PROJECT EZ

STEM LESSON GUIDE FOR FT EZ BASIX BUNDLE

LEARN TO DESIGN, BUILD AND FLY YOUR OWN AIRCRAFT!

Project: EZ BasiX

Length: 6 to 10 Hours

Grade: All Grade Levels

Concept Connection: Newton's 3rd Law of Motion

Learning Strand: FT Workbench to Engineering and Design

TABLE OF CONTENTS

"Welcome parents and students, are you ready to take flight with us? In this Project EZ lesson we are going to explore the basics of flight using the observations of Sir Isaac Newton, build some awesome DIY foam flyers, build and fly an actual remote controlled airplane, and challenge you to engineer and fly your very own airplane design!"

The Flite Test STEM Team

PROJECT EZ

STEM LESSON GUIDE FOR FT EZ BASIX BUNDLE

LEARN TO DESIGN, BUILD AND FLY YOUR OWN AIRCRAFT!

MATERIALS NEEDED

Included

FT Freighter with Remote Control
EZ Power Pack 2 Channel
EZ3 First Flyers Pack includes

3 Airframes
Extra Fuselage
3 Extra Foam Board Sheets

Still Need

Hot Glue Gun and Glue
Utility Knife and Scissors
6x AA Batteries for EZ Controllers
Packaging Tape
Ruler
Optional Color Markers

IMPORTANT SAFETY NOTICE

Safety is the most important thing in all flight experiences - every time, all the time.
Please follow these guidelines;

Adult Supervision

Adult supervision is required at all times for this lesson.

Hot Glue Guns

Can be extremely hot, and should always be handled with care. Young students should always be supervised when using hot glue. Review hot glue safety with your students prior to using hot glue guns.

Utility Knives

Cutting blank foam during creation will require assistance and adult supervision. Make cuts facing down and on a protective surface.

Adhesives

This package may include adhesives that require adequate ventilation and adult supervision. Follow all manufactures safety guidelines.

Batteries

Possible battery and electric shocks - Follow all instructions for charging and handling batteries.

Flight

Follow Flite Test Community Association (FTCA) Before You Fly Protocols to insure optimal flight safety.

INTRODUCTION: Understanding the Plane

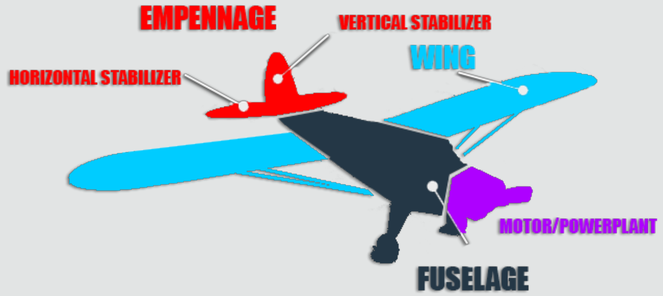
Objective: Students will understand the different elements that make a plane and how they affect flight.

FT STEM Learning Strand: FT Workbench - Time: 1-2 HRS

PARENTS AND TEACHERS

Prior to Learning Activity #1, the student must gain an understanding of the plane, its basic parts, control surfaces, and aerodynamic principles being applied. The following content can be read over, presented to, retaught, or tested based on your students' personal learning preferences.

Content Connection 1 - Basic Plane Parts

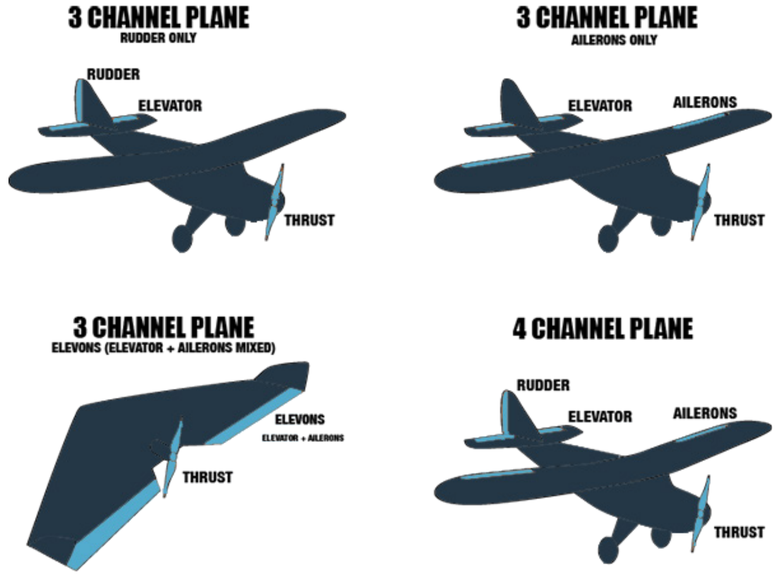


Fuselage: Is the main body of the plane that everything else connects to. In the trailing edge of the fuselage you have the empennage. The front of the fuselage will house the payload, for remote control (RC) it will be the power plant (Motor), battery, and flight controller.

Empennage: Consists of the vertical stabilizer that controls the yaw (left and right) movement of the plane, and the horizontal stabilizer that controls the pitch movement of the plane.

The Wing: Wings come in many shapes and sizes. They generate the lift needed for the plane to fly.

Content Connection 2 - Remote Controlled Channels



There are 3 major sets of control surfaces. The control surfaces deflect the flow of air, in turn, pushes the control surface the opposite direction. This changes the angle of the plane on that axis.

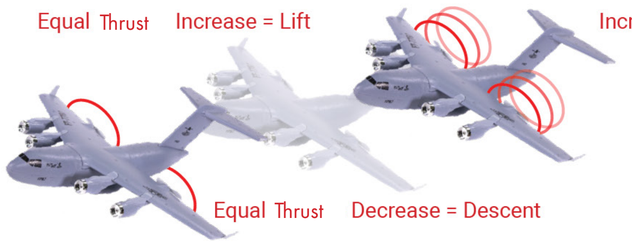
Elevator (Pitch up or Down) - Controls the pitch angle of the airplane. The elevator is situated horizontally on the tail of the airplane.

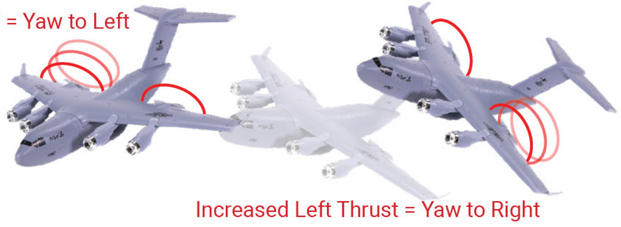
Rudder (Yaw left or right) - Controls the yaw. The rudder is situated vertically on the tail of the airplane.

Ailerons (Roll left or right) - Controls the roll, or bank of the airplane. The ailerons are located on trailing edge of the wing.

Elevons (Involves both roll and pitch) - Controls the pitch AND roll of an airplane. The elevons are a combination of the elevator and ailerons situated on the trailing edge.

Content Connection 3 - Differential Thrust





Differential Thrust: The FT STEM Micro Freighter uses differential thrust to control movement around the Yaw axis by increasing/decreasing the speed of one motor to apply greater thrust to one side of the aircraft.

What will happen when both motors operate at the same speed?

What will happen if the motor on one side spins faster than the motor on the other side?

Video Content Connection 4

ISTE: Empowered Learner (1B, C, D) Knowledge Constructor (3A, B, C, D)

LEARNING ACTIVITY #1: Exploring Forces of Flight

Objective: Students will understand how differential thrust and lift by thrust works through the construction and flight of an RC stabilized aircraft.

FT STEM Learning Strand: Build to Fly - Time: 2-3 HRS

PARENTS AND TEACHERS

Here are few tips for assembly and some flight activities to explore as students experience the thrill of remote-control flight (and the occasional crash landing).

Materials:

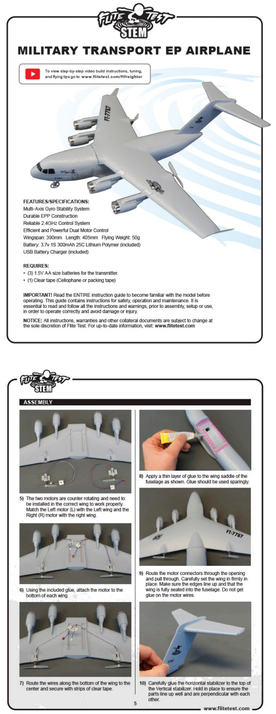
- FT Freighter and components
- 3 AA batteries for the transmitter (controller)

Build Option 1 - Manual

FT Micro Freighter - Let's build!

Time: 1 HR

See Build Instructions Click Image



Build Option 2 - Video Build

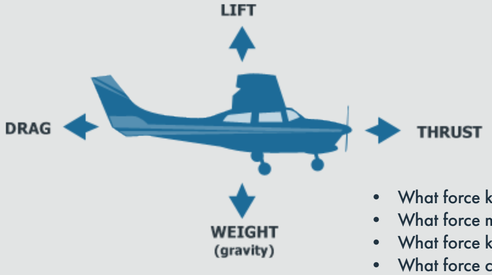
Content Connection 1 Reflection

PARENTS AND TEACHERS

When you have finished building the FT Freighter, while following the included instructions and are ready to fly, here are a few concepts and suggested questions you can ask your students to help them understand some basic concepts around flight.

Checking For Understanding

The Four Forces acting on an airplane:
Lift, Gravity, Thrust, and Drag.



- What force keeps the airplane on the ground? (or makes it fall to the ground)
- What force makes the airplane move forward?
- What force keeps the airplane flying in the air?
- What force causes the airplane to slow down in the air?

Operating your aircraft – Let's Fly!

If your students are beginner pilots, here are a few exercises that would be good to practice:
Begin flying the plane on low rates until they get some experience in operating the plane
Flying (and landing) in a straight line away from the pilot
Flying (and landing) in a straight line towards the pilot (steering controls will be reversed)
Flying in a circle or a figure eight
When you're ready to fly, have the students practice flying the FT Micro Freighter in the same patterns.

ISTE: Empowered Learner (1B, C, D) Knowledge Constructor (3A, B, C, D)

LEARNING ACTIVITY #2: Newton's 3rd Law

Project EZ BasiX

Objective: Students will understand Newton's 3rd Law of motion and its connection with the Four Forces of flight by conducting DIY scratch build aviation.

- Learn basic Flite Test build fundamentals and finding the center of gravity through the construction of our EZ First Flyers.

FT STEM Learning Strand: FT Workbench - Time: 1-2 HRS

PARENTS AND TEACHERS

In this lesson have your students' materials ready as they will be building the EZ3 First Flyers to test Newton's theory on motion.

Materials:

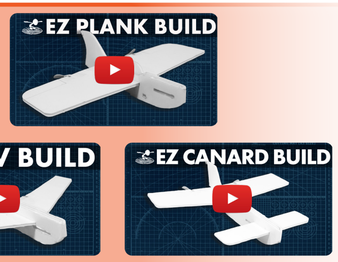
- EZ3 First Flyers Pack
- Hot Glue Gun
- Utility Knife
- Area to test glider

Content Connection 1 Newtons Law and Application

It was in the year 1686 that Sir Isaac Newton developed the three laws of motion. For the elementary students we are going to focus on Newton's 3rd Law stating, "For every action, there is an equal and opposite re-action."

For example, if object "X" exerts a force on object "Y" then object "Y" also exerts an equal and opposite force on object "X". Wait wait wait, what? We need to put this into practice and see the law explained!

Build Time! Using **ONE** of your EZ First Flyers pack, follow the build video posted below on how to construct an aircraft to put the theory to the test by first chuck gliding your aircraft;



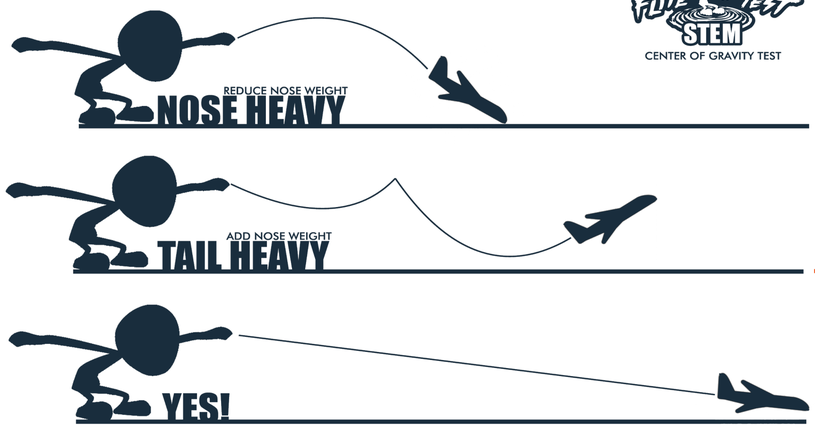
Test the Center of Gravity of your EZ First Flyer!

It is time to test your new aircraft! Before your first throw we need to find the center of gravity on the glider.

"COG or Center of Gravity is the aircraft's point of balance!"

Look at the diagram to the left where you see the FT Gremlin throwing his glider, you need to conduct the same tests by throwing your aircraft nice and straight and seeing the results of its flight path! If nose heavy, add some weight to the back with a little hot glue. If the tail is heavy, add some weight to the nose of the aircraft. You want the aircraft to fly nice and straight and for a good distance!

Content Connection 2 - Center of Gravity



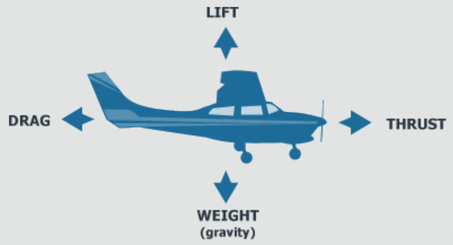
CENTER OF GRAVITY TEST

Content Connection 3 - Four Forces of Flight

Describe What is Happening

Answer: Newton's law explains a couple actions in this scenario! The first being when you provide the force of thrust when you throw the glider. When the aircraft is flying, the change in pressure of the air flowing above and below its wings is creating lift! For every action about the forces of flight there is an equal and opposite reaction. See below the Four Forces that act on your aircraft. Study these and understand how they work by testing them out on your chuck glider. Examples of things to try below;

- Add weight to your glider and throw straight and level from your ear away from your body.
- Throw your glider at a higher angle of attack



PARENTS AND TEACHERS

Encourage your student to conduct many practice flights throwing their plane, observe how the plane behaves with different throwing motions. Have them say whatever is on their mind on how and why their glider is flying. If it glides, it will fly!

Safety:

- Throw glider in open area
- Throw glider away from people

ISTE: Empowered Learner (1B, C, D) Knowledge Constructor (3A, B, C, D) Data Analysis NCTM

LEARNING ACTIVITY #3: Design Challenge

Objective: Students will learn to apply the FT Engineering and Design Model to create their own DIY aircraft.

FT STEM Learning Strand: Engineering and Design - Time: 2-4 HRS

PARENTS AND TEACHERS

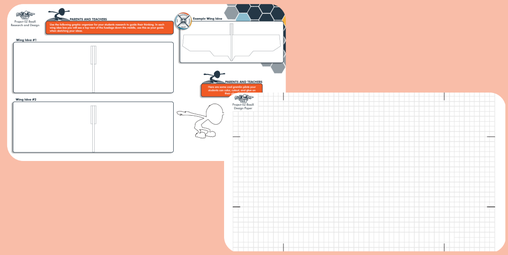
You have some options before Activity #3

Option 1: Using your last set of EZ3 First Flyers, have your student learn to install the additional EZ Power Pack to make them fly.

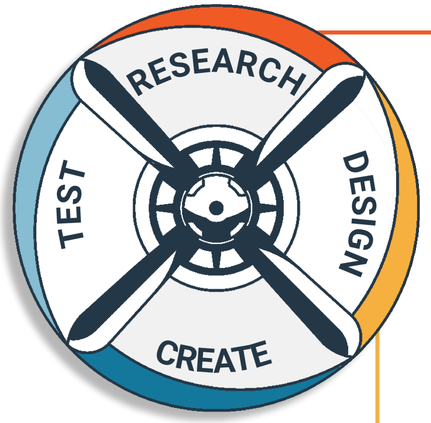
Option 2: Using the EZ Power Pack provided, the extra fuselage and two foam board planks, have your student take on the challenge of desiging a new wing by following the guide in Learning Activity #3.

Materials:

- EZ Power Pack
- 2 foam board planks provided
- Fuselage ready plank
- Hot Glue Gun
- Utility Knife
- Scissors
- Ruler
- Pencil
- EZ BasiX Research Paper
- EZ BasiX Drawing paper



Content Connection - Research



RESEARCH: Time 1-2 HRS

In this stage of the FT STEM Engineering and Design model, the student is provided a problem, in this challenge the EZ First Flyer fuselage is incomplete and needs a wing! Use the Research stage of our engineering and design model to find innovative aircraft wing designs to help you create a solution. Solutions are endless for this project, students be creative and think outside the box!

Basic Research Tips;

- Search the words "aircraft wing shapes" and click images, here your student can see all sorts of cool wing possibilities for their EZ First Flyer.
- Searching the words "tapered wing shape" also provides a good reference around wing designs that will work within your provided fuselage shape.
- Using the Research Paper, sketch your favorite wing shapes you found during your search.

"tapered wing shape" www.google.com (Accessed May 1, 2020)

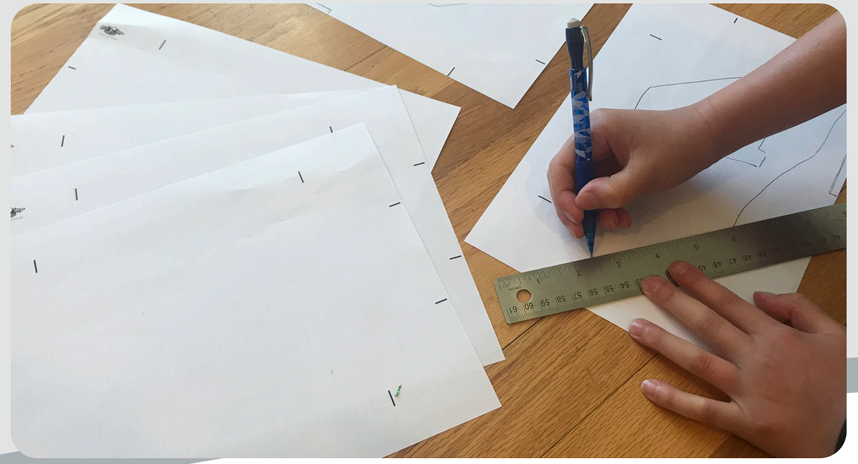
Content Connection - Design

DESIGN: Time 1-2 HRS

Now it is time to finalize your design, pick your favorite wing idea from your Research Paper and use for drawing your wing template! Using the FT STEM Design paper provided on the next page, begin drawing you aircraft using a ruler and measurements.

Parents and Teachers Helpful Tips:

- Keep the sizing of the aircraft wing or aircraft within the EZ 3 First Flyers
- Use the provided fuselage plank and extra foamboard to help with this process
- The wing must be as wide as the wing insert of the provided fuselage
- The back of the wing where the motors are mounted must be perpindicular to the fuselage
- Use a ruler to measure lengths and stay symmetrical
- Trace an older First Flyer wing aircraft and modify based on the students findings in their Research
- Remember, failure is an option and it is common, this will be challenging. The most important thing is that students learn from it and have fun!
- See our example as guidance



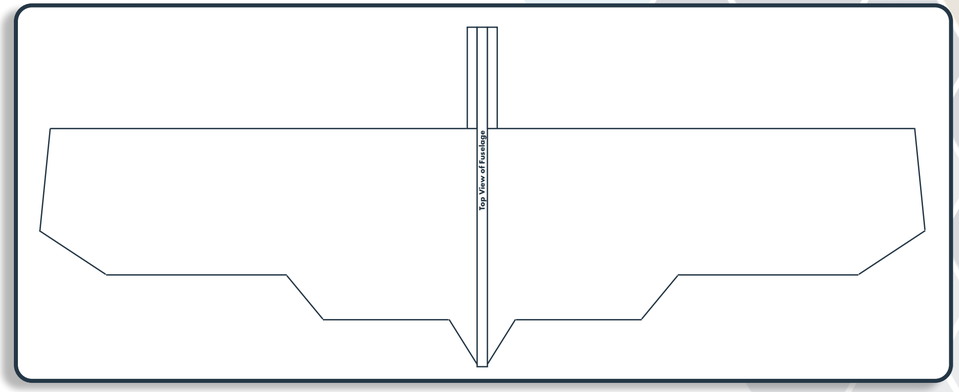
ISTE: Empowered Learner (1B, C, D) Innovate Designer (4A, B, C, D) Numbers & Operations NCTM

Project EZ BasiX
Research Paper

PARENTS AND TEACHERS

Use the following graphic organizer for your students research to guide their thinking. In each wing idea box you will see a top view of the fuselage down the middle, use this as your guide when sketching your ideas.

Example Wing Idea

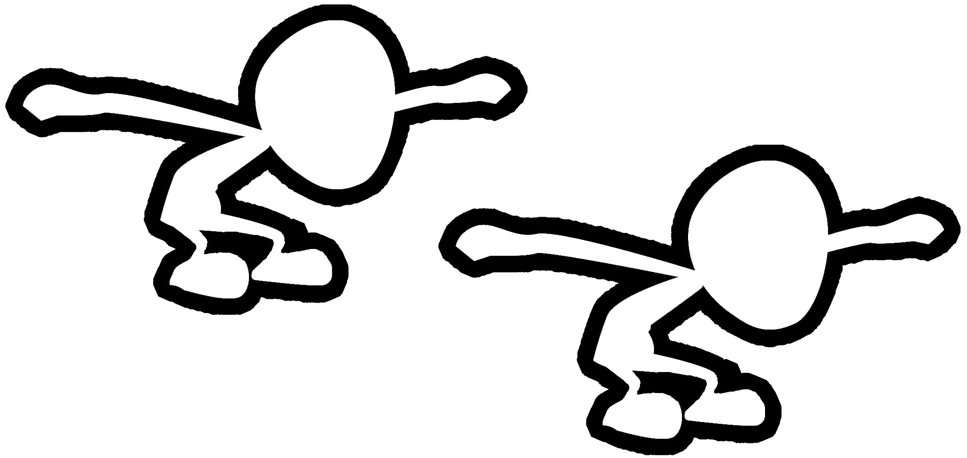


Wing Idea #1

PARENTS AND TEACHERS

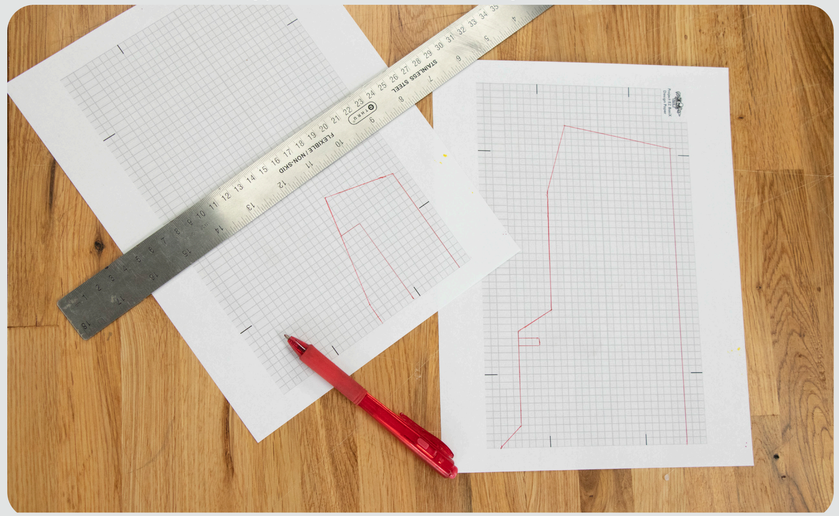
Here are some cool gremlin pilots your students can color, cutout, and glue on their plane!

Wing Idea #2



Project EZ BasiX
Design Paper

Draw your wing shape (tail optional) on the design paper. You can draw one half of the wing and flip the pattern over to be sure that your surfaces are the same on both sides of the plane.
(A wingspan of about 16 inches (400 mm) is a good starting point.)



Tape your template(s) to the foam board, cut around it with a utility knife. Be sure that you will have enough foam when you flip the pattern over.

CREATE: Time 1-2 HRS

Its build time! With your drawings complete and taped, the next step is to start cutting your wing out and finishing your EZ First Flyer creation!

Use the EZ First Flyer Build Video as reference

Parents and Teachers some helpful tips;

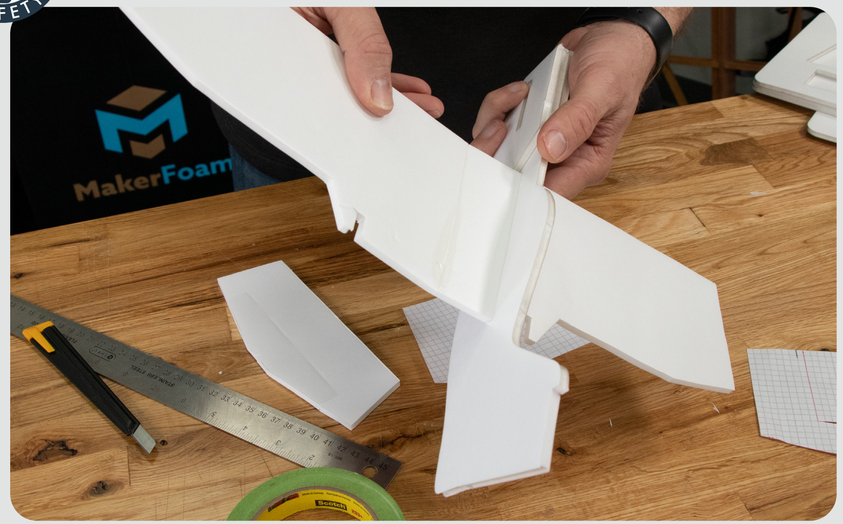
- Assist your student in the cutting and gluing of the chosen material
- Keep the templates after the student cuts them out just in case they need to remake a new piece
- Using your additional EZ Power Pack, map out first where you plan to install them on the aircraft
- See our example as we will show a wing and a tail, but the tail is optional.

Add dihedral (see the video) to the wing for better stability. Make a shallow cut along the centerline of the wing and squeeze a small amount of glue into the opening. Quickly put the bottom of the wing against the table and place a roll of tape under the bottom of the wing until the glue sets.

Cut a slot into your fuselage for the wing and tail, if applicable, using your wing template.

ISTE: Empowered Learner (1B, C, D) Innovate Designer (4A, B, C, D) Numbers & Operations NCTM

Insert your wing into the fuselage and apply a small amount of glue to hold it in place.



Find and mark the center of gravity of your plane by using it as a glider.
If it will glide, it will fly! Once you have completed your build and it flies, mark your CG and install your extra EZ Power Pack components.

PARENTS AND TEACHERS

In this last stage of the design process, we really want to focus on having fun, staying positive, and having your student describe what went well and what needs improvement on their design. Remember failure is an option and we learn the most when that happens. This is where true learning happens!

TEST: Time Forever!

It is what you have been working so hard for, it all comes down to this, test flying your own wing creation.

Parents and Teachers some helpful tips:

- Use a nice open area safe from houses, power and telephone lines, and people!
- Pick a day with great weather with calm winds
- Do your pre-flight inspection and make sure you check the following;
  - All glued pieces are secure
  - Props are on motor shafts
  - Batteries in both controller and plane are fully charged
  - Battery is secured to aircraft
  - Take extra props and tape for on the spot repairs
  - Identified wind direction as you want to throw into it
  - Seeing if there are any potential safety hazards in your area
  - Designate a takeoff and a landing area
  - Are you ready?

Reflection and Final Thoughts

What didn't work and why?

If you were to design another wing, what would you do differently?

What changes would you make to your build process?

Are you seeing the flight behavior that you expected with your design?

TAKE IT FURTHER!

Game Challenge - Improve your flight skills!

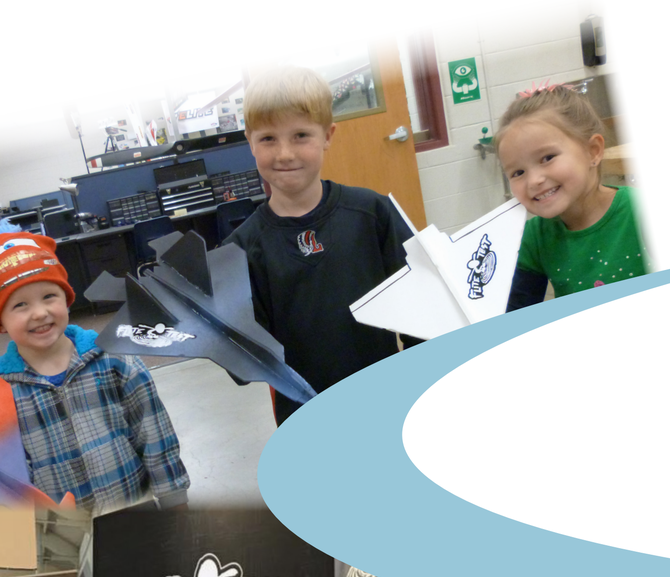
- Spot landing challenge - pick a spot and land on it, closest wins!
- Fly around an obstacle course - fastest time wins!
- Re-design for longest flight times - Longest flight time wins!
- Create a complete new aircraft design with common materials

ISTE: Empowered Learner (1B, C, D) Innovate Designer (4A, B, C, D) Numbers & Operations NCTM

EDUCATE EMPOWER ELEVATE

We would like to thank you for participating in this Project EZ lesson, we hope you learned a lot about how fun aviation and engineering can be through STEM DIY remote controlled scratch build RC. If you want more Project EZ lessons please visit our www.ftstem.com to dive into more design challenges . If you are interested in seeing more of our curriculum and what it has to offer, start a Free trial today!

The Flite Test STEM Team



We would love to see your designs, please share your pictures and videos to support@ftstem.com