



LESSON 7: Testing and Redesigning

LESSON OVERVIEW

This lesson will guide students to test their prototype and make changes to their original models to modify and improve their design. Students will think about what is working and what could be done better as they test their inventions. They will evaluate their invention with peers through feedback and then analyze and apply this feedback to modify their invention design. Finally, students will discover the role of failure in the design process and begin to develop a growth mindset as they see failure as a necessary part of inventing.

This lesson is not designed to be used as a stand-alone lesson. It builds off YIPLit Lesson 6: Planning and Building. A step-by-step prototype plan completed in Lesson 6 is the foundation for the activities in this lesson and should be completed prior to beginning. It is recommended that as much time as possible be given to this lesson to allow for multiple rounds of testing, redesigning and rebuilding. If time is available, plan to spread Lesson 7 across multiple class periods. This lesson is extended to further incorporate Lessons 1, 2, 3, 4, 5, 6, 8.

OBJECTIVE

Students will be able to:

- Create and implement a planning process to develop a prototype from a design drawing.
- Test and evaluate their prototype through use and peer feedback to inform decisions on how to modify and improve it.
- Give and receive feedback by evaluating the usefulness and appeal of a prototype.
- Explore design alternatives to develop a second iteration of their prototype.
- See failure as an opportunity to learn, improve, and grow.

MATERIALS

- Google Slides: YIPLit Lesson 7
- Book: **Walrus in the Bathtub** by Deborah Underwood, illustrated by Matt Hunt; ISBN-10: 0803741014 OR...
- Read-aloud Video: <https://youtu.be/-dIJrpgFoVs> Reading time- 5:33
- Timer (timer countdown included in Google Slides, or use a clock, phone, or other device)
- Invention Testing Feedback Grid Worksheet (included in the YIPLit Inventor's Journal)
**Make extra copies if students have time to swap prototypes with more than one other peer.*
- Materials List Worksheet (included in the YIPLit Inventor's Journal)
- Changes to Prototype Worksheet (included in YIPLit Inventor's Journal)
- YIPLit Inventor's Journals
- Maker Space materials (see Notes for the Teacher for ideas)
- Pencils, pens, markers or crayons for writing and drawing
- Video (optional for teacher preparation): *Dr. Pascha Makes and Invention Box*

Link: <https://www.youtube.com/watch?v=OZZFDIa1-0U>, (MIT Lemelson Full Steam Ahead, 16:35 minutes).

NOTES FOR THE TEACHER

Teacher may use slides provided or lead instruction and discussion on their own.

You may wish to use a “Maker Space” in your school for Lessons 6 and 7, if available. Or you may create a “Maker Space” in your classroom. Consider putting up posters with quotations about invention, or posters of famous inventors. Make the space comfortable and fun so that students feel inspired to invent. Consider having students build their own Invention Boxes or build a large box for the class. Invention Boxes are simply boxes or bags filled with materials and supplies to build design models and prototypes. Boxes may include things such as recycled materials (cereal boxes, toilet paper rolls, plastic bottles, yogurt containers, Styrofoam plates, etc.), craft supplies (pipe cleaners, beads, pom poms, popsicle sticks, clothes pins, etc.), yarn and string, construction paper, scissors, tape (duct tape, clear tape, washi tape), rubber bands, glue, markers and more.

NOTE: For more ideas about how to make an Invention Box, you may refer to video, “Dr. Pascha Makes and Invention Box”, MIT Lemelson Full Steam Ahead, 2020. Link: <https://www.youtube.com/watch?v=OZZFDIa1-0U>, (16:35 minutes).

Because this project is about umbrellas, teacher may consider collecting old umbrellas from the community or local Goodwill stores, etc. Or, you may also consider collecting many “long” items such as paper towel and wrapping paper tubes, canes dowels, etc. as well as fabric scraps.

Hot glue guns are recommended for class because they dry quickly and securely so students can maximize their build time in class. If hot glue guns are used, it is recommended that an adult do the gluing.

During the Peer Sharing activity, consider using a timer and have one student share and receive feedback for 5 minutes and then switch, so the second partner can share and receive feedback. If time allows, try to have students share their inventions with more than one peer for different perspectives. Students may use more than one Invention Testing Feedback Grid if needed (make extra copies).

NOTE: You may choose to allow students to take their inventions home to work on between sessions. If so, you are encouraged to communicate the requirements and expectations of the project with families, as well as the family’s role in this project.

NOTE FOR COMPETITION IN NORTHERN NEW ENGLAND INVENTION CONVENTION AND INVENTION CONVENTION US NATIONALS

A 3-D model or prototype of the invention is strongly recommended for competition at the regional, national and global levels hosted by the Young Inventors’ Program and Invention Convention Worldwide. Prototypes and models may be *working or non-working*. Inventors are encouraged to build models that are “materials neutral”, meaning they can be made of reused and recycled materials and the overall product should not require purchased materials. (Purchased materials are allowed, but costs should be

kept to under \$25 total per invention.) Any materials that are used, whether purchased or found/borrowed, should be listed in the Materials List in the YIPLit Inventors' Journal.

INSTRUCTION & ACTIVITIES

Teacher may lead the following lesson plan with flexibility to adapt as needed to fit technology and class format:

Teacher Instruction:

Take students to a “Maker Space”. You may use a maker space in your school, if available, or create one in your classroom (see Notes for the Teacher above). Tell students they will continue to build the model of their invention from Lesson 6. They should finish their first version of the prototype and test it so they can make modifications and develop a second iteration of the prototype.

Activity: Build! (20-30+ minutes)

NOTE: Lesson 7 is a continuation of Lesson 6. Allow students as much time as possible to build, test, and then redesign and rebuild multiple iterations of the prototype. If time is available, spread Lesson 7 across two or more class periods.

Allow students to continue to build their invention prototypes. Remind them to spend some time trying it out as they build. They may ask classmates for ideas and help as they build. Create a collaborative and creative space for everyone to “make”. If students make changes to their design plan or to their step-by-step instructions, ask them to write or draw these changes their Changes to Prototype Plan Worksheet (included in the YIPLit Inventor's Journal) - these are important records in the invention process.

NOTE: Teacher may choose to end Session 1 of YIPLit Lesson 7 here, or you may move on to the next activity.



Teacher Instruction:

NOTE: If you are beginning a new class period, take time to “warm-up” and remind students where they are in the Invention Process (or have them share where they think they are in the Invention Process). You may wish to allow a few more minutes to build inventions at the start of this new session or you may continue on to the following:

Bring students back together for a discussion. Ask them to think about the following questions.

- How might you go about testing your original design?
- How will you know to try something different and that you need to make modifications to your first design?
- How will you be able to know what modifications you might want to make to your original design?
- Why is testing important to the invention process?

Activity: Peer Testing and Sharing (10 minutes)

NOTE: Help students keep track of time to be sure each partner/team gets a chance to give and receive feedback. Consider using a timer and have one student share and receive feedback for 5 minutes and then switch, so the second partner/team can share and receive feedback. A timer is included in the Google Slides: Lesson 7).

Ask students/teams to get into pairs (if students are working in teams, then the team can pair with another student or another team). Students/teams will swap inventions and allow a peer/team to use, test and review the design model. Then, have students complete the Invention Testing Feedback Grid (included in the YIPLit Inventor's Journal) with their partner. They should think about the idea feedback they gave and received in Lesson 5 (PLUSES, POTENTIAL, CONCERNS). The partner will share:

1. What they liked about the invention they tested. (PLUSES)
2. What ONE suggestion do they have to make it better. (POTENTIAL)
3. What questions they have about the invention. (CONCERNS)

Then, the students will also use this feedback to fill in the box on the lower right: What new ideas were introduced?

NOTE: If time allows, you may ask students to seek another user's feedback by having a second round of peer sharing. Print more Invention Testing Feedback Grid worksheets if needed.

Ask students/teams to consider this feedback and think about changes they can make to their original prototype to improve it. Have them write these modification plans or draw a new design for version 2 of the prototype on the Changes to Prototype Worksheet (included in YIPLit Inventor's Journal).

Activity: Redesign! (15+ minutes)

Allow students/teams more time to tinker and make modifications to their prototypes. They should continue to test them as they work to evaluate the success of their changes. Did the changes improve the design? Do more changes still need to be made?

NOTE: Any more changes should be documented in the YIPLit Inventor's Journal. There is space provided at the end of the journal or students may insert additional pages with notes and new design drawings that illustrate their changes as they develop iterations of their inventions.

Ask students to help clean up the maker space at the end of the building session. Give instructions on what to do with their finished projects or what they can do if they are not yet finished (Can they take them home to work on them? Will there be more time for them to finish?).

NOTE: You may choose to allow students to take their inventions home to work on between sessions. If so, you are encouraged to communicate the requirements and expectations of the project with families, as well as the family's role in this project.

Closure/Check for understanding:

Students will use a Ticket Out the Door or in a Think-Pair-Share show one modification they made to their invention prototype after testing it.

IDEAS FOR VIRTUAL INSTRUCTION

Testing and Sharing

Have students complete the Invention Feedback Grid (included in the YIPLit Inventor's Journal) as they ask someone to test and evaluate their first prototype. Have students share or submit their grids for review. You may have an online class sharing session using a virtual platform such as a chat, a shared document, or Zoom breakout rooms to allow students to share their inventions and receive feedback for modifications.

Redesign!

Ask students to consider the feedback and think about changes they can make to their original prototype to improve it. Have them write these modification plans or draw a new design for version 2 of the prototype on the Changes to Prototype Worksheet (included in YIPLit Inventor's Journal). Then have students tinker and make modifications to their prototypes. They should continue to test them as they work to evaluate the success of their changes. Did the changes improve the design? Do more changes still need to be made? You may ask them to submit a reflection or an update on their progress through a virtual platform.