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**TRY**Engineering

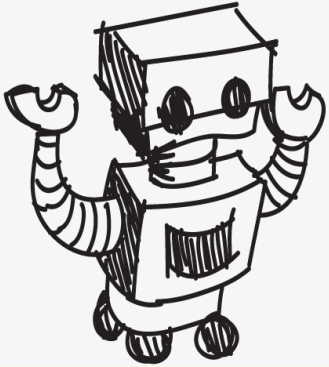


**Lesson Plan:**

**Take Flight**



# Real-World Application



# How Does a Glider Work?

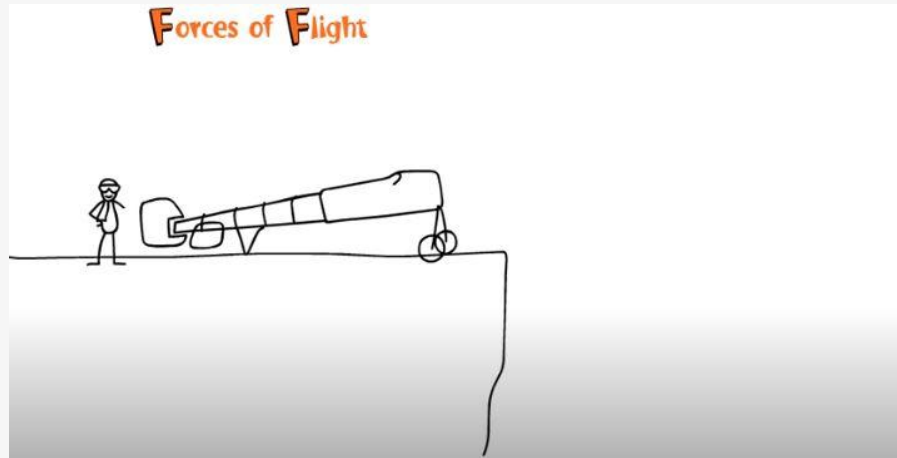
- Learn the basics of how a glider works. (Video 1:00)



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>

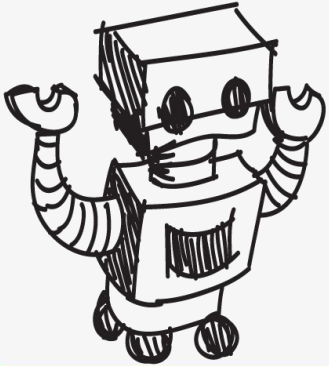
# Did you Know?

- 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.



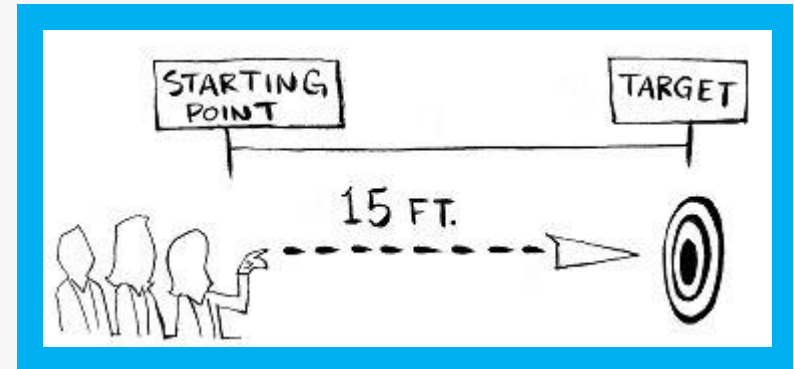
# Defining the Challenge: Criteria & Constraints

## 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.





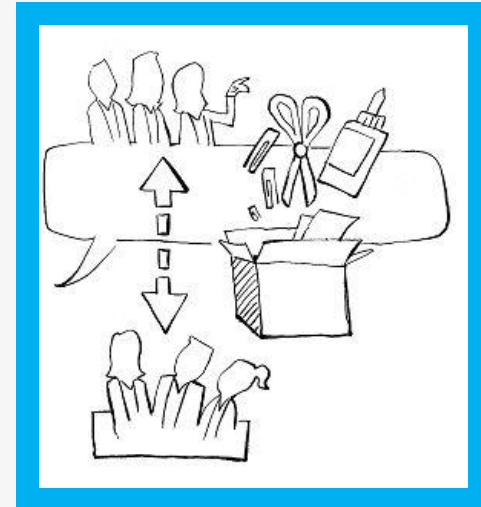
# Material

## 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

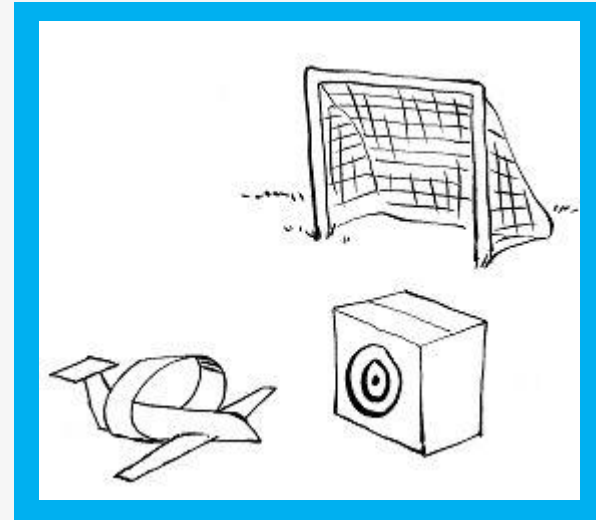
- Each team will test their design by flying their glider from a starting point to a target fifteen feet away. Measure and record the distance that each glider successfully flies.



# Testing Materials and Process

## Testing Process, continued

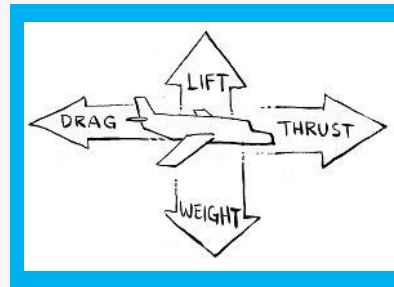
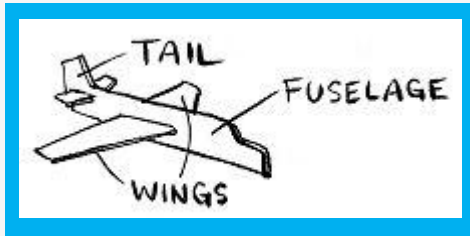
- To flight test, identify a large target such as a box, goal or bench so that gliders fly away from students. An objective person should “fly” each glider so the strength of the launch is consistent. Each plane will be tested three times with the furthest distance of the three used to determine the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



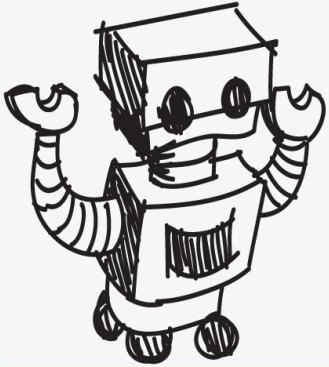
# Consider...

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

- Three main parts of a glider: the wings, the body (or fuselage), 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

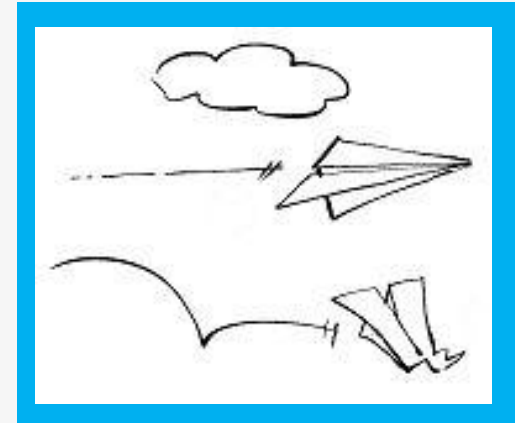


# Reflect & Debrief

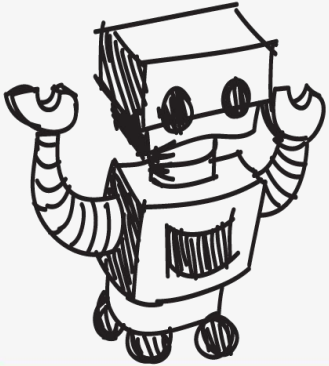


# Reflection

- 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>



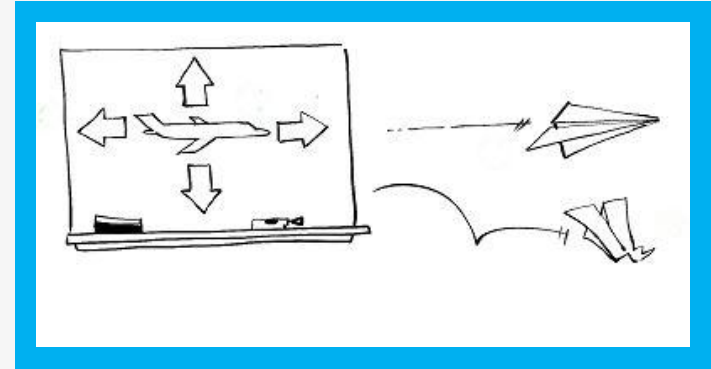
# Engineering Design Process

- 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

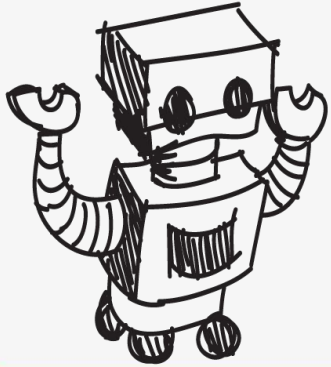


# Productive Failure

- 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.

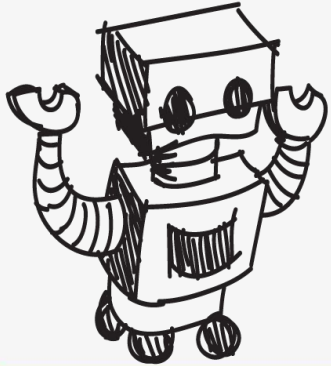


# Vocabulary

- 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)

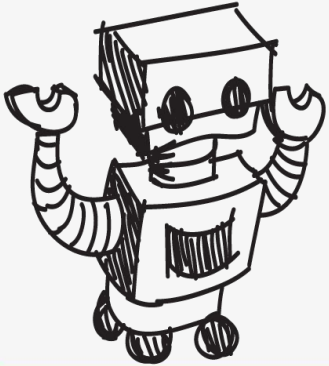
## Writing Activity

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.

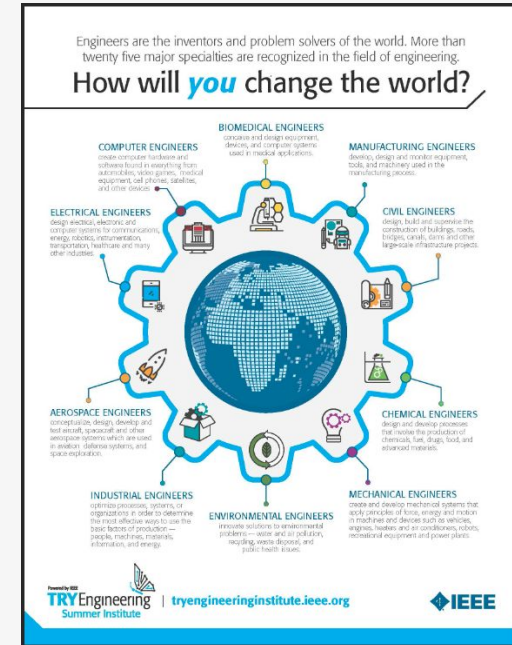
*(Video 3:43)*



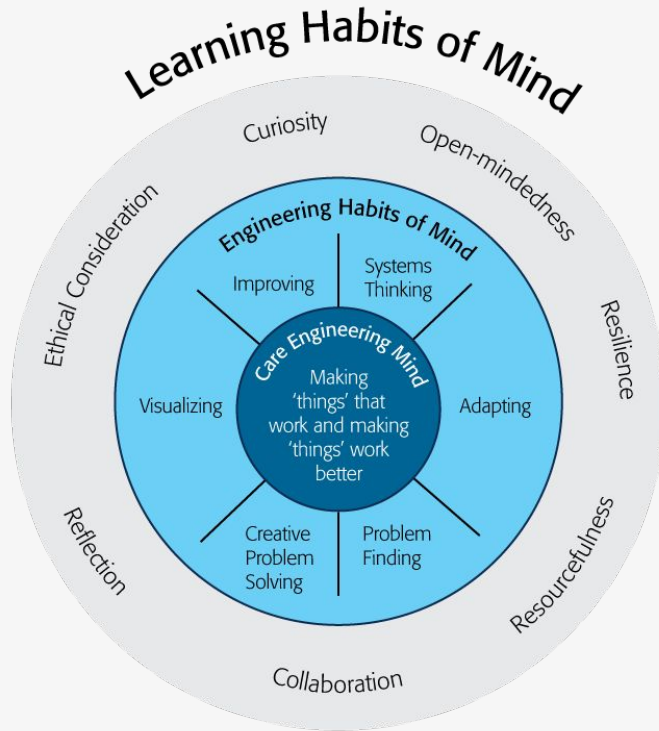
Source: TeachEngineering YouTube Channel - <http://www.youtube.com/watch?v=H9VDkvGmVo>

# 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.

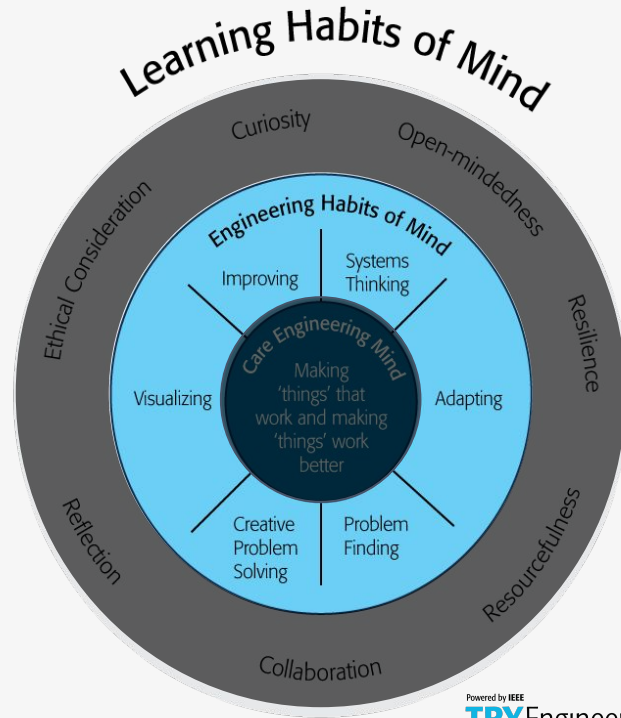
Source:

<https://online-journals.org/index.php/i-jep/article/view/5366>



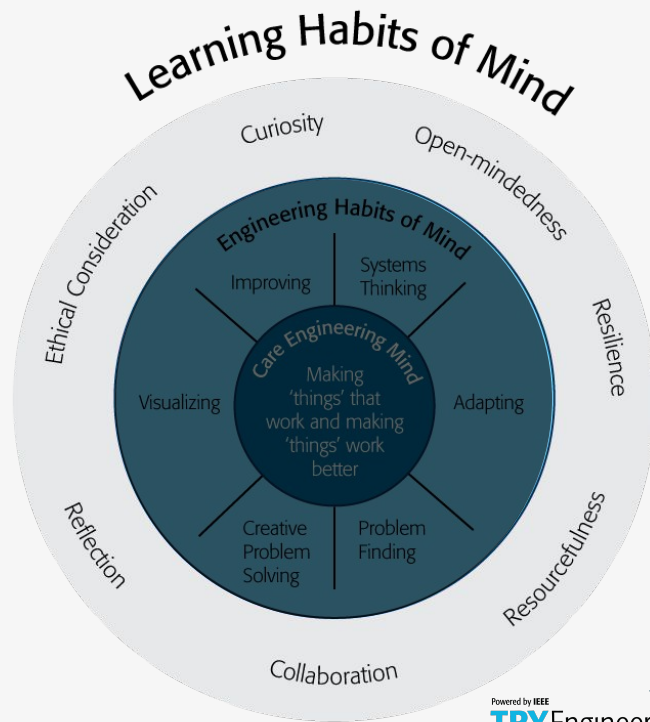
# Engineering Habits of Mind Checklist

- ❑ 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



## Greatest Engineering Achievements OF THE 20<sup>TH</sup> CENTURY

### Welcome!

How many of the 20th century's greatest engineering achievements will you use today? A car? Computer? Telephone? Explore our list of the top 20 achievements and learn how engineering shaped a century and changed the world.

1. Electrification
2. Automobile
3. Airplane
4. Water Supply and Distribution
5. Electronics
6. Radio and Television
7. Agricultural Mechanization
8. Computers
9. Telephone
10. Air Conditioning and Refrigeration

11. Highways
12. Spacecraft
13. Internet
14. Imaging
15. Household Appliances
16. Health Technologies
17. Petroleum and Petrochemical Technologies
18. Laser and Fiber Optics
19. Nuclear Technologies
20. High-performance Materials

LinkEngineering



Greatest  
Achievements



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

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# Learn more about how engineers make the world a better place



The banner features the NAE logo (three interlocking puzzle pieces in blue, green, and yellow) and the text "NAE GRAND CHALLENGES FOR ENGINEERING" with "NATIONAL ACADEMY OF ENGINEERING" in smaller text below. Navigation buttons for "Challenges", "News", and "Community" are in green rounded rectangles. The main visual is a large green puzzle piece on the left containing a white atomic symbol, set against a dark background with a complex network of glowing green lines and dots radiating from a central point. Below this, the text "Provide energy from fusion" is displayed in a large, dark font. Underneath, a paragraph reads: "Human-engineered fusion has been demonstrated on a small scale. The challenge is to scale up the process to commercial proportions, in an efficient, economical, and environmentally benign way." At the bottom of the banner is a row of twelve diamond-shaped icons representing various engineering fields: a smartphone, VR, a gear, a bridge, a water drop, a molecular structure, a CO2 canister, a microscope, a brain, a laptop, a padlock, a gear with a star, a circular arrow, and a DNA helix.

NAE GRAND CHALLENGES  
FOR ENGINEERING  
NATIONAL ACADEMY OF ENGINEERING

Challenges News Community

## Provide energy from fusion

Human-engineered fusion has been demonstrated on a small scale. The challenge is to scale up the process to commercial proportions, in an efficient, economical, and environmentally benign way.





For more engineering lesson plans and  
resources like games, engineering careers,  
and STEM opportunities visit IEEE's  
[TryEngineering.org](https://www.tryengineering.org)

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