

SUDBURY, ONTARIO, CANADA

Design a North Star Finder

Technology and the Skilled Trades Grades 9 and 10

Lesson Plan - Prototype

Learning Outcomes	Specific Expectations
	A2 Designing and Performing
Students will define materials needed to build	A2.1 use project management skills to develop a
their prototype (from the previous lesson).	process to create a product and/or service
	A2.2 identify factors that could impact the
Students will explain the reason for needing	development of their projects and apply appropriate
chosen materials.	strategies to increase the probability of a positive
	outcome
Students will create a prototype according to	A2.3 describe properties and characteristics, including
their design, following the Engineering	sustainability, of materials, and justify the selection of
Design Process.	the materials and other resources they are using in the
	creation of products and/or services
Students will explore coding through their	A2.4 select, use, and maintain tools and equipment
Micro:bits.	appropriately as part of creating products and/or
	delivering services
	A2.6 create products and/or deliver services,
	documenting their development process using
	appropriate industry terminology

Description

This lesson is the third instalment in a series that follows the Ontario Tech Ed curriculum. In this lesson, students will create a prototype of the idea that they created and refined in the first two lessons (*Empathize and Define* and *Ideate*). Students will explore the engineering design process as they create their star-finder prototype, test it, refine it, and finally code their Micro:bits to make a functioning star-finder! This lesson is followed by *Reflect and Communicate*.

Materials

- Various materials to build students' ideas could include
 - 3D printer and filament
 - Wood and tools (power tools or hand tools)
 - o Lego
 - o Recycled materials
 - o Other materials the students might request for their projects
- Micro:bits and batteries
- Grid paper
- Rulers
- Pencils and erasers



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- Computers to access makecode.microbit.org
- Sticky notes
- Coding Guide (from additional resources section)
- Building Examples and Instructions (from additional resources section)

Introduction

There are many ways that students might choose to make their star finder. Each star finder should be a physical thing that can hold a Micro:bit and move it up/down and around so that when we code the Micro:bit to detect Polaris, we are able to move it around.

Throughout this project (spanning all 5 lesson plans provided), students will create a star-finder by following the steps of the engineering design process. This lesson plan will span the *Designing and Performing* and the *Analyzing and Refining* parts of the process. The first steps (in the introduction) will have students creating a process for creating their prototype, the action section will have them making it and coding their Micro:bits, and then in the conclusion they will test their prototypes and make refinements.





Step 1: Choosing An Idea

Have each group pick an idea from the ones that they narrowed down in the last lesson. The idea they pick should be something that they can feasibly create in the allotted time frame with materials at hand. In the next steps, students will create a design plan, drawing, and materials list. If they realize at any point in this process that their project will not be feasible, then they can return to step 1 and choose another of their ideas from the previous lesson.

Step 2: Planning and Designing

In this section, they will determine their process for building their star-finder, as well as the materials they will use to build it.

Once each group has an idea chosen, they will draw their design, to scale, on grid paper. On their design, they should include measurements, labels, and any other elements that may be needed, depending on how they plan on constructing it (for example, if they are planning to 3D print their star-finder, they should include the separation between pieces so that it is printable).

Have your students make their design plan; a list of step-by-step instructions for building their star-finder. What elements of the star-finder are going to be built first, and which are going to be last? There are certain elements that might rely on the construction of another. This plan should include each element of their star-finder (i.e. making the base first, then the moving arm, then the Micro:bit holder), with coding their Micro:bit and testing their star-finder as the last two steps. This will guide them through the *Designing and Performing* and the *Analyzing and Refining* sections of the Engineering Design Process.

The next task is to choose materials and do a materials analysis. This may have already been decided, based on their design. Each element of their design should have the material listed on their design plan. Verify each group's plan to ensure that the materials they have chosen are able to be acquired.

Step 3: Project Management

Each section in their step-by-step instructions should be assigned a leader so that there is someone in charge of each section. While each step of the building process will still be done as a group, each leader will oversee that their step runs smoothly, giving each student the chance to be a project manager.

At this point, it would also be a good idea to have students figure out how they plan to get their project done. Is this something they will make during class time, will they get together after school, and similar questions are all things to figure out at this stage. What kind of barriers might there be to them finishing their projects (things like scheduling conflicts might come up



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here)? Collaboration and working as a team are a big part of project development, and this is a great opportunity for them to work on teamwork skills.

Action

In the action stage, students will be building their star finders and coding their Micro:bits. This may take several classes, depending on the depth of their designs. There may be an additional step needed here to source materials for the construction stage.

Step 4: Building Star Finders

Following their designs and plans from the previous steps, students should begin the construction of their star finders. Be sure that students are aware of safety protocols that they need to follow when using different tools (see our additional lesson plan on safety). If you or your students are looking for inspiration, there are examples of different ways to build star finders in the additional resources section of this lesson plan, as well as in the accompanying video.

Step 5: Coding Micro:bits

For this step, each group will need a Micro:bit with its accompanying batteries/battery pack, computer, and USB cord to connect the two. Students will log on to <u>makecode.microbit.org</u>. They may want to create an account so that their code can be saved, and they can access it another day.

Please see the coding guide in the additional resources section. Here you will find a tutorial for coding the Micro:bits to be a star-finder. If the students have experience with coding and with Micro:bits, then this could be a good opportunity for them to try their hand at making their own code. See the additional resources section for the Coding Guide provided, with step-by-step pictures and instructions for coding the Micro:bit.

Once they have created their code, they can download it onto the Micro:bit and attach the Micro:bit to their star finder.

Consolidation

As per the engineering design process, the next step is to test their star finders and analyze their results. Remind students that although it may feel like they already have a final product, there are still refinements that can be made to make it even better.

Step 6: Testing Your Star Finder

Have each group test their star finder first. They should ensure that all their pieces are functional, that the star finder can move horizontally and vertically, and that it can hold the Micro:bit. Use the website <u>Stellarium</u> to locate the North Star, as a reference point for testing



your own star finders. Have the students make notes on their star finder, including anything that they wish to improve.

Step 7: Gallery Walk

Have students set up their star finders around the room. Each group can have one candidate stay with their project, while the others circle the room looking at other groups' projects. Each student that is walking around the gallery of star finders should bring a pen and sticky notes with them. When they are looking at others' projects, they should write down comments on sticky notes and stick them next to the projects. All comments should either be positive or constructive. Discuss with students what a constructive comment can look like.

Step 8: Refining and Adjusting

In this stage of the engineering design process, students will have the chance to adjust their projects based on the feedback they received from their classmates, and their comments. This may take different amounts of time for each group.

Step 9: Reflection

The final piece of this lesson is to have the students reflect on their creations. They should discuss with their groups some or all of the following questions:

- How do you feel about the star finder you created? Are you proud of how it turned out?
- What changes would you make to your star finder if you had no limit on tools and resources?
- How did your group work as a team? What went well? What could have gone better?
- What kind of impacts will your star finder have on different communities and audiences?

Additional Resources

These will be on the website with the Lesson Plan.

- Building Examples and Instructions
- Coding Guide

If you are an All-Access Pass member, check out our introduction to Micro:bit asynchronous lesson to learn more about the basic functions of a Micro:bit. Our asynchronous ICE (Innovation, Creativity, and Entrepreneurship) SHSM workshop is also available online through the All-Access Pass and the middle chapters of that workshop go into more detail on these ideas, with video content.