LESSON 4: INTENT TO INVENT

Invention Process Steps: Designing and Building
Grade Level: 6-8
Base Time: 45 minutes

Essential Question

How do inventors plan and complete their invention from beginning to end?

Lesson Overview

This lesson will guide students as they plan their invention. Students will collect their ideas about their inventions and record them as they create a Problem Statement and define their Solution. Students will also draw the initial model of their invention, thinking about materials and parts as well as problems they may encounter along the way. Inventors will then share their plans with others and evaluate the feedback they receive and decide how it will impact their design or decide to disregard the feedback.

Objective

Students will be able to:

- Outline a plan for their own invention.
- Compile ideas into a drawing of an initial model.
- Identify steps in sequence and identify materials needed to build model.
- Engage in constructive feedback sharing with peers.

Lesson Standards

Next Generation Science Standards:
• MS-ETS1-1
• MS-ETS1-2

Common Core ELA Standards:
• CCSS.ELA-LITERACY.SL 6-8.1
• CCSS.ELA-LITERACY.RST 6-8.3
• CCSS.ELA-LITERACY.W 6-8.1

Materials

Resources for the Educator

- 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).
- Family Email Template
- Invention Technical Drawings
- Different Views Templates

Materials

- YIP Inventor's Journal
- Worksheet: Intent to Invent (included in Inventor's Journal)

- Worksheet: Prototype Design #1 (included in Inventor's Journal)

Notes for the Educator

Educator may lead the following lesson plan with flexibility to adapt as needed to fit technology and class format. Educator may use slides and script for Lesson 4 or lead instruction and discussion on their own.

This lesson begins the building process which will require educator guidance and as much independent work time as possible. Students will need time to build and test their original invention. Much of the work can be done in class, at home, or in some combination. Educators may assign a specific number of hours (we recommend 4-6 hours) to be devoted to design and building. If doing work at home, you may ask students to check in on their progress. Educators are strongly encouraged to allow time for students to connect with them and their peers to ask questions and share ideas for invention improvement. All parts of this process should be documented in the YIP Inventor's Journal or an alternative Invention Logbook.

NOTE: Logbooks of some kind are required for submission to the Northern New England Invention Convention and the Invention Convention US Nationals.

You may wish to create a "Maker Space" in your classroom/space for Lessons 4-6. Make the space comfortable and fun so that students feel inspired to invent. Consider making an Invention Box, a large box or bag filled with materials and supplies to build design models and prototypes. It 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. For more ideas about how to make an Invention Box, you may watch this 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).

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.

A 3-D model or prototype of the invention is strongly recommended, but not required for competition at the regional, national and global levels hosted by the Young Inventors' Program and Invention Convention Worldwide. A detailed, labeled drawing of the design is sufficient for the display and presentation. 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 money to buy materials.

NOTE: You may wish to seek additional volunteers to help younger students with building they require more support with cutting, gluing, and motor skills involved. School staff and parent and community volunteers are good resources if permitted.

NOTE: If assigning work to be done at home, educators are encouraged to communicate the requirements and expectations of the project with families, as well as the family's role in this project. An email template is provided in the Educator Resources- please adapt the letter as needed.

Instruction & Activities

Educator Instruction:

Explain to students how to plan to execute their invention project to turn their idea into a model/prototype. Having an organized plan before beginning to build and develop the invention will help students with time management and execution of a long-term project. Students will use the Intent to Invent Worksheet included in the Inventor's Journal to organize their project goals, plans and materials.

As you think about creating an initial prototype design, encourage students to ask questions that are necessary to produce the finished product- in other words, think backwards. What is the final product the inventor intends to create? Then, what is needed to put it together? Consider questions such as:

- How big should it be?
- What materials could it be made of?
- What does it look like from different views (the side, above, below)?
- How do the parts fit together?

Activity: Different Views (10 minutes)

First, share some examples of some technical drawings used by engineers and inventors to help them build their own prototypes. Ask students what stands out about these drawings? They show different perspectives of the same device, they are well labeled and sometimes include measurements, they show how parts fit together and more.

Next, divide the students into small groups. Give each group a picture with a common object shown from a different view (you may use the Different Views Templates in the Educator Resources). Ask the students to determine what the object is. Prompt them to ask questions that help gather information that will lead them to the correct identification.

NOTE: Different Views Template objects identified as 1) top view of a basketball hoop, 2) top view of a classroom desk and chair, 3) side view of a video game controller.

At the end of the activity, bring the class together to discuss the process and to reflect on the challenges they faced and what they discovered.

Educator Instruction:

Introduce the Intent to Invent Worksheet included in the YIP Inventor's Journal. Ask students to think of a recipe. Recipes provide the cook with all of the details about how to make a dish, from the ingredients and equipment needed, to how to put those ingredients together, in order, using specific techniques that will produce a desired outcome… delicious food.

When developing an invention plan, students will need to create a "recipe" for designing and building and will need to include details and clarity in their plan so that they can follow it.

Activity: Intent to Invent (10 minutes)

If working as a team, team members should work together to define their problem and solution idea as well as to develop the steps they will take to build their invention and the materials they will need. Each student should complete their own worksheet, but responses can be similar.

Allow students 8 -10 minutes to work on their Intent to Invent Worksheet.

Educator Instruction:
Drawings are another way of planning and sharing instructions. Think of the instructions that come with a Legos set or a birdhouse kit. Show the class a few examples of technical drawings (you may use the YIP examples in the Educator Resources.)

Activity: Prototype Design Drawing (10 minutes)
Ask students to draw a detailed and well labeled design of their invention prototype. What do they want their invention to look like? They may use the Prototype Design #1 Worksheet in their Inventor's Journal or they may use another sheet of paper which they can insert into their journal later. Remind students that this is the first design and there will likely be iterations (changes) in later drawings.

After students sketch their designs, ask them to think about what challenges they may face as they start to build? What might be difficult? Why? Are there ways to work around these challenges if they do come up? You may have students/teams share their drawings with another student/team as they consider the building process.

NOTE: YIP recommends educators to review the design drawings before allowing students to start to build their prototypes. If needed, ask students to go back and add more detail.

Educator Instruction:
You may move on to building if time allows or ask students to begin building at home or in the next class.

Now that you have a design plan and a drawn set of instructions, it is time to build.

Activity: Invention Building (as much time as possible, to be continued into next lesson)
Allow students time to build their prototypes. As they build, ask them to think about their design drawing and to make note of any changes they might be making or challenges they face as they go through the process. They should use their YIP Inventor's Journal as a place to record any notes.

Ideas for Virtual Instruction

Activity: Blind Draw
Using an online class meeting tool (Google Classrooms, Zoom), share with students a picture of a common object drawn from a different view (you may use the Different Views Templates in the Educator Resources). Ask the students to determine what the object is. Ask students to share their process and to reflect on the challenges using a virtual platform of choice.

Activity: Intent to Invent
Ask students to complete the Intent to Invent Worksheet included in the YIP Inventor's Journal. Students may submit their work using the virtual platform of choice.

Activity: Prototype Design Drawing

Ask students to draw a detailed and well labeled design of their invention prototype. What do they want their invention to look like? They may use the Prototype Design #1 Worksheet in their Inventor's Journal or they may use another sheet of paper which they can insert into their journal later. Students may submit their work using the platform of choice.

Activity: Invention Building

Ask students to begin to build their invention prototype using materials from home (recycled materials, craft and school supplies, old fabrics and cardboard boxes, etc.) Students may submit photos or updates on their progress using a platform of choice.

Check for Understanding

Educator may wish to do one of the following to check for understanding:

Ask students to share one challenge they anticipate as they build their invention prototype.

Take Home Assignment

(optional if giving homework)

Ask students to continue to build a prototype. Ask them to think about how they might test the design and/or changes they might wish to make.