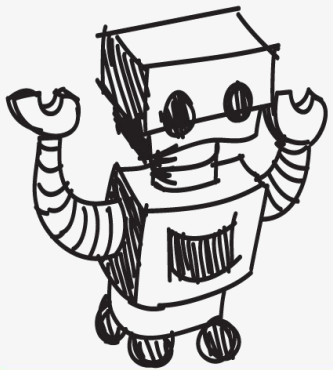
Recommended Reading

- Jet Plane: How It Works, David Macaulay (ISBN: 978-1626722118)
- The Big Book of Airplanes, DK (ISBN: 978-1465445070)
- Flight, DK (ISBN: 978-0756673178)

Writing Activity

Write an essay or a paragraph about how glider technology has changed over the past hundred years. Or, write an essay about how you think the world has been impacted because people can fly.

Engineering Fields



What is Engineering?

Learn about engineering and how engineers are creative problem solvers and innovators who work to make the world a better place.
(Video 3:43)

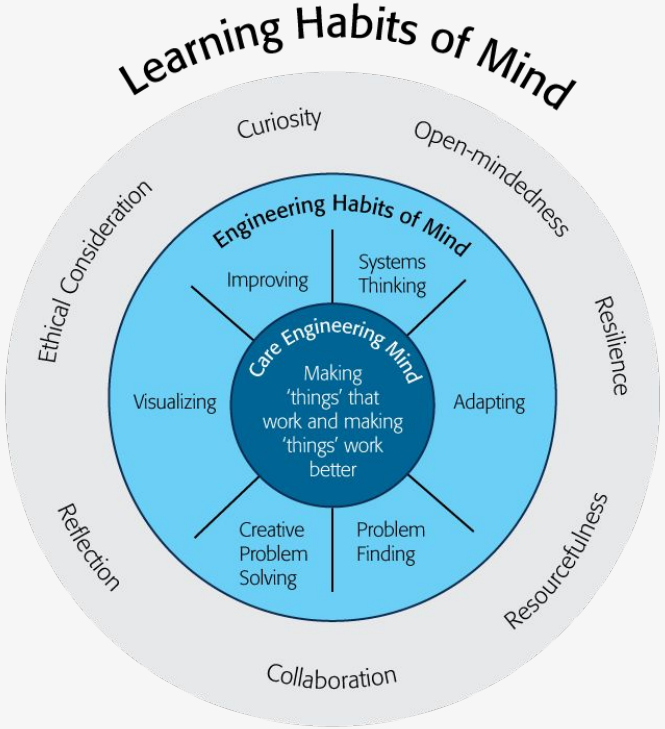
Source: TeachEngineering YouTube Channel - http://www.youtube.com/watch?v=H9VDkvqGmVo

Related Engineering Fields

- There are several types of engineering fields that are involved with designing gliders. Here are just some of the related engineering fields.
  - Mechanical Engineering
  - Electrical Engineering

- Download the Engineering Fields Infographic
  How will **YOU** change the world?

Engineering Habits of Mind



Engineering Habits of Mind (EHM) is about how engineers think everyday. The Core Engineering Mind is about making things that work and making them work better.

Source: https://online-journals.org/index.php/i-jep/article/view/5366)

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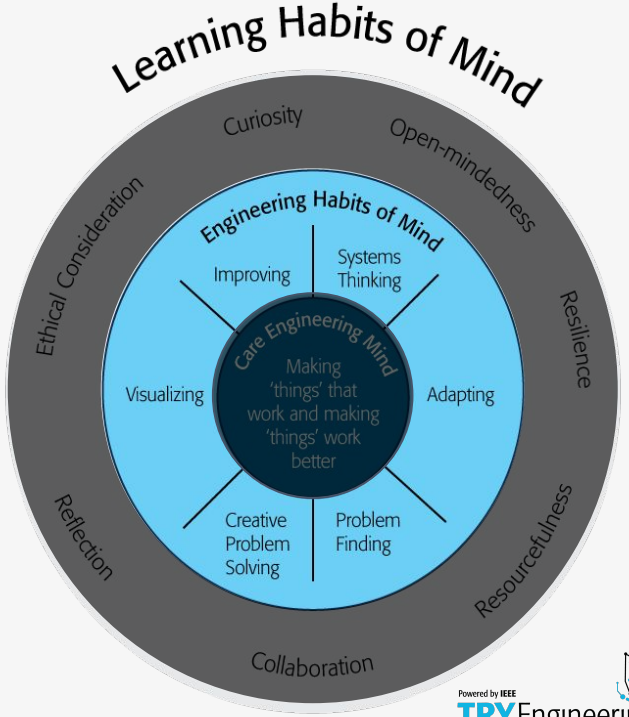
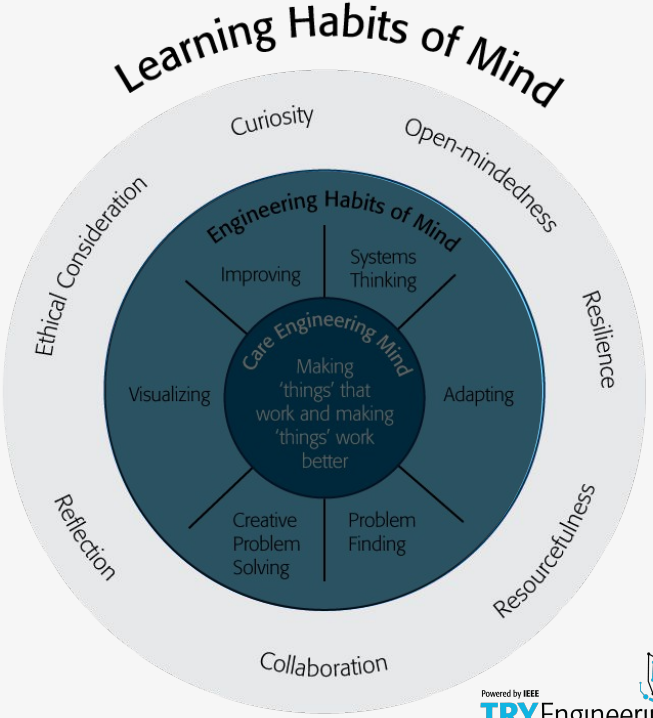
Engineering Habits of Mind Checklist

- Systems thinking
- Problem-finding
- Visualising
- Improving
- Creative problem-solving
- Adapting



Learning Habits of Mind Checklist

- Open-mindedness
- Resilience
- Resourcefulness
- Collaboration
- Reflection
- Ethical Consideration
- Curiosity

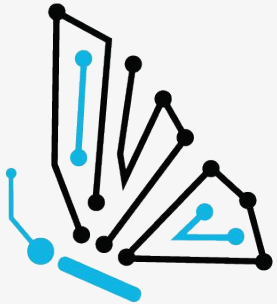


Greatest Engineering Achievements of the 20th Century

Source: http://www.greatachievements.org/

Learn more about how engineers make the world a better place

For more engineering lesson plans and resources like games, engineering careers, and STEM opportunities visit IEEE's TryEngineering.org



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