LESSON PLAN

Phone Holder: Assembly with TinkerCAD

Design Project 2 | Lesson 2.3 | Duration 45min

Goal

Students will build on their 3D modeling skills, explore technical design thinking, and apply what they learned to model the first phase of their personal phone holder geometry.

Objective

By the end of this lesson, students will understand how dimensions and slot placement affect function. They will build and test a class example in TinkerCAD, then apply the same techniques to model a holder for their own phone and two tested angles.

By the end of the lesson:

- Log in to TinkerCAD with the class credentials and start a new 3D Design file, renamed to identify the student and lesson.
- Model the class example's Part 1 (185 x 90 x 10mm panel) and Part 2 (a support built from a resized box with a charger opening and two side struts), cutting slot openings 0.5mm wider than the part sliding into them so the two printed parts fit together.
- Rotate and align the two parts at a working angle (Part 1 at 67.5° counterclockwise, Part 2 at 22.5° clockwise) and confirm the support slots cleanly into the panel.
- Test a different slot position by copying the assembly and rotating both parts by an additional 10°, observing how moving where the two parts meet changes the resulting angle.
- Apply the same modeling techniques to their own two-part phone holder, sized to their own phone's dimensions (from Lesson 2.1) and their own two tested angles (from Lesson 2.2's cardboard mockup and technical drawing), working independently at their own pace.

Design Cycle

We are in the "Ideate" phase of the Design Cycle.

In this lesson, ideating means turning Lesson 2.2's tested cardboard concept and drawing into a precise, dimensioned digital model — practicing the exact modeling moves on a class example first, then applying them to the student's own two-part design.

Materials

- Computer with mouse
- Design Brief 2.0 (Apple: Personal Phone Holder)
- Lesson 2.3 - Design Guide slide deck
- Lesson 2.2 technical drawing
- Login credentials @ mondaytechschool.org
- Lesson 2.1 phone measurements

Do Now

1. **If you wanted a shallower angle, would you cut the slot closer to the top of the panel or the bottom?**

   Use responses to surface students' current intuition about slot position and angle before they test it directly in TinkerCAD. Ask: "What made you choose top or bottom — what's your reasoning?"

Lesson Sequence

Discussion Steps:

1. **Recap Lesson 2.2: two tested angles, detailed cardboard mockup, and final drawing.**

   Have students restate their two working angles and describe their cardboard mockup and final four-view drawing before starting today's digital modeling. Ask: "Which of your two tested angles do you expect will be trickier to model precisely in TinkerCAD?"

2. **Teacher demonstrates the rule: a slot must be 0.5mm wider than the part going into it, or the two printed parts will not fit together once printed.**

   This is the lesson's core engineering takeaway — model it once on the board or screen before students start building. Ask: "Why would a slot cut to the exact same size as the part cause a problem once both pieces are 3D printed?"

Design Guide Steps:

1. **Log in to TinkerCAD and set up your file.**

   Log in with the class credentials at mondaytechschool.org (Student Accounts > Email or Username > Password), select +Create > 3D Design from the dashboard, and rename the file to identify the student and lesson (e.g. "02 Phone Holder - [Your Name]"). Ask: "What's one TinkerCAD navigation control you'll need today — orbit, pan, or zoom?"

2. **Model and assemble the two parts of the example phone holder. (Part 01)**

   Start with a cube and drag it onto the Workplane as Part 1, editing its dimensions to 185mm length, 90mm width, and 10mm height. Duplicate Part 1 as a phone mock-up, sized 150mm by 78mm by 8.75mm and set as a hole for visibility, then center it on Part 1 in orthographic view. Cut two slot openings into Part 1 — each a hollow box 9.5mm long and 56mm wide, spaced 8.5mm apart and positioned 16.75mm from the panel's edge — then Union Group the openings into Part 1. Build Part 2 (the support) from a box resized to 105mm long, with a 15mm hollow charger opening and two 97mm x 9.75mm side struts sized to slide into Part 1's openings; Union Group the openings into Part 2 and set its height to 9mm. This is where students learn precision modeling techniques and engineering thinking, and build confidence in TinkerCAD. Ask: "Which measurement took the most tries to get exactly right?"

3. **Assemble the two parts at a working angle. (Part 01, continued)**

   Rotate Part 1 by 67.5° counterclockwise and Part 2 by 22.5° clockwise (staying inside the snap circle for precise 22.5° increments), then lower both to 0mm above the Workplane. Switch to Right View, temporarily set Part 1 to Hole to see through it, and adjust Part 2's position until the support slots cleanly into Part 1's openings — then set Part 1 solid again to confirm the fit. Ask: "Does your support slide into the panel without gaps or overlap?"

4. **Test a different slot position and see the angle it produces. (Part 02)**

   Copy the whole phone holder assembly, then rotate the copied Part 1 clockwise by 10° (staying on the outer circle to avoid snapping, typing 10° for precision) and lower it to 0mm height; rotate the copied Part 2 clockwise by the same 10° and lower it to match. Moving where the two parts meet is what controls the angle of the phone holder — that's the lesson's core takeaway. Ask: "Compared to the class example's original angle, does this new angle feel shallower or steeper — and why?"

5. **Apply everything you've learned to model your own phone holder. (Part 03)**

   Bring together your Firefly moodboard research from Lesson 2.1, your hand sketch, cardboard mockup, and final drawing from Lesson 2.2, and the TinkerCAD techniques just practiced to model the first phase of your own phone holder — your own two parts, sized to your own

phone's dimensions and cut with your own two tested angles — moving the slots until you find the two angles your design needs. Students work independently at their own pace. Ask: "Which of your two parts, panel or support, do you expect will need more slot adjustments to get right?"

6. **Circulate and confirm.**

   Confirm each student has modeled both parts of their own phone holder, sized to their Lesson 2.1 phone measurements, with slots cut 0.5mm wider than the mating part and both tested angles represented. Ask: "Does your modeled angle match the angle in your Lesson 2.2 drawing?"

Exit Tickets

Before Leaving:

1. **What rule keeps two printed parts from fitting together if you get it wrong, and what is the rule?**

   Look for the 0.5mm slot-clearance rule stated specifically, not just "make it bigger."

2. **Which measurement from your TinkerCAD model came directly from your Lesson 2.1 phone measurements?**

   Look for a specific dimension (phone width, height, or thickness) tied to Lesson 2.1's data.

3. **How did moving your slot position change the angle of your holder?**

   Look for a specific description of the direction moved and the angle result, not a vague "it changed."

4. **What's one part of your own model that still doesn't match your Lesson 2.2 drawing, and what will you develop first?**

   Look for a specific mismatch and a specific next step, not "it's basically done."

Extension

For early finishers:

1. **Test a third slot position on your own two parts — different from your two tested angles — and see what new angle it produces.**

   Compare it to your two working angles and decide whether it's worth using instead of one of them.

Apple: Personal Phone Holder: Assembly with TinkerCAD

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Lesson Phase	Teacher Does	Student Does
Do now	**Poses** the question: if you wanted a shallower angle, would you cut the slot closer to the top of the panel or the bottom?	**States** a prediction (top or bottom) with reasoning about how slot position affects angle.
Discussion: Recap Lesson 2.2	**Has** students restate their two working angles and describe their cardboard mockup and final four-view drawing.	**States** their two tested angles and describes their cardboard mockup and four-view drawing from Lesson 2.2.
Discussion: Slot Clearance Rule	**Demonstrates** the rule that a slot must be cut 0.5mm wider than the part going into it, or the two printed parts will not fit together once printed.	**Explains** why a slot cut to the exact same size as its mating part would fail once 3D printed.
Design Guide Setup: TinkerCAD Login and File Setup	**Directs** students to log in with the class credentials, select +Create > 3D Design, and rename their file to identify themselves and the lesson.	**Logs in** to TinkerCAD, starts a new 3D Design file, and renames it.

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Lesson Phase	Teacher Does	Student Does
Guide Part 1: Model and Assemble the Class Example	**Models** building Part 1 (185 x 90 x 10mm panel) and the phone mock-up, cutting two precisely spaced slot openings into Part 1, then building Part 2 (support) with a charger opening and two side struts sized to slide into Part 1's openings.	**Builds** Part 1 and the phone mock-up at the given dimensions, cuts the two slot openings using Union Group, and builds Part 2 with its charger opening and side struts sized to fit Part 1's slots.
Guide Part 1: Assemble at a Working Angle	**Directs** students to rotate Part 1 (67.5° counterclockwise) and Part 2 (22.5° clockwise), lower both to the Workplane, and use Right View with Part 1 temporarily set to Hole to confirm the support slots in cleanly.	**Rotates and lowers** both parts to the working angle, checks the fit in Right View with Part 1 temporarily transparent, and confirms a clean slot fit before setting Part 1 solid again.
Guide Part 2: Test a Different Slot Position	**Directs** students to copy the whole assembly and rotate both copied parts by an additional 10°, observing the new angle produced.	**Copies** the assembly, rotates both parts by 10°, and compares the resulting angle to the original.
Guide Part 3: Model Your Own Phone Holder	**Directs** students to bring together their Lesson 2.1 research, Lesson 2.2 mockup and drawing, and today's TinkerCAD techniques to model their own two-part holder independently.	**Models** their own Part 1 and Part 2, sized to their own phone measurements and cut at their own two tested angles, working at their own pace.
Circulate and Confirm	**Circulates** to confirm each student has modeled both parts of their own phone holder, sized to their phone measurements, with correctly cleared slots and both tested angles represented.	**Shows** a modeled two-part phone holder matching their own phone measurements and both angles from Lesson 2.2.

Lesson Phase	Teacher Does	Student Does
Exit Ticket	**Gives** the four exit-ticket prompts and looks for the 0.5mm slot-clearance rule stated specifically, a measurement tied to Lesson 2.1 data, a specific angle-change description, and a specific mismatch with a next step.	**States** the slot-clearance rule. Names a measurement carried over from Lesson 2.1. **Describes** how moving the slot changed the angle. Names one part of their model that still needs fixing and what they'll do next.
Extension	**Offers** the third-slot-position challenge for early finishers.	**Tests** a third slot position on their own two parts and compares the resulting angle to their two working angles.