7TH GRADE · VISUALIZATION CHALLENGE

Flight of Fancy

Teacher Facilitation Guide

Duration: ~ 7 50-minute class sessions

CHALLENGE OVERVIEW

In this challenge, students build on their glider work from the Data Challenge by creating a precise 3D digital model of the physical cardstock glider using 3D modeling software. Students measure every part of the glider using calipers and rulers, then translate those measurements into a digital model — part by part. By the end of the challenge, each student has a complete 3D model of the glider and a real experience with the kind of computer-aided design (CAD) tools engineers use in industry.

BY THE END OF THIS CHALLENGE, STUDENTS WILL BE ABLE TO:

- Explain what 3D modeling software is and describe how engineers use it
- Use calipers and rulers to measure a physical object accurately and record measurements in an organized way
- Use 3D modeling software to create digital shapes based on precise measurements
- Model each part of a glider (vertical stabilizer, horizontal stabilizer, wings, and fuselage) as a separate 3D object
- Assemble individual parts into a complete 3D model and compare it to the physical glider

MODULE STRUCTURE
Activity 1 — What is 3D Modeling? (Day 1, ~50 min)
Activity 2 — Measuring the Glider (Day 2, ~50 min)
Activity 3 — Modeling the Stabilizers (Days 3–4, ~100 min)
Activity 4 — Modeling the Wings and Fuselage (Days 5–6, ~100 min)
Activity 5 — Assembly and Reflection (Day 7, ~50 min)

MATERIALS

Cardstock gliders — 1 per team (from Data Challenge)

Calipers — 1 per team (recommended) or rulers

Rulers

Computers or Chromebooks with TinkerCAD access

Printed measurement recording sheets

Engineering Notebook

Handout 1 – Simple Practice Shapes
Handout 2 – Glider Measurement Sheet
Handout 3 – Glider Measurements Reference
Handout 4 – Modeling Tutorial: Stabilizers
Handout 5 – Modeling Tutorial: The Wing and Fuselage
Handout 6 – Glider Assembly and Reflection

Software options: This challenge is designed to work with TinkerCAD (free, browser-based, recommended for most classes), IronCAD, or Autodesk Inventor. Step-by-step software tutorials for each part of the glider are provided as separate handouts. This guide focuses on facilitation — how to set up the workflow, manage pacing, and support students — not on the software steps themselves.

STANDARDS ALIGNMENT

NGSS Engineering Design
MS-ETS1-2: Evaluate competing design solutions using a systematic process

Science and Engineering Practices
Practice 3: Planning and carrying out investigations
Practice 5: Using mathematics and computational thinking
Practice 8: Obtaining, evaluating, and communicating information

Common Core Standards for Mathematical Practice
SMP 1: Make sense of problems and persevere in solving them
SMP 5: Use appropriate tools strategically
SMP 6: Attend to precision

See the Flight of Fancy Visualization Challenge Planning Guide for complete alignment details.

KEY VOCABULARY	
Term	**Definition**
3D modeling	Creating a digital three-dimensional representation of an object using software. Also called CAD (Computer-Aided Design). (Activity 1)
Dimension	A measurable extent — length, width, and height are the three dimensions used in 3D modeling. (Activity 1)
Caliper	A measuring tool used to precisely measure the width, thickness, or depth of an object, often to a fraction of a millimeter. (Activity 2)
Vertical stabilizer	The upright tail fin of a glider or airplane. Controls side-to-side movement (yaw). (Activity 3)
Horizontal stabilizer	The horizontal tail surface of a glider or airplane. Controls up-and-down movement of the nose (pitch). (Activity 3)
Wing planform	The shape of a wing when viewed from above. (Activity 4)
Fuselage	The main body of the aircraft. Contains the payload and connects the wings and tail. (Activity 4)
Assembly	Combining separate parts into a complete model. (Activity 5)
Tolerance	The acceptable range for a measurement. In engineering, a part is acceptable if it falls within a stated tolerance (e.g., within ±1 mm). (Activity 5)

ACTIVITY 1

What is 3D Modeling?

TIME
~50 min

Essential Question: How do engineers use digital tools to design real things?

Students are introduced to 3D modeling as a tool engineers use in real design work. They explore examples of what 3D modeling software can do, then get hands-on experience with a simple practice exercise in the software so they are comfortable with the basics before they need to model the glider.

SETUP & MATERIALS

- Laptops or tablets with TinkerCAD accounts created at tinkercad.com (recommended; free, no download needed)
- Projector for teacher demonstration
- Simple Practice Shapes Handout

TEACHER TIP — SOFTWARE SETUP

- TinkerCAD is strongly recommended for most classes: it is free, runs in any browser, requires only an email to register, and is designed for beginners. Students can sign up individually or the teacher can create a class and invite students without individual email accounts.
- IronCAD and Autodesk Inventor are more powerful options if your school has licenses and students will continue using them in future courses. However, the learning curve is steeper. The software-specific tutorial handouts cover all three options.
- Set up accounts before class if possible — account creation during class can use up 15–20 minutes.

Part 1 — 3D Modeling in the Real World (15 min)

Open by asking students: Have you ever seen a product design video online — something being "built" digitally before it is made for real? That is 3D modeling.

Field	**How 3D modeling is used**
Aerospace engineering	Every part of a commercial airplane is modeled digitally before a single piece of metal is cut. Engineers test designs on screen before spending millions on a prototype.
Architecture	Buildings are modeled in 3D to check that all the parts fit together — plumbing, electrical, and structure — before construction begins.
Product design	Everything from sneakers to smartphones is modeled digitally first. Designers can test how the product looks and functions without making a physical prototype.
Medicine	Surgeons use 3D models of patient anatomy — built from scan data — to plan complex operations before they enter the operating room.

Connect to the challenge: In this challenge, students will build a 3D model of the cardstock glider. Engineers do this all the time — they create a digital model of an existing product so they can study it, modify it, and improve it without touching the physical object.

DISCUSSION PROMPTS

- Why would an engineer want to design something on a computer before making it in real life?
- What are the advantages of a digital model over a physical model?
- Can you think of a field where 3D modeling would save a lot of time or money?

Part 2 — Software Orientation and Practice Exercise (30 min)

Demonstrate the basic interface of TinkerCAD (or your chosen software) on the projector before students work on their own. Focus on the four essential skills they will use throughout the challenge:

1. Adding a basic shape to the workspace (e.g., a box or cylinder)
2. Resizing the shape by entering exact dimensions (length, width, height)
3. Moving and rotating a shape in 3D space
4. Saving your work

Then distribute the Simple Practice Shape worksheet and have students complete it independently. The worksheet walks students through modeling three simple shapes — a box, a cylinder, and a triangular prism — with specific dimensions given. This is not about the glider yet; it is just to build comfort with the software.

TEACHER TIP

- The most common early frustration with TinkerCAD is accidentally moving or resizing the wrong object. Show students how to click on empty space to deselect, and how to use Ctrl+Z to undo. These two skills prevent most early disasters.
- If some students finish the practice shapes quickly, challenge them to try combining two shapes — for example, making a box with a half-cylinder on top (like a house shape). This previews the kind of shape-combining they will need for the fuselage.

Part 3 — Preview the Challenge (5 min)

Show students the cardstock glider and tell them: over the next six days, they will build a digital version of this — every part, to exact measurements. By the end, their 3D model should look like the real thing.

Walk students through the four parts of the glider they will model, pointing to each on the physical glider: the vertical stabilizer (the upright tail fin), the horizontal stabilizer (the flat tail surface), the wings, and the fuselage (the main body).

ACTIVITY 2

Measuring the Glider

TIME
~50 min

Essential Question: How do measurements translate a physical object into a digital one?

Before any modeling can begin, students measure every part of the physical glider and record all dimensions. Accurate measurement is the foundation of accurate modeling — a 2 mm error here produces a visible error in the digital model. Students use both calipers and rulers, and record all measurements on the Glider Measurement Sheet before opening the software.

SETUP & MATERIALS

- Cardstock gliders — 1 per team (the same gliders used in the Data Challenge)
- Calipers — at least 1 per team (digital or manual; digital are easier for students new to measuring)
- Rulers — 1 per student
- Glider Measurement Sheet
- Glider Measurements Reference

TEACHER TIP — USING CALIPERS

- If this is students' first time using calipers, spend five minutes demonstrating before they start. Show how to open the jaws, place the object, close the jaws to the object's edge, and read the measurement. Digital calipers are much easier for beginners — the reading appears on a screen rather than requiring interpretation of a vernier scale.

Part 1 — Introduction to Measuring and Calipers (10 min)

Demonstrate the difference between measuring with a ruler and measuring with calipers. Use a simple object — a pencil or a coin — to show how calipers can measure thickness precisely when a ruler would be awkward.

Tell students: Every measurement they record today must be in millimeters. They will enter these exact numbers into the software when modeling begins. A sloppy measurement now means a sloppy model later.

DISCUSSION PROMPTS

- When would you use a caliper instead of a ruler? When would a ruler be the better choice?
- What might happen in the digital model if you record a measurement of 12 mm when the real dimension is 14 mm?
- How do you think engineers keep track of measurements when designing a complex product with hundreds of parts?

Part 2 — Measuring All Glider Parts (35 min)

Students work in teams to measure every part of the glider and record all values on the Glider Measurement Sheet. Tell students to refer to the Glider Diagram Reference sheet for a more detailed description of the dimension each measurement refers to and the best measurement tool to use for each dimension (calipers or ruler).

TEACHER TIP – GLIDER MEASUREMENTS

- The fuselage has the most measurements by far. If teams are running short on time, prioritize measuring the vertical stabilizer, horizontal stabilizer, and wings first — these are simpler shapes and students will model them first. The fuselage measurements can be completed at the start of Day 3 if needed.
- Encourage teams to work together to divide parts to measure among group members and share measurements after double checking them. Another option is to have a group member designated as "quality control" to complete the second measurement for each part (and re-measure) if necessary.

Part 3 — Check Measurements Before Wrapping Up (5 min)

Before ending class, have students do a quick check: Is every field on the Glider Measurement Sheet filled in? Are all units in millimeters? If any measurement is missing, students should measure it now rather than guessing later. Collect completed Glider Measurement sheets.

ACTIVITY 3

Modeling the Stabilizers

Essential Question: How do we build an accurate 3D shape from measurements?

TIME ~100 min

Students begin building their 3D model, starting with the vertical and horizontal stabilizers. These two parts are the simplest shapes in the glider — mostly flat with simple tapers — which makes them ideal for building confidence with the software before students tackle the more complex wings and fuselage. Students follow the software tutorial handout for their part and work at their own pace while the teacher circulates.

SETUP & MATERIALS

- Laptops with TinkerCAD (or chosen software) open and accounts logged in
- Completed Glider Measurement Sheets from Activity 2
- Physical gliders for reference
- Modeling Tutorial: Stabilizers handout
- Teacher pre-built model files (optional — see Teacher Tip below)

TEACHER TIP — PRE-BUILT BACKUP FILES

- Before class, build your own model of the vertical stabilizer in TinkerCAD (or your chosen software). If a team falls significantly behind, you can share your pre-built part with them so they can continue with the rest of the model rather than getting stuck on one piece.
- This is not a shortcut — it is a classroom management tool. You might also pre-build the fuselage, which is the most time-consuming part, in case you need it in Activity 4.

Part 1 — Vertical Stabilizer (~40 min)

The vertical stabilizer (the upright tail fin) is the recommended starting point. Its main shape is a flat rectangle with angled slants cut from the corners — achievable by combining and subtracting basic shapes in TinkerCAD.

Key modeling steps (refer to Student Sheet 3.1 for software-specific instructions):

1. Create the overall bounding rectangle using the length, maximum height, and thickness measurements.
2. Use the slant measurements to mark where the corners are cut away.
3. Create wedge shapes (or use the "hole" function in TinkerCAD) to subtract the corners.
4. Compare the completed shape to the physical part and adjust if needed.

TEACHER TIPS – MODELING THE STABILIZERS

- The most common mistake at this stage is confusing length and width — students sometimes rotate the shape without realizing it and enter measurements in the wrong fields. Encourage students to hold the physical part next to their screen and compare orientation before finalizing dimensions.
- In TinkerCAD, wedge shapes can be rotated and used as "holes" to cut angled corners. This is a key technique students will use again on the wings and fuselage. If students are stuck, a quick 2-minute demo of the hole function at the board can unblock the whole class.
- By the end of Activity 3, the goal is for all students to have a completed vertical stabilizer and be at least halfway through the horizontal stabilizer. Students who are ahead can begin the wing.

Part 2 — Horizontal Stabilizer (~40 min)

The horizontal stabilizer is similar to the vertical stabilizer but oriented flat (horizontally). The key difference from the vertical stabilizer is that the horizontal stabilizer is wider relative to its height, and it may have a slightly different taper shape depending on the glider model. Remind students to re-check their measurements for this part specifically — do not assume it is the same shape as the vertical stabilizer.

DISCUSSION PROMPTS

- How did your completed vertical stabilizer compare to the physical part when you held them side by side?
- What was the trickiest part of modeling the angled corners? What did you figure out?
- Is there anything you would measure differently if you were starting over?

ACTIVITY 4

Modeling the Wings and Fuseläge

TIME
~100 min

Essential Question: How do we model more complex shapes — and what do we do when it gets hard?

Students tackle the two most challenging parts of the glider model: the wing (which requires modeling a curved or tapered shape) and the fuselage (which has multiple slots and a complex body shape). These parts require the most problem-solving and persistence. Students continue to follow the software tutorial handout and work at their own pace, with the teacher circulating and supporting.

SETUP & MATERIALS

- Laptops with TinkerCAD (or chosen software) open
- Completed Glider Measurement Sheet
- Physical gliders for reference
- Modeling Tutorial: The Wing & Fuselage handout
- Teacher pre-built model files (fuselage especially — see Teacher Tip below)

Part 1 — Wings (~50 min)

Students model one wing only — the other is a mirror image. Most 3D modeling software includes a mirror or duplicate-and-flip function. Check that this works in your chosen software and demonstrate it at the start of class if needed.

Key modeling steps:

1. Create the bounding rectangle for half the wing using the maximum length and maximum width measurements.
2. Use the curve or taper measurements to shape the leading edge (front) and trailing edge (back) of the wing.
3. Set the correct thickness using the wing thickness measurement.
4. Mirror or duplicate-and-flip the completed wing to create the second wing.

TEACHER TIPS – MODELING THE WINGS

- The wing curve is the hardest shape in the whole model for most students. In TinkerCAD, the closest approach is to use a series of small steps (stair-step approximation) or to use the smooth curved shapes in the shape library. Remind students that the goal is a close approximation — it does not need to be perfectly smooth.
- If the wing planform is a swept-back or swept-forward shape (not a simple rectangle), students will need to rotate the wing body to set the correct sweep angle. This is a good opportunity to connect back to the wing planform data from the Data Challenge.

Part 2 — Fuselage (~50 min)

The fuselage is the most complex part. It has a tapered body shape plus multiple slots where the wings and stabilizers attach. Encourage students to tackle it in layers:

1. Model the main body shape first (the long tapered box/cylinder).
2. Add the nose weight slot (a rectangular cutout near the nose).
3. Add the wing slot (a narrow slot in the middle of the body where the wings slot in).
4. Add the horizontal and vertical stabilizer slots at the rear.

Remind students to keep their measurement sheet close — they will be looking up specific slot locations (distance from the front, distance from the bottom) as they add each feature.

TEACHER TIPS – MODELING THE FUSELAGE

- If a team is significantly behind, give them the pre-built fuselage file. It is more valuable for students to experience assembling all parts into a complete model in Activity 5 than to get stuck on one challenging modeling step and miss the end of the challenge.
- Common fuselage mistakes: forgetting to account for where the wing slot sits on the fuselage (distance from front and bottom matters), and making the body perfectly rectangular when it should be slightly tapered toward the tail. Both are worth addressing quickly if you spot them while circulating.
- By the end of Activity 4, the goal is for all students to have all four parts of the model completed (even if some parts used pre-built files). Assembly in Activity 5 should not require additional modeling — it is about putting finished pieces together.
- If a student has completed the fuselage early: challenge them to add additional detail — model the paper clip or clay nose weight in the slot, or add a simple cockpit shape to the top of the fuselage.

DISCUSSION QUESTIONS

- Which part of the glider was the hardest to model? Why?
- Where did you have to make a decision about how to simplify a shape because the exact curve or angle was too hard to model precisely?
- Do real engineers face the same problem — having to approximate shapes that are too complex to model exactly?

ACTIVITY 5

Assembly and Reflection

TIME
~50 min

Essential Question: Does our digital model match the real thing?

Students bring all four parts of their 3D model together into a single assembled glider, then compare the digital model to the physical glider. This comparison is the quality check for the whole challenge — it tells students (and the teacher) how accurate the modeling work was and surfaces any significant errors. The activity closes with a structured reflection.

SETUP & MATERIALS

- Laptops with completed model parts saved in TinkerCAD (or chosen software)
- Physical gliders for comparison
- Glider Assembly and Reflection sheet
- Rulers for measurement comparison (optional)

Part 1 — Assembly (20 min)

Students open all four model parts and combine them into a single assembly. In TinkerCAD, this means importing each part into one workspace and positioning them relative to each other. Demonstrate the process briefly on the projector first.

Assembly steps:

1. Open a new TinkerCAD project named "[Team Name] — Assembled Glider."
2. Import or copy each part into the workspace one at a time.
3. Position the horizontal and vertical stabilizers in their correct slots at the rear.
4. Position the wings in the wing slot at the center.
5. Adjust alignment until the model looks like the physical glider.

TEACHER TIP – GLIDER ASSEMBLY

- Assembly can be the most satisfying moment of the whole challenge — seeing all the parts come together. Give students a few minutes to just look at their completed model before jumping into the reflection. The visual payoff is worth it.
- If two parts don't fit together correctly (e.g., the wing is too wide for the wing slot), this is a useful teaching moment about tolerance and how small measurement errors compound. Do not correct it for them — ask what they think caused the mismatch and what they would measure again to fix it.

Part 2 — Compare Model to Physical Glider (15 min)

Have students hold the physical glider next to their screen and visually compare the model to the real thing. Then guide them through a more structured comparison:

What to compare	What to look for
Overall proportions	Does the digital glider look roughly the same length, width, and height as the physical one?
Wing shape	Does the wing planform (shape from above) match the physical wing?
Stabilizer placement	Are the stabilizers at the correct position on the fuselage — not too far forward or backward?
Slot accuracy	Do the parts appear to slot together the way the physical parts do?

Students record their observations on the Assembly and Reflection sheet — noting where the model is accurate and where it differs from the physical glider.

TEACHER TIP – DISCUSS SCALE IN CAD

- This would be a good time to point out that they can do this one-to-one size comparison because their CAD model is the exact size as the physical glider. Most things being modeled in CAD (e.g., cars, buildings, roller coasters), are to scale, in that one mm in CAD represents one cm or one m in real life.

Part 3 — Reflection (15 min)

Close the challenge with these reflection questions on Assembly and Reflection Sheet. Students can complete these individually, then share with the class:

REFLECTION QUESTIONS

- Which part of the glider was the most accurate in your model? What made it easier to model correctly?
- Which part had the most visible difference from the physical glider? What would you measure or model differently if you could start over?
- What is one way that 3D modeling software makes engineering design easier? What is one limitation?
- How might the 3D modeling skills you practiced here be useful later — in the Design Challenge or in a future class or job?

DISCUSSION QUESTIONS

- When engineers build a 3D model of something, they don't always expect it to be perfect the first time. What do they do when the model doesn't match the real object?
- Now that you've modeled the glider, can you imagine using these skills to design a modified wing in the Design Challenge?

TEACHER TIP

- If time allows, invite two or three teams to share their completed 3D models on the projector. Seeing the variety of approaches — and the range of accuracy — across different teams makes for a rich class discussion. It also gives students who struggled a chance to see that others faced the same challenges.
- Collect or have students export a screenshot of their final assembled model. These images will be useful as a visual reference in the Design Challenge when students modify the wing design.

Companion Handouts

Handout 1: Simple Practice Shapes

Name:	**Date:**	**Period:**

Directions

- Model each shape below in TinkerCAD (or your software) using the exact dimensions given.
- After you finish each shape, take a screenshot and paste it into the box — OR sketch the shape as it looks on your screen.
- Then answer the question below each shape.

Shape 1 — Box (50 mm long × 30 mm wide × 15 mm tall)

Screenshot or sketch of your box:

What steps did you follow to set the correct dimensions?

Shape 2 — Cylinder (20 mm diameter × 40 mm tall)

Screenshot or sketch of your cylinder:

How is creating a cylinder different from creating a box in the software?

Shape 3 — Wedge (40 mm long × 30 mm wide × 25 mm tall)

Screenshot or sketch of your wedge:

A wedge is like a box with one edge slanted. How might you use a wedge shape when modeling the glider?

Bonus: Try combining two shapes — for example, a box with a cylinder on top. Sketch or screenshot it below and describe what you made.

Screenshot / Sketch:

Handout 2. Glider Measurement Sheet

Name:	Date:	Period:

Directions

- Measure every dimension listed below using calipers or a ruler.
- Record all measurements in millimeters (mm).
- Measure twice and record both numbers. If they match, you're good. If not, measure again.
- Do NOT start modeling until this entire sheet is filled in.

Part	Dimension	Measurement 1 (mm)	Measurement 2 (mm)
Vertical Stabilizer (upright tail fin)	Maximum height (bottom to top tip)		
	Length (front edge to back edge, at the base)		
	Thickness (how thick the fin is)		
	Height where the front slant begins (from bottom)		
	Height where the back slant begins (from bottom)		
Horizontal Stabilizer (flat tail surface)	Total length (tip to tip)		
	Width (front edge to back edge)		
	Thickness		
Wing (Measure 1 wing panel – both sides are mirror images)	Maximum length (root to tip)		
	Maximum width (front edge to back edge)		
	Thickness at the thickest point		
	Distance from front edge to widest point		
	Root width (where wing meets fuselage)		
	Tip width (if tapered)		

Fuselage (Main body of plane)	Total length (nose to tail)		
	Maximum height (top to bottom, at tallest point)		
	Maximum width (side to side)		
	Height at the rear (narrow end)		
	Length from nose to where body starts to slope down		
	Wing slot: width (front to back of slot)		
	Wing slot: length (left to right across fuselage)		
	Wing slot: depth		
	Wing slot: distance from nose		
	Wing slot: distance from bottom		
	Horizontal stabilizer slot: width		
	Horizontal stabilizer slot: depth		
	Vertical stabilizer slot: width		
	Vertical stabilizer slot: depth		
	Nose weight slot: width		
	Nose weight slot: depth		

Before You Start Modeling — Checklist

☐ Every row in this sheet is filled in.

☐ All measurements are in millimeters.

☐ I measured each dimension twice. If the numbers didn't match, I re-measured.

Handout 3. Glider Measurements Reference

Name:	Date:	Period:

Use this card while measuring. It tells you exactly what each measurement means and which tool to use.

Part	Measurement	What to Measure	Best Tool
VERTICAL STABILIZER	**Maximum height**	Measure from the bottom edge straight up to the highest point of the fin.	Caliper
	Length (base)	Measure from the front edge to the back edge along the bottom of the fin.	Ruler
	Thickness	Measure the fin from one flat side to the other at the thickest point.	Caliper
	Front slant start height	Measure up from the bottom to where the slant begins on the front edge.	Ruler
	Back slant start height	Measure up from the bottom to where the slant begins on the back edge.	Ruler
HORIZONTAL STABILIZER	**Total length**	Measure tip to tip across the full width of the horizontal stabilizer.	Ruler
	Width (chord)	Measure from the leading edge (front) to the trailing edge (back) of the stabilizer.	Ruler
	Thickness	Measure the stabilizer from the top face to the bottom face.	Caliper
WING (one panel)	**Maximum length**	Measure from the root (where wing meets fuselage) to the tip.	Ruler
	Maximum width (chord)	Measure from the leading edge to the trailing edge at the widest point.	Ruler
	Thickness	Measure from top face to bottom face at the thickest point.	Caliper
	Root width	Measure the chord at the point where the wing would connect to the fuselage.	Ruler
FUSELAGE	**Total length**	Measure from the tip of the nose to the very end of the tail.	Ruler
	Maximum height	Measure from the bottom to the highest point on the fuselage body.	Ruler
	Maximum width	Measure side to side at the widest point of the fuselage.	Caliper
	Wing slot	Measure slot width, length, and depth; also measure its distance from the nose and from the bottom of the fuselage.	Caliper
	Stabilizer slots	Measure the width and depth of each slot. These are narrow — calipers are essential.	Caliper

Handout 4. Modeling Tutorial: Stabilizers

Name:	**Date:**	**Period:**

Before You Begin

- Open TinkerCAD (or your software) and log in to your account.
- Open your saved Glider Measurement Sheet and keep it next to your keyboard.
- Create a new project called: [Your Name] — Vertical Stabilizer.
- Have the physical glider nearby so you can compare as you go.

Part 1 — Vertical Stabilizer

The vertical stabilizer is the upright tail fin. It is mostly a flat shape with angled corners cut away. Start with a box and then cut the corners.

Steps:

- Add a Box shape to the workspace.
- Set the dimensions: Length = your base length measurement, Width = your thickness measurement, Height = your maximum height measurement. Enter all values in millimeters.
- Look at the front edge of the physical stabilizer. Does it have a straight angle from the bottom up? Use a Wedge shape (set as a "hole") to cut the front corner away. Match the angle to your slant measurements.
- Do the same for the back corner if it is also angled.
- Select all pieces and group them into one shape (Edit → Group in TinkerCAD).
- Hold the physical stabilizer next to your screen. Does the shape look right? If not, adjust.
- Save your work.

Checkpoint: Sketch your completed vertical stabilizer below, or paste a screenshot. Label the height and length on your sketch.

Screenshot / Sketch:

What was the trickiest part of modeling the vertical stabilizer? How did you solve it?

Part 2 — Horizontal Stabilizer

The horizontal stabilizer is similar to the vertical one, but it lies flat. It connects across the rear of the fuselage.

Steps:

- Create a new project called: [Your Name] — Horizontal Stabilizer.
- Add a Box shape. Set Length = total length tip-to-tip, Width = chord width, Height = thickness.
- The horizontal stabilizer may have a tapered or angled shape — check the physical part. If the tips are angled, use the same wedge-as-hole technique you used on the vertical stabilizer.
- Group all pieces into one shape.
- Compare to the physical part. Adjust if needed.
- Save your work.

How does the horizontal stabilizer differ from the vertical stabilizer? Note at least one difference in shape or dimensions.

Take a screenshot of both stabilizers side by side and paste it below, or sketch them both.

Screenshot / Sketch:

Handout 5. Modeling Tutorial: The Wing and Fuselage

Name:	Date:	Period:

Reminder

You already modeled the stabilizers. The wing and fuselage are harder, but the techniques are the same.

Work slowly. Use your measurement sheet. Compare to the physical glider often.

If you get stuck, ask your teacher — do not spend more than 10 minutes stuck on the same step.

Part 1 — Wing (one panel)

You only need to model one wing panel. The second wing is a mirror image — most software lets you duplicate and flip it.

Steps:

- Create a new project called: [Your Name] — Wing.
- Add a Box shape. Set Length = wing length (root to tip), Width = maximum chord (front to back), Height = wing thickness.
- If the wing tapers toward the tip: use a Wedge shape as a hole to cut the tip into a taper. Match the root width and tip width from your measurements.
- If the wing has a swept shape: rotate the wing body to the correct angle before finalizing dimensions. (Hint: place a wedge cut on the leading or trailing edge to create the sweep.)
- Group all pieces into one wing panel.
- Duplicate the wing panel. Flip the duplicate horizontally to create the mirror image.
- Compare both wings to the physical glider. Do they look correct?
- Save your work.

Checkpoint: Screenshot or sketch your two wing panels below. Label the length, maximum width, and sweep direction (if any).

Screenshot / Sketch:

Part 2 — Fuselage

The fuselage is the most complex part. Build it in layers — main body first, then add each slot.

Steps:

- Create a new project called: [Your Name] — Fuselage.
- Main body: Add a Box. Set Length = total fuselage length, Width = maximum width, Height = maximum height.
- Taper: The back of the fuselage is narrower and shorter than the front. Use a wedge subtraction to taper both the height and width toward the rear. Match your height-at-rear measurement.
- Nose weight slot: Create a small Box sized to the nose slot dimensions. Position it at the correct location (distance from nose). Set it as a hole and subtract from the fuselage.
- Wing slot: Create a Box sized to the wing slot dimensions. Position it at the correct distance from the nose and from the bottom. Set as a hole and subtract.
- Stabilizer slots: Create small Box holes for the horizontal and vertical stabilizer slots at the rear. These are narrow — use caliper measurements.
- Group all remaining pieces into one fuselage shape.
- Compare to the physical fuselage. Check that the slots are in the right locations.
- Save your work.

Checkpoint: Screenshot or sketch your completed fuselage below.

Screenshot / Sketch:

What was the hardest step in building the fuselage? What would you do differently if you modeled it again?

Handout 6. Glider Assembly and Reflection

Name:	Date:	Period:

Assembly Checklist — Complete before starting

☐ Vertical stabilizer — modeled and saved

☐ Horizontal stabilizer — modeled and saved

☐ Both wing panels — modeled and saved

☐ Fuselage — modeled and saved

Part 1 — Assembly

- Open a new project called: [Your Name] — Assembled Glider.
- Import or copy each part into the workspace one at a time.
- Position the horizontal stabilizer in its slot at the rear of the fuselage.
- Position the vertical stabilizer in its slot at the rear of the fuselage.
- Position both wing panels in the wing slot at the center of the fuselage.
- Rotate and adjust until the model looks like the physical glider.
- Take a screenshot of the completed assembly.

Paste your screenshot of the assembled model below, or sketch it.

Screenshot / Sketch:

Part 2 — Compare Digital to Physical

Hold the physical glider next to your screen. Fill in the table below.

What I compared	How accurate is my model?	What is different?
Overall proportions		
Wing shape (planform)		
Stabilizer placement		
Slot alignment		

Part 3 — Reflection

Which part of the glider was the most accurate in your model? What made it easier to get right?

Which part had the biggest difference from the physical glider? What would you measure or model differently?

3D modeling engineers always say: "All models are wrong, but some are useful."

What do you think that means, based on your experience building this model?

How might the 3D modeling skills you practiced here be useful in the Design Challenge coming up?

This STEM Innovation and Design module was produced by Georgia Institute of Technology's Center for Education Integrating Science, Mathematics, and Computing with support from National Science Foundation Award #2101441.