



LESSON 6: Planning and Building

LESSON OVERVIEW

This lesson will support students in making an Prototype Plan to help them carry out their invention project. They will develop list of the steps required build their invention prototype and a list of materials they will need. Finally, they will use a “maker space” (whatever may be available) to build a prototype (working or non-working) using materials provided (recycled carboard, plastic, tape, arts and crafts supplies, glue, etc.).

This lesson is not designed to be used as a stand-alone lesson. It builds off YIPLit Lesson 5: Researching and Redesigning. A design plan completed in Lesson 5 is the foundation for the activities in this lesson and should be completed prior to beginning. This lesson is extended to further incorporate Lessons 1, 2, 3, 4, 5, 7, 8.

OBJECTIVE

Students will be able to:

- Develop a plan to build an invention prototype from a design drawing.
- Identify the main materials needed to build the invention prototype.
- Apply divergent thinking and constructive feedback to inform decision making regarding creation of invention prototype.

MATERIALS

- Google Slides: YIPLit Lesson 6
 - 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
 - Prototype Plan Worksheet (included in YIPLit Inventor’s Journal)
 - Materials List Worksheet (included in the 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 an 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.

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:

NOTE: Students should already have a completed, detailed, labeled invention design drawing (done in teams or individually). A space for these drawings is provided in the Invention Design #2 Worksheet in the YIPLit Inventor’s Journal. If they have not yet completed a design drawing, they should do so before beginning this lesson.

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). Students will begin to build the model of their detailed design drawing from Lesson 5- the umbrella they have invented to help a character from ***Walrus in the Bathtub*** solve their problem. Tell students that a model of a design is called a “PROTOTYPE”. A PROTOTYPE is the original model of something and is what is used to base future designs. A PROTOTYPE is the test case and it becomes what you use to change and develop your final, finished product.

Explain that these prototypes do not have to work, but they will need to represent the invention using the materials you have provided (or at home). *Allow students to see the available materials before you start.*

Tell the students that before they begin to build, they need a plan. You cannot just “wing it”.

Activity: Prototype Plan (10 minutes)

Ask students to study their design drawings from Lesson 5’s Invention Design #2 (in YIPLit: Inventor’s Journal). If they are working in teams, they will complete this activity as a team. How are they going to turn their drawing into a 3D model or prototype? Tell students that they will complete the Prototype Plan Worksheet (included in YIPLit Inventor’s Journal). Having a step-by-step plan will make building much easier.

Ask students if they have ever helped someone with a cooking or baking project. What did they use to instruct on what ingredients to use, what order to add them, and how to mix and cook them? They used a recipe! Now, they need to create their own “recipes” for their inventions.

Show students the Prototype Plan Worksheet and help them think of how they can write step by step instructions for building their prototypes. Ask them to list, in order, the steps for making their model. If students need help in writing, they can draw the steps in order, or just use key words. Adults may be needed to help them write. The idea is that they have some instructions before they build.

Students should also list the materials they plan to use to make their prototype. Ask them to think of the possible problems that might occur. How could they solve them if they do occur? Tell them is okay if they alter the plans as they go by adding or eliminating steps, or by using different materials as they build- this is all part of the invention process. But they do need to have something to guide them when they start.

NOTE: Remind students that they should still be using the information gathered from their research and feedback sharing session and should still be considering ways to improve their invention design using SCAMPER and divergent thinking.

NOTE: If students are working as a team, they should work together on the Prototype Plan. Each participant will need to determine what role they will play in the project. Will they all be completing the sheet (they each should have a copy of it in their own Inventor’s Journal at the end of the project)? Will they all look at the supplies together before making their step-by-step plan using the materials available? Will there be two or more parts to the build? Does someone think about the umbrella and the others think about how they will represent the character for whom they are building it? Groups should delegate work so that each member is putting forth equal effort in the project and everyone is participating. Teacher facilitation may be necessary.

Teacher Instruction:

NOTE: It is recommended that teachers review and approve the Prototype Plan before students begin to build to ensure that students have an action plan and some direction as they start the project.

When students are ready and you have seen and approved their written plans on their Prototype Plan worksheet, they may begin to build! Give any instructions on how you wish students to use the materials and share them so that all students have access to what they need.

Activity: Build! (25 minutes)

Allow students 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 these changes down in their Prototype Plan worksheet- these are important records in the invention process.

NOTE: Let students know that there will be another session for building and testing their prototypes.

NOTE: If allowing students to take prototypes home to work, give any instructions for what they should do and when they need to bring the prototype back for the next time you will work on them in class. Be sure to communicate with families about your expectations for the “take home” project and for how they can support the project at home.

Closure Activity: Clean Up the Maker Space (5 minutes)

Ask students to help clean up the maker space and to put their projects in a safe place until they resume building the next session.

IDEAS FOR VIRTUAL INSTRUCTION

Prototype Plan

Ask students to complete the Prototype Plan worksheet (included in YIPLit Inventor’s Journal). Have students share or submit their plans for review before they start to build their prototype. You may have an online class sharing session using a virtual platform such as a chat, a shared document, or Zoom breakout rooms. Or ask students to submit their plans through a virtual platform.

Build!

Have students begin building their invention prototypes using recycled and other craft materials. Remind them to spend some time trying it out as they build. They may ask family members and others at home for ideas and help as they build. If students make changes to their design plan or to their step-by-step instructions, ask them to write these changes down in their Prototype Plan worksheet (included in YIPLit Inventor’s Journal)- these are important records in the invention process. If appropriate, communicate with families about your expectations for the project and for how they can support the project at home. You may ask them to submit a reflection or an update on their progress through a virtual platform.