Logbook

Invention Logbook

Grades 6-8

Teaching Edition

ANDREWS UNIVERSITY
STEM
Science | Technology | Engineering | Math

Table of Contents

Teacher resources and videos available on our website:
www.andrews.edu/go/invent

Contact us at stemconnect@andrews.edu
with any questions, comments, or suggestions.

Introduction

STEM has become increasingly important in the world today, as companies expect applicants to understand basic science and math concepts and be able to think critically and solve problems in the workplace. Learning these skills starts in the classroom where you as a teacher are expected to instruct your students in STEM.

The goal of this project is to engage students with math and science through a hands-on learning opportunity. They are encouraged to work collaboratively, think for themselves, and solve real-world problems. The engineering design process will serve as the problem-solving method.

Traditional math and science classes are important for teaching the basic skills, but it is difficult for students to appreciate what they are learning without a practical application. This project lets them think and experiment and learn by doing. When students are able to use math and science as tools to solve problems, they develop a greater appreciation for what they are learning. Even beyond the STEM professions, the problem solving skills they learn from this project are useful for everyone.

Project Summary

Students will choose a problem and create an invention to solve that problem. They will collaborate in groups of 3-4 to solve the problem together. Each team of students will complete one Logbook together over the course of the project. The Logbook will keep their work organized and provide instructions for each step of the process. We have designed this as a workbook with prompts and space to write/draw.

When you start the project, print one copy of the Logbook for each group and put it in a 3-ring binder. This way you can add more pages as needed. Alternatively, you are welcome to use a notebook for each team instead of the workbook version. If you choose to do that, give each group one notebook to fill out together and use the digital version of the Logbook as an outline.

In addition to the Logbook, we recommend students journal what they did for that day or week. This helps them reflect on their progress and set goals for next time. This can be done in a notebook or using the Weekly Progress worksheet available online.

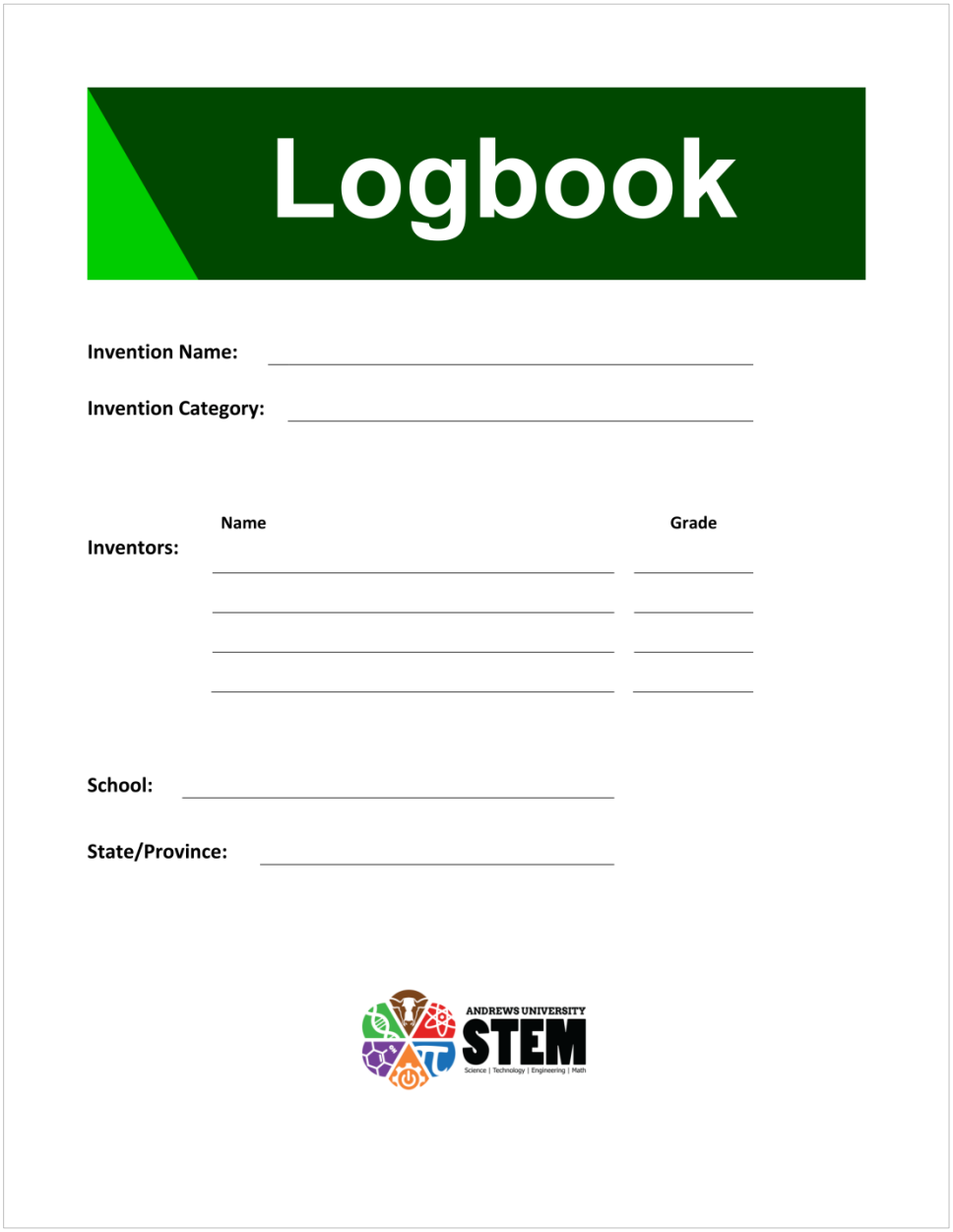
As Adventist educators, we are encouraged to integrate biblical principles throughout our curriculum. To meet this need, we have included a biblical connection with this project. Give examples throughout the project and let each group think of a favorite Bible story, character, or a verse that relates to their invention. It is easy to separate STEM from spirituality, but we hope this will help students see STEM as a God-given gift to bring Him glory.

Cover Page

Invention Name:
Let the students come up with a fun and creative name that describes their group's invention. They should write it here on the cover page and use it in their presentation.

While it might be tempting to name the invention early on, the students should wait until the end of the project when they know more about it.
We recommend naming the invention during the Communicate step.

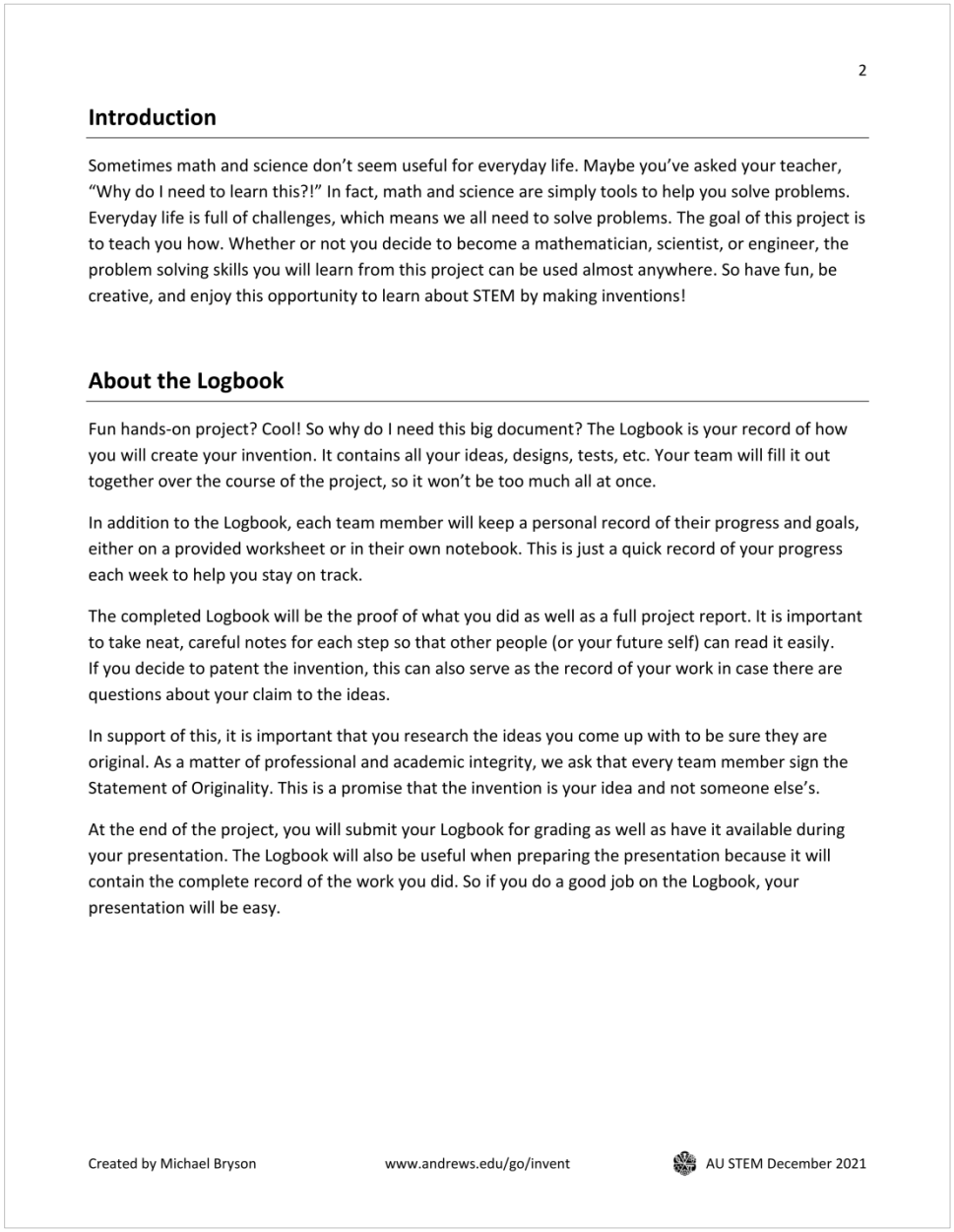
Invention Category:
The students will choose the invention category that best describes their invention and write it here on the cover page.
See the Invention Categories handout for more information.



If you decide to use composition notebooks or other blank notebooks instead of the provided Logbook, include the information from this page on the cover or first page of the notebook.

Logbook Introduction

Read this quick intro to your students or summarize it when you start the project.



Introduction

Sometimes math and science don't seem useful for everyday life. Maybe you've asked your teacher, "Why do I need to learn this?!" In fact, math and science are simply tools to help you solve problems. Everyday life is full of challenges, which means we all need to solve problems. The goal of this project is to teach you how. Whether or not you decide to become a mathematician, scientist, or engineer, the problem solving skills you will learn from this project can be used almost anywhere. So have fun, be creative, and enjoy this opportunity to learn about STEM by making inventions!

About the Logbook

Fun hands-on project? Cool! So why do I need this big document? The Logbook is your record of how you will create your invention. It contains all your ideas, designs, tests, etc. Your team will fill it out together over the course of the project, so it won't be too much all at once.

In addition to the Logbook, each team member will keep a personal record of their progress and goals, either on a provided worksheet or in their own notebook. This is just a quick record of your progress each week to help you stay on track.

The completed Logbook will be the proof of what you did as well as a full project report. It is important to take neat, careful notes for each step so that other people (or your future self) can read it easily. If you decide to patent the invention, this can also serve as the record of your work in case there are questions about your claim to the ideas.

In support of this, it is important that you research the ideas you come up with to be sure they are original. As a matter of professional and academic integrity, we ask that every team member sign the Statement of Originality. This is a promise that the invention is your idea and not someone else's.

At the end of the project, you will submit your Logbook for grading as well as have it available during your presentation. The Logbook will also be useful when preparing the presentation because it will contain the complete record of the work you did. So if you do a good job on the Logbook, your presentation will be easy.

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Project Guidelines

Requirements:

- The teacher must sign off on the project and design before the prototype is built.
- The final design and solution must be completely original or sufficiently different that it can be considered a true innovation and not a copy of existing inventions/products.
  See the Solution section of the Logbook for more information (pg. 12-13).
- All group members must sign the originality statement promising that the design ideas in the Logbook follow the originality requirements.
- The invention prototype does not need to be fully functional, but it should be able show how the final design would operate. If the group can create a functional or partially functional prototype, they should do so.
- If the invention cannot be demonstrated at the final presentation due to size constraints or other considerations, a video must be made demonstrating its use.
- For all presentations, each group will need a Tri-Fold board explaining the project, the signed and completed Logbook, and the prototype. Some or all of these items can be used in the verbal presentation but regardless, they need to be available to show people afterwards.
  See the Presentation Guidelines handout for more information.

Restrictions:

- Animals may not be brought to the final presentation at the invention event. If the design is for animals or uses animals in any way, you must find a way to demonstrate its function without the animal present.
- Inventions may not use wall outlet electricity (110V or higher) unless you are only using unmodified consumer products such as a fan or smartphone charger.
  Battery operated devices are acceptable as long as they use common low voltage batteries (i.e. no car batteries, etc.).
- Inventions may not use any flames or heat sources (lighters, matches, candles, fireworks, heating elements, etc.) or any combustible liquids.
- Inventions may not use biohazards or other dangerous materials.
- Inventions may not be or make use of any weapons such as guns, knives, explosives, stun guns, pepper spray, or blunt weapons.

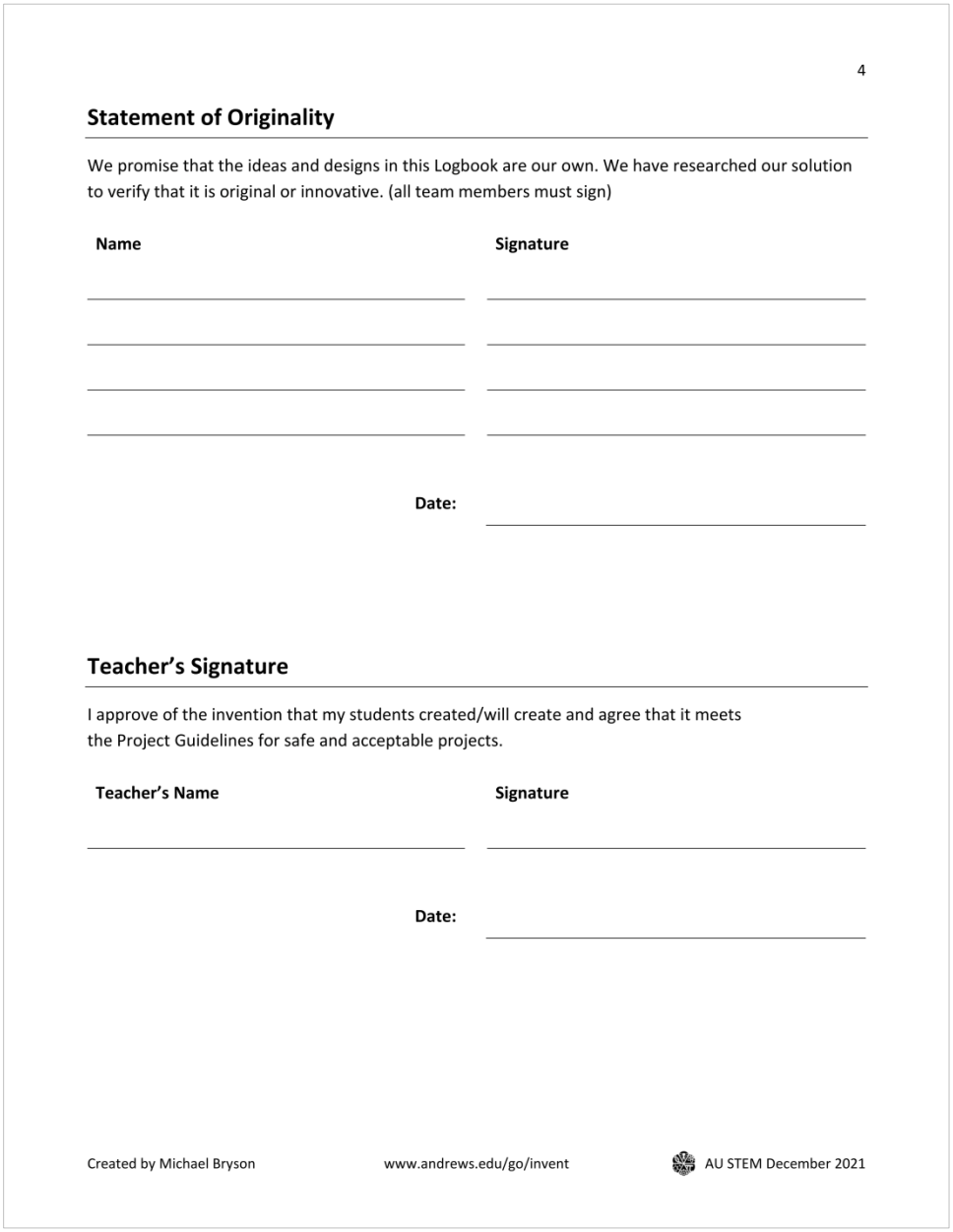
If you have any questions about the project guidelines or feel that the project deserves an exception to the above Requirements & Restrictions, the teacher may contact us at stemconnect@andrews.edu.

Signatures

Statement of Originality:
Students are encouraged to identify original/unique invention ideas for their project. This statement helps students formalize this commitment.

Originality also pertains to the origin of students' ideas. Students should work together to develop their inventions, rather than relying on adults or copying an idea they've seen.

Each student in the group must sign the originality statement sometime before the project is over.



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Statement of Originality

We promise that the ideas and designs in this Logbook are our own. We have researched our solution to verify that it is original or innovative. (all team members must sign)

Name	Signature

Date:

Teacher's Signature

I approve of the invention that my students created/will create and agree that it meets the Project Guidelines for safe and acceptable projects.

Teacher's Name	Signature

Date:

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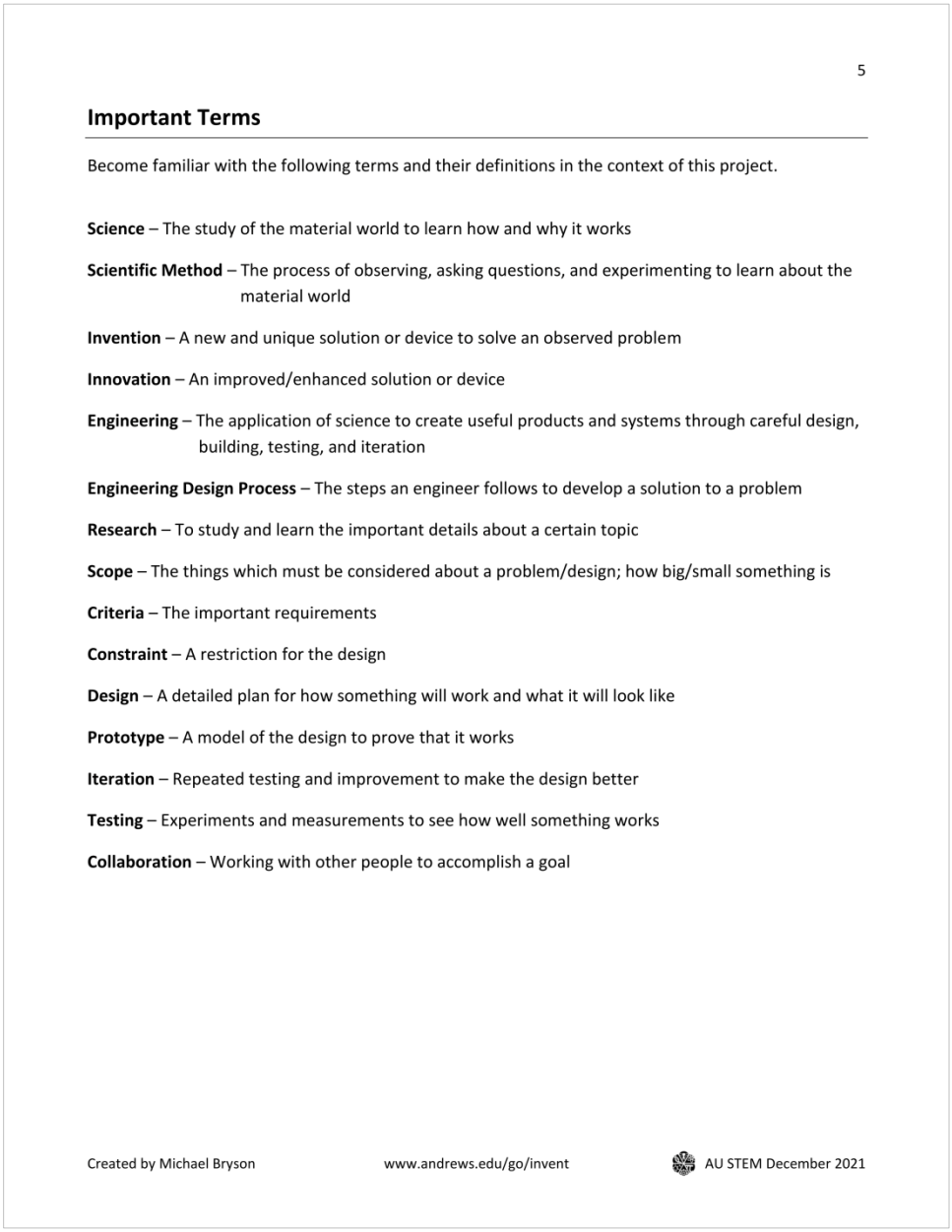
Teacher's Signature:
Once your students choose a solution to their problem, discuss it with them to make sure it meets the Project Guidelines (pg. 3). Once you are satisfied, sign off on the idea. You may need to check again after they build the prototype and whenever they revise the design.

Vocabulary

Introduce the following words to your students. The provided definitions are intended to help your students understand the vocabulary and concepts covered in this project.

Feel free to use and teach the words in the way that best helps your students.

This vocabulary list is also available as a separate document you can print or refer to in class.



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Important Terms

Become familiar with the following terms and their definitions in the context of this project.

Science – The study of the material world to learn how and why it works

Scientific Method – The process of observing, asking questions, and experimenting to learn about the material world

Invention – A new and unique solution or device to solve an observed problem

Innovation – An improved/enhanced solution or device

Engineering – The application of science to create useful products and systems through careful design, building, testing, and iteration

Engineering Design Process – The steps an engineer follows to develop a solution to a problem

Research – To study and learn the important details about a certain topic

Scope – The things which must be considered about a problem/design; how big/small something is

Criteria – The important requirements

Constraint – A restriction for the design

Design – A detailed plan for how something will work and what it will look like

Prototype – A model of the design to prove that it works

Iteration – Repeated testing and improvement to make the design better

Testing – Experiments and measurements to see how well something works

Collaboration – Working with other people to accomplish a goal

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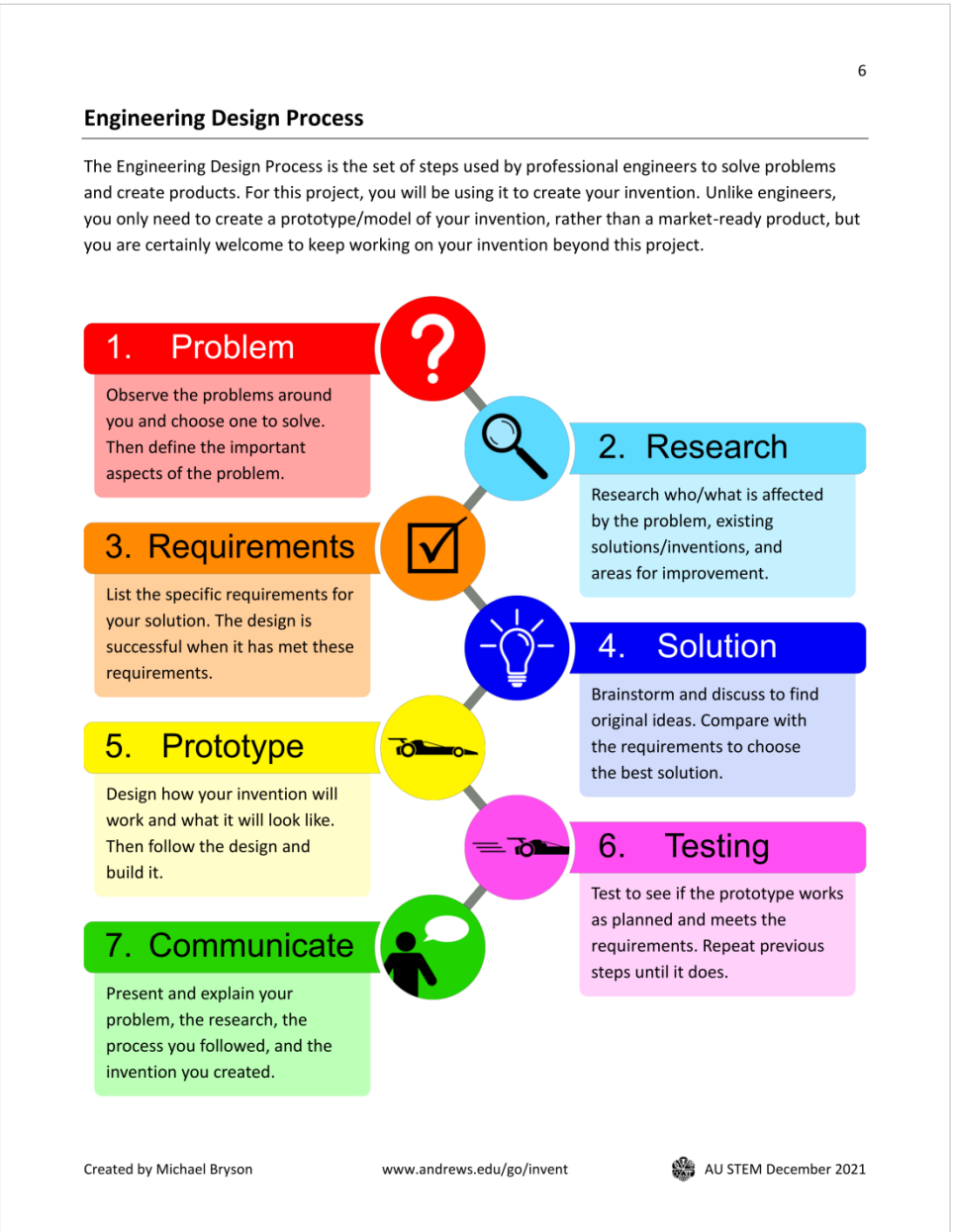
Engineering Design Process

The engineering design process is how engineers solve problems and develop the products we use every day. Many inventors throughout history were engineers, so it makes sense to use this process when creating a new invention.

Beyond engineering and inventing, the engineering design process can also serve as a pattern for solving all kinds of problems. The steps in this process will help your students identify and develop good ideas and focus their efforts to produce tangible and fulfilling results.

Learn More:
To learn more about engineers and the engineering design process, check out the engineering videos and examples on our website.



This diagram provides an overview of the engineering design process and the following pages will expand on this, providing concrete steps for your students to follow as they develop their inventions.

This engineering design process diagram is also available as a separate document you can print or refer to in class. We also have a printable quick reference version (without descriptions).

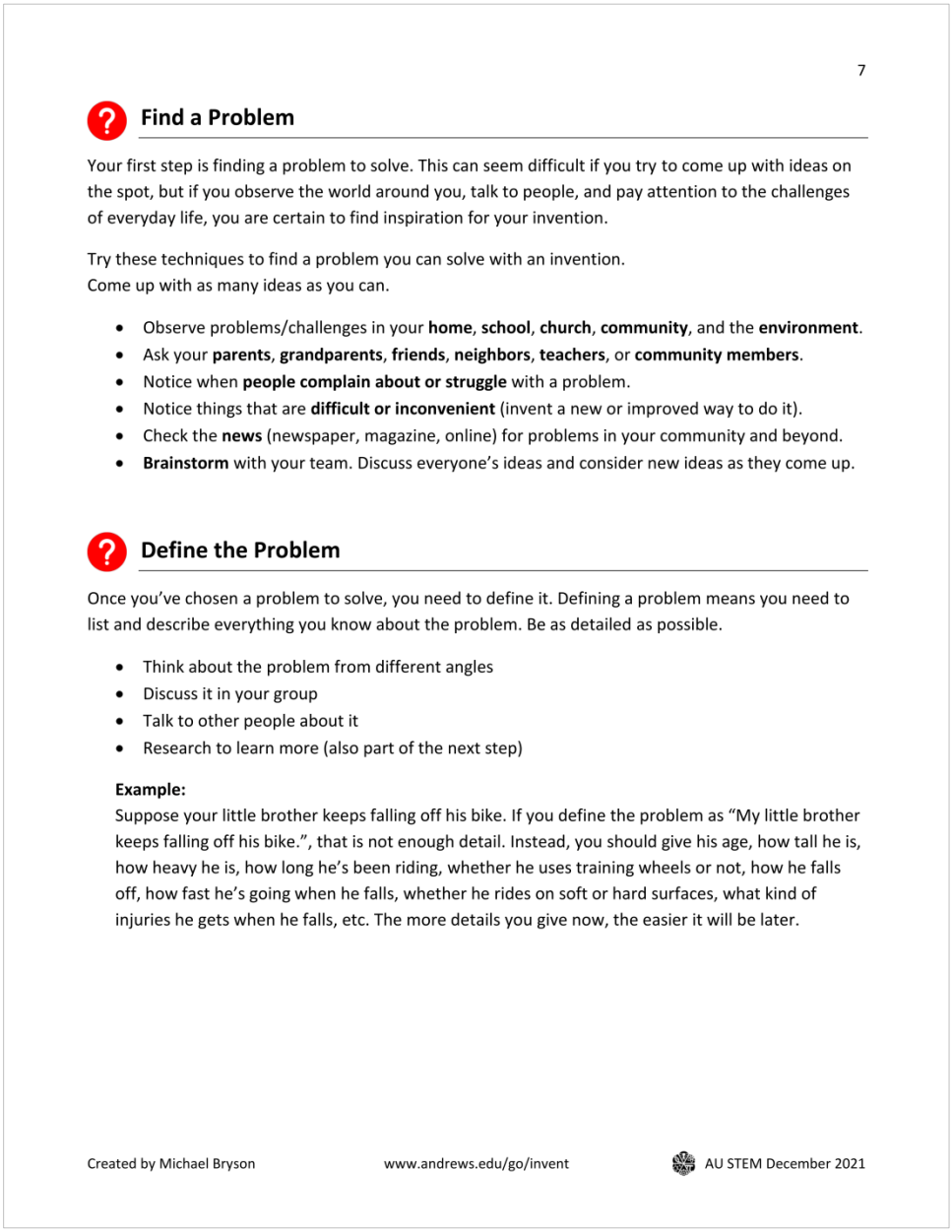
Problem

Find a Problem:
Divide the class into groups of 3-4. The groups will stay the same for the entire project. Each group needs to choose a different problem and create an invention to solve it.

Finding a problem is often the hardest step so you may need to try different things to help the students find good problems. Discuss the Invention Categories in-class or let the students read it together. This list suggests many areas where problems may be found.

Let the students look for problems on their own (worksheet available). Have them check around their house, talk to people they know, and pay attention to challenges throughout their day. Start this as soon as you begin the project.

Let them share with their group or the whole class. Discussion introduces ideas much faster than simply working alone. They should record the ideas as they talk together.



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Find a Problem

Your first step is finding a problem to solve. This can seem difficult if you try to come up with ideas on the spot, but if you observe the world around you, talk to people, and pay attention to the challenges of everyday life, you are certain to find inspiration for your invention.

Try these techniques to find a problem you can solve with an invention.
Come up with as many ideas as you can.

- Observe problems/challenges in your **home**, **school**, **church**, **community**, and the **environment**.
- Ask your **parents**, **grandparents**, **friends**, **neighbors**, **teachers**, or **community members**.
- Notice when **people complain about or struggle** with a problem.
- Notice things that are **difficult or inconvenient** (invent a new or improved way to do it).
- Check the **news** (newspaper, magazine, online) for problems in your community and beyond.
- **Brainstorm** with your team. Discuss everyone's ideas and consider new ideas as they come up.

Define the Problem

Once you've chosen a problem to solve, you need to define it. Defining a problem means you need to list and describe everything you know about the problem. Be as detailed as possible.

- Think about the problem from different angles
- Discuss it in your group
- Talk to other people about it
- Research to learn more (also part of the next step)

Example:
Suppose your little brother keeps falling off his bike. If you define the problem as "My little brother keeps falling off his bike.", that is not enough detail. Instead, you should give his age, how tall he is, how heavy he is, how long he's been riding, whether he uses training wheels or not, how he falls off, how fast he's going when he falls, whether he rides on soft or hard surfaces, what kind of injuries he gets when he falls, etc. The more details you give now, the easier it will be later.

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Choose a Problem:
Each group needs to choose a problem they can solve with an invention (something they can build). Give them a deadline and remind them to choose quickly so they have enough time to make the invention. If they still can't decide, you might need to discuss with them or suggest a problem. Compiling a list of problems from the whole class might help with this. Let them do as much as they can on their own, but don't spend more than 1-2 weeks on this step.

Problem (continued)

Define the Problem:
After the students choose a problem, they need to write down everything they know about it.

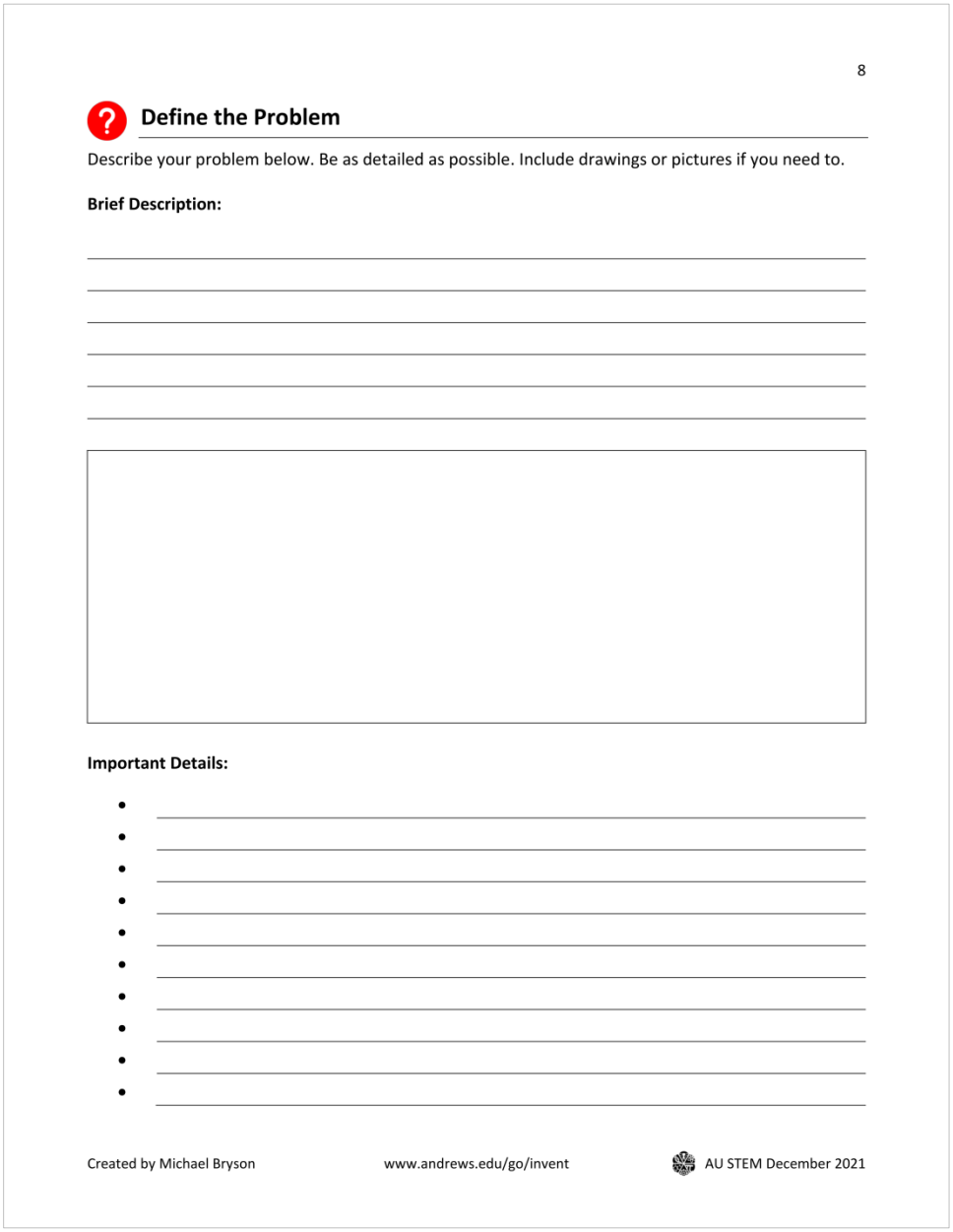
Read the example from the previous page (student edition) and practice defining the problem together on the board.

Think about what the problem is, where it is, what needs to be fixed, why it is important, etc.

Imagine you are describing the problem to someone who has no knowledge about it. What information do they need to know?

After completing the example, let each group discuss their problem and describe it in the Logbook. The more details the better.

In addition to the written description, students are welcome to draw a picture or take a photo to further explain things.



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Define the Problem

Describe your problem below. Be as detailed as possible. Include drawings or pictures if you need to.

Brief Description:

Important Details:

-
-
-
-
-
-
-
-
-
-

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Notice that this step is different from the upcoming Requirements step. The requirements describe the *solution*, while this step describes the *problem*.

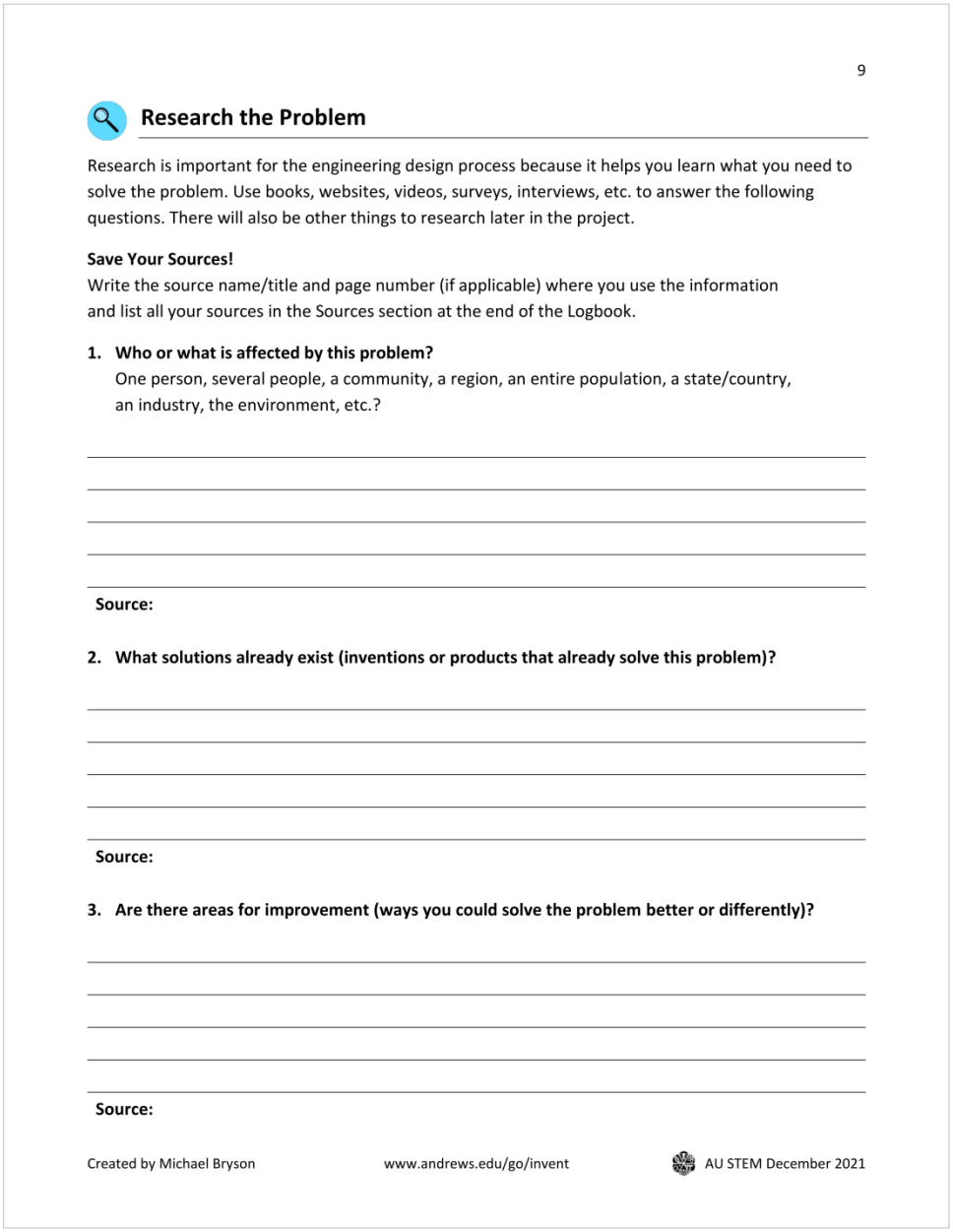
It is important to understand the problem before considering solutions. This will make the following steps easier.

Research

Let students work in their groups to research the problem. The provided questions will guide their search but they are welcome to look beyond the prompts to learn more.

Ask them to use books, websites, videos, surveys, interviews, etc. to find the relevant information.
If they are not already familiar with this type of research, you may need to give additional instructions.

They should also cite where they found the information. Each question will be followed by a brief citation and will correspond to a detailed citation at the end of the Logbook. You can choose how they format these and what details to include. Print additional source pages as needed.



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Research the Problem

Research is important for the engineering design process because it helps you learn what you need to solve the problem. Use books, websites, videos, surveys, interviews, etc. to answer the following questions. There will also be other things to research later in the project.

Save Your Sources!
Write the source name/title and page number (if applicable) where you use the information and list all your sources in the Sources section at the end of the Logbook.

1. **Who or what is affected by this problem?**
   One person, several people, a community, a region, an entire population, a state/country, an industry, the environment, etc.?

Source:

2. **What solutions already exist (inventions or products that already solve this problem)?**

Source:

3. **Are there areas for improvement (ways you could solve the problem better or differently)?**

Source:

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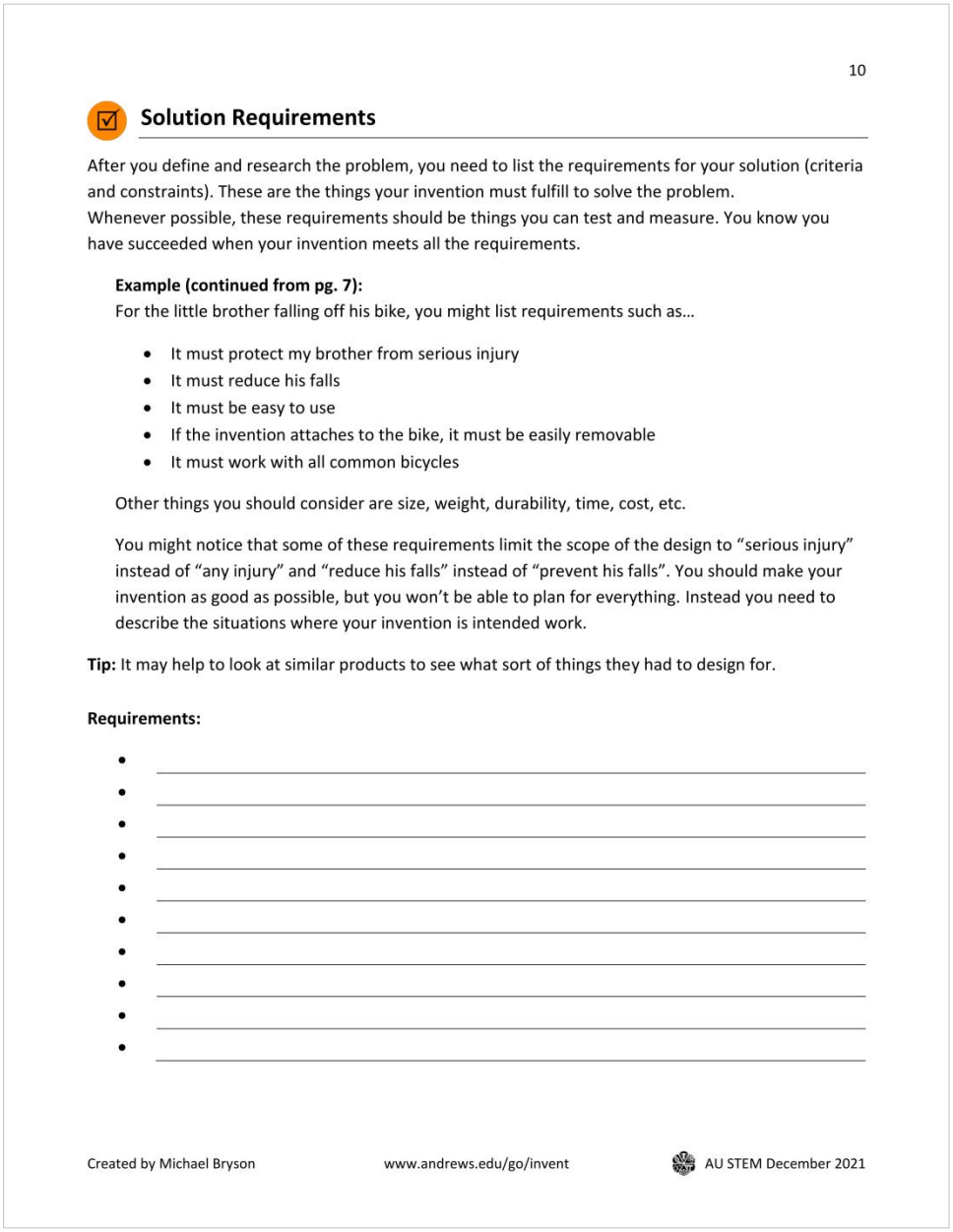
Requirements

Requirements are important. They tell you what the solution needs to do, help you choose the best solution, and let you test how well it works.

Good Requirements:
Read the example together and talk about what makes a good requirement.

1. They are detailed enough to describe what the solution needs to do (criteria), without saying exactly how it will be done.
2. They describe the limitations for the solution (constraints) that the design must accommodate.
3. They describe the specific conditions where the design is intended to work.

Sometimes it helps to consider an extreme case. Would it make sense to protect your brother by wrapping him in tons of bubble wrap? Can you think of a constraint that would limit this sort of solution?



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Solution Requirements

After you define and research the problem, you need to list the requirements for your solution (criteria and constraints). These are the things your invention must fulfill to solve the problem.
Whenever possible, these requirements should be things you can test and measure. You know you have succeeded when your invention meets all the requirements.

Example (continued from pg. 7):
For the little brother falling off his bike, you might list requirements such as…

- It must protect my brother from serious injury
- It must reduce his falls
- It must be easy to use
- If the invention attaches to the bike, it must be easily removable
- It must work with all common bicycles

Other things you should consider are size, weight, durability, time, cost, etc.

You might notice that some of these requirements limit the scope of the design to "serious injury" instead of "any injury" and "reduce his falls" instead of "prevent his falls". You should make your invention as good as possible, but you won't be able to plan for everything. Instead you need to describe the situations where your invention is intended work.

Tip: It may help to look at similar products to see what sort of things they had to design for.

Requirements:

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List the Requirements:
Let the students discuss together to determine their requirements. Remind them this is <u>not</u> the time to choose a solution. They should describe generally what any good solution needs to do to solve their problem. This will help them find solutions on the next step.

It may help to search for similar products. Images and descriptions can hint at the requirements for those products and provide suggestions.

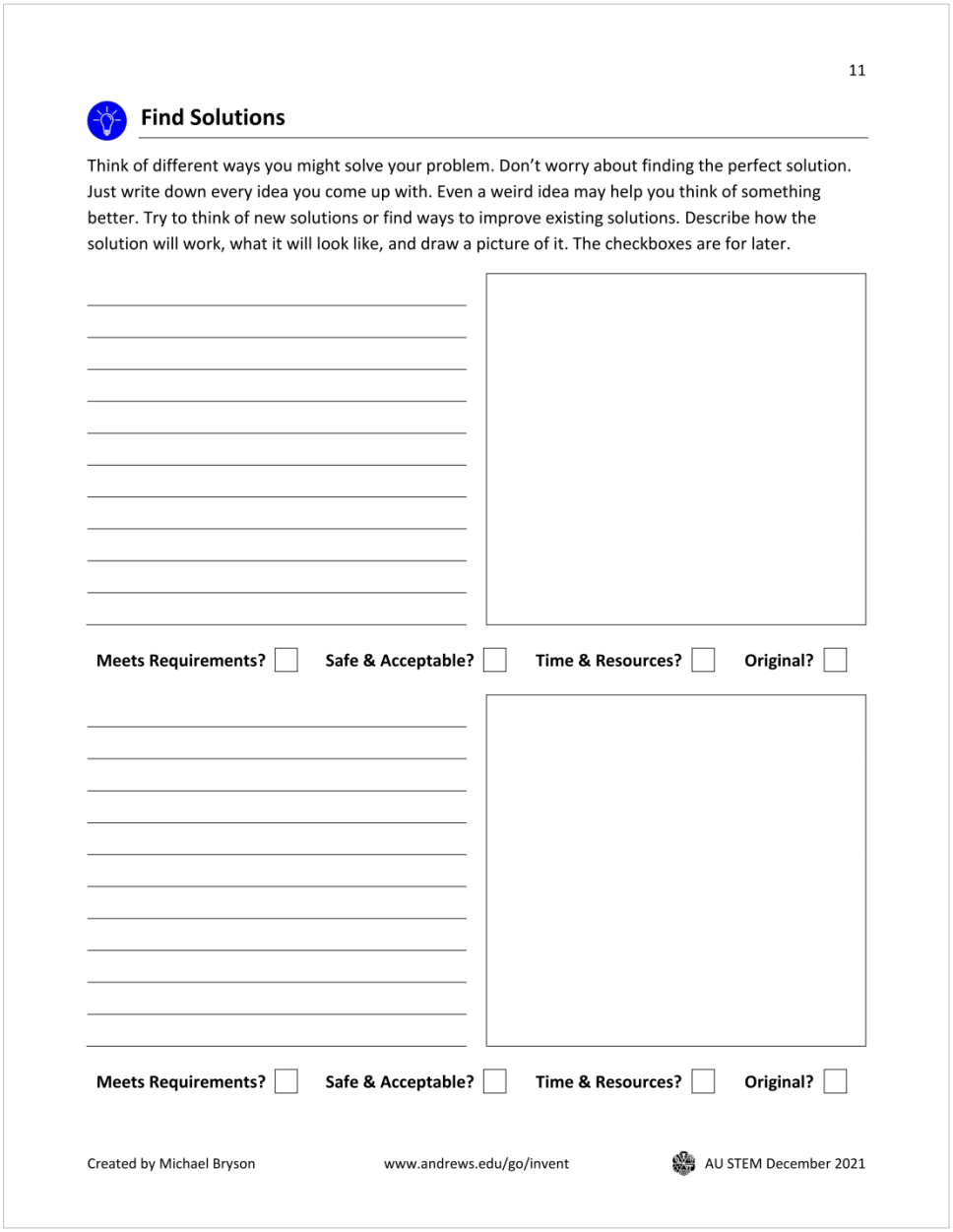
Solution

Find Solutions:
Brainstorming solutions is a fun activity. You can really let your imagination go and think of any and every solution that comes to mind. There are no bad ideas at this point, because even a weird idea might inspire something great.

Let the students talk in their groups and think up as many solutions as they can. Ideally, these should be things they can build, and they should be new (original) ideas.

Have them draw the ideas in their Logbook and write a brief description for each. The 4 checkboxes are for later.

The Logbook provides space for two solutions, but students should think of more than that. Print extra solution pages for each group and add them to the Logbook as needed.



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Find Solutions

Think of different ways you might solve your problem. Don't worry about finding the perfect solution. Just write down every idea you come up with. Even a weird idea may help you think of something better. Try to think of new solutions or find ways to improve existing solutions. Describe how the solution will work, what it will look like, and draw a picture of it. The checkboxes are for later.

Meets Requirements? ☐ Safe & Acceptable? ☐ Time & Resources? ☐ Original? ☐

Meets Requirements? ☐ Safe & Acceptable? ☐ Time & Resources? ☐ Original? ☐

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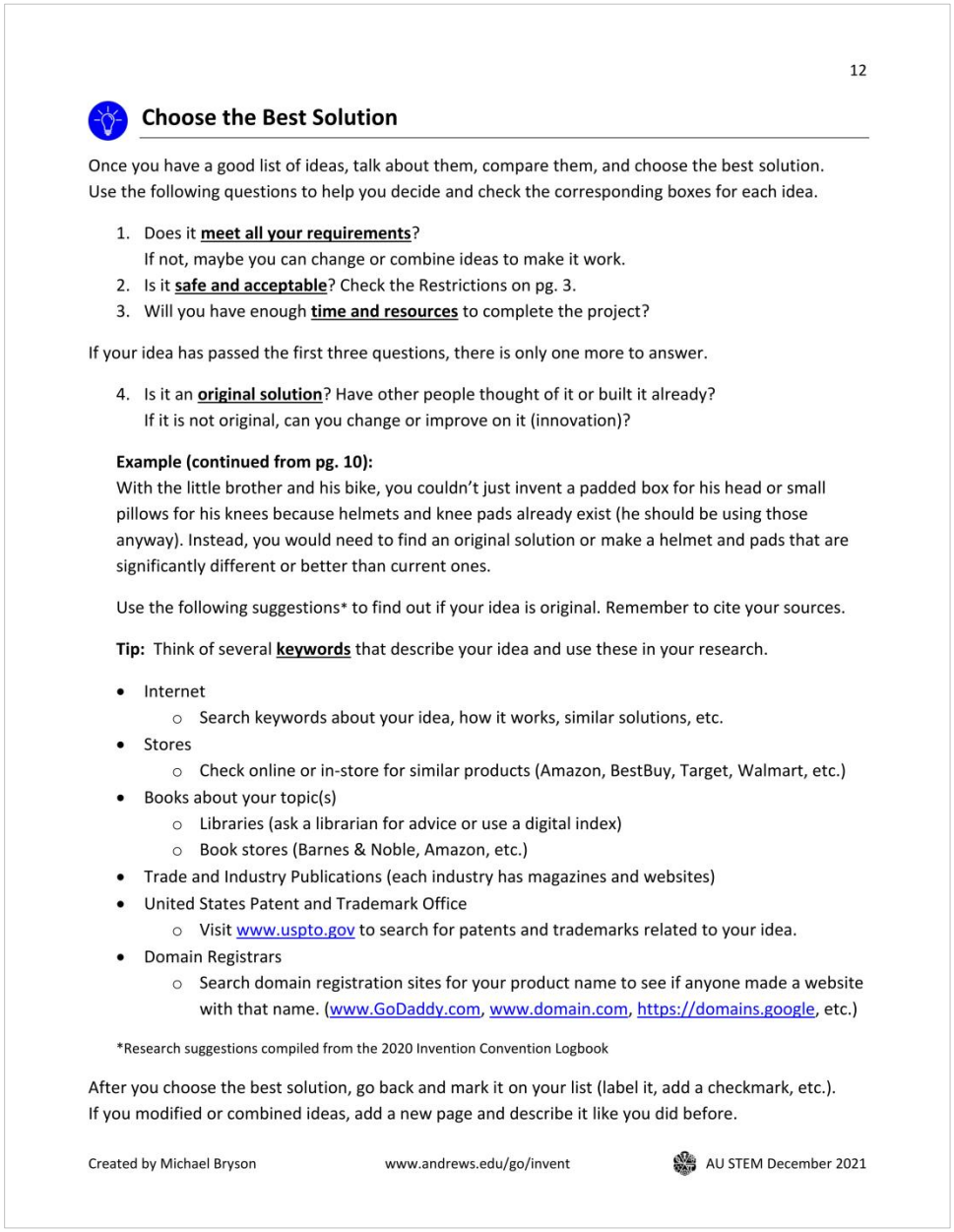
Solution (continued)

Compare Ideas:
The students will narrow their list by answering questions for each idea. If they answer yes to a question, they should check the corresponding box.

For example, if one of the solutions meets all their requirements, they will check the box for "Meets Requirements".

Question 4: Originality
Read the example and talk about why originality is important. If someone had the idea first, it is too late for you to *invent* it, but you might be able to do it differently or better (innovation).

Researching originality can be time consuming, so it should only be done for ideas that pass questions 1-3. Even then, the research does not need to be comprehensive until a solution is chosen. A brief web search usually gives a reasonable answer. This will be followed up in more detail for the solution they choose (next page).



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Choose the Best Solution

Once you have a good list of ideas, talk about them, compare them, and choose the best solution. Use the following questions to help you decide and check the corresponding boxes for each idea.

1. Does it **meet all your requirements**?
   If not, maybe you can change or combine ideas to make it work.
2. Is it **safe and acceptable**? Check the Restrictions on pg. 3.
3. Will you have enough **time and resources** to complete the project?

If your idea has passed the first three questions, there is only one more to answer.

4. Is it an **original solution**? Have other people thought of it or built it already?
   If it is not original, can you change or improve on it (innovation)?

Example (continued from pg. 10):
With the little brother and his bike, you couldn't just invent a padded box for his head or small pillows for his knees because helmets and knee pads already exist (he should be using those anyway). Instead, you would need to find an original solution or make a helmet and pads that are significantly different or better than current ones.

Use the following suggestions* to find out if your idea is original. Remember to cite your sources.

Tip: Think of several **keywords** that describe your idea and use these in your research.

- Internet
  - Search keywords about your idea, how it works, similar solutions, etc.
- Stores
  - Check online or in-store for similar products (Amazon, BestBuy, Target, Walmart, etc.)
- Books about your topic(s)
  - Libraries (ask a librarian for advice or use a digital index)
  - Book stores (Barnes & Noble, Amazon, etc.)
- Trade and Industry Publications (each industry has magazines and websites)
- United States Patent and Trademark Office
  - Visit www.uspto.gov to search for patents and trademarks related to your idea.
- Domain Registrars
  - Search domain registration sites for your product name to see if anyone made a website with that name. (www.GoDaddy.com, www.domain.com, https://domains.google, etc.)

*Research suggestions compiled from the 2020 Invention Convention Logbook

After you choose the best solution, go back and mark it on your list (label it, add a checkmark, etc.). If you modified or combined ideas, add a new page and describe it like you did before.

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Choose the Best Solution:
After answering the questions for each solution, the group should choose the idea that answered yes to all 4 questions, or if multiple solutions passed, they may need to just pick one or combine ideas.

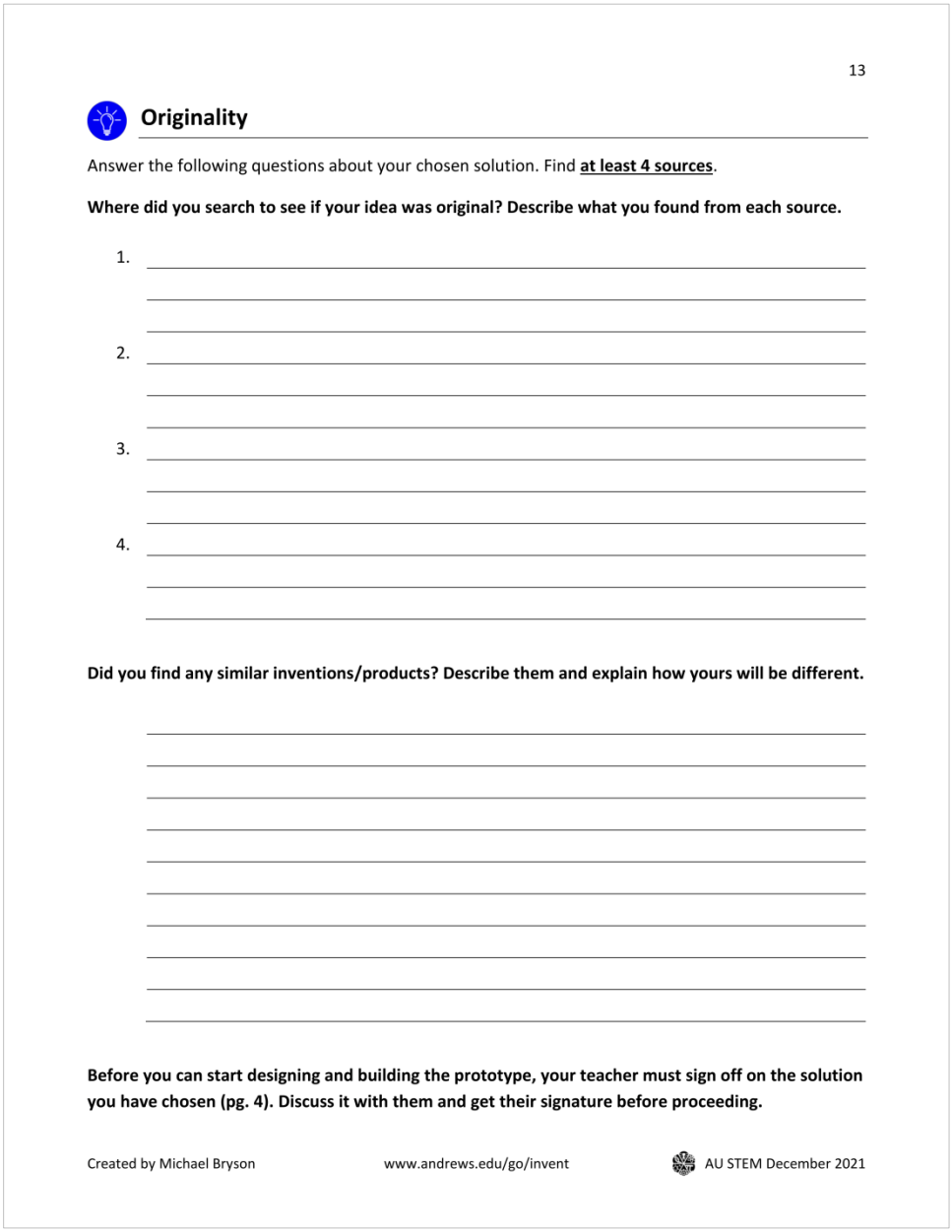
If they came up with new solutions during this process, provide them with additional solution pages.

Originality

The students need to finish their originality research for the solution they chose. Ideally, their solution will be completely original, but if not, they need to make it sufficiently different. They should at least improve upon what currently exists.

Even if the idea is original, there will likely be existing products that are similar in some way. They need to explain how their invention or innovation will be different.

Remind them to cite their sources.



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Originality

Answer the following questions about your chosen solution. Find **at least 4 sources**.

Where did you search to see if your idea was original? Describe what you found from each source.

1.

2.

3.

4.

Did you find any similar inventions/products? Describe them and explain how yours will be different.

Before you can start designing and building the prototype, your teacher must sign off on the solution you have chosen (pg. 4). Discuss it with them and get their signature before proceeding.

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Approve the Invention Idea:

Compare each group's idea with the Project Guidelines (pg. 3) and sign on page 4 if you feel it is appropriate. You may need to check again when they revise their design or if they choose a new solution.

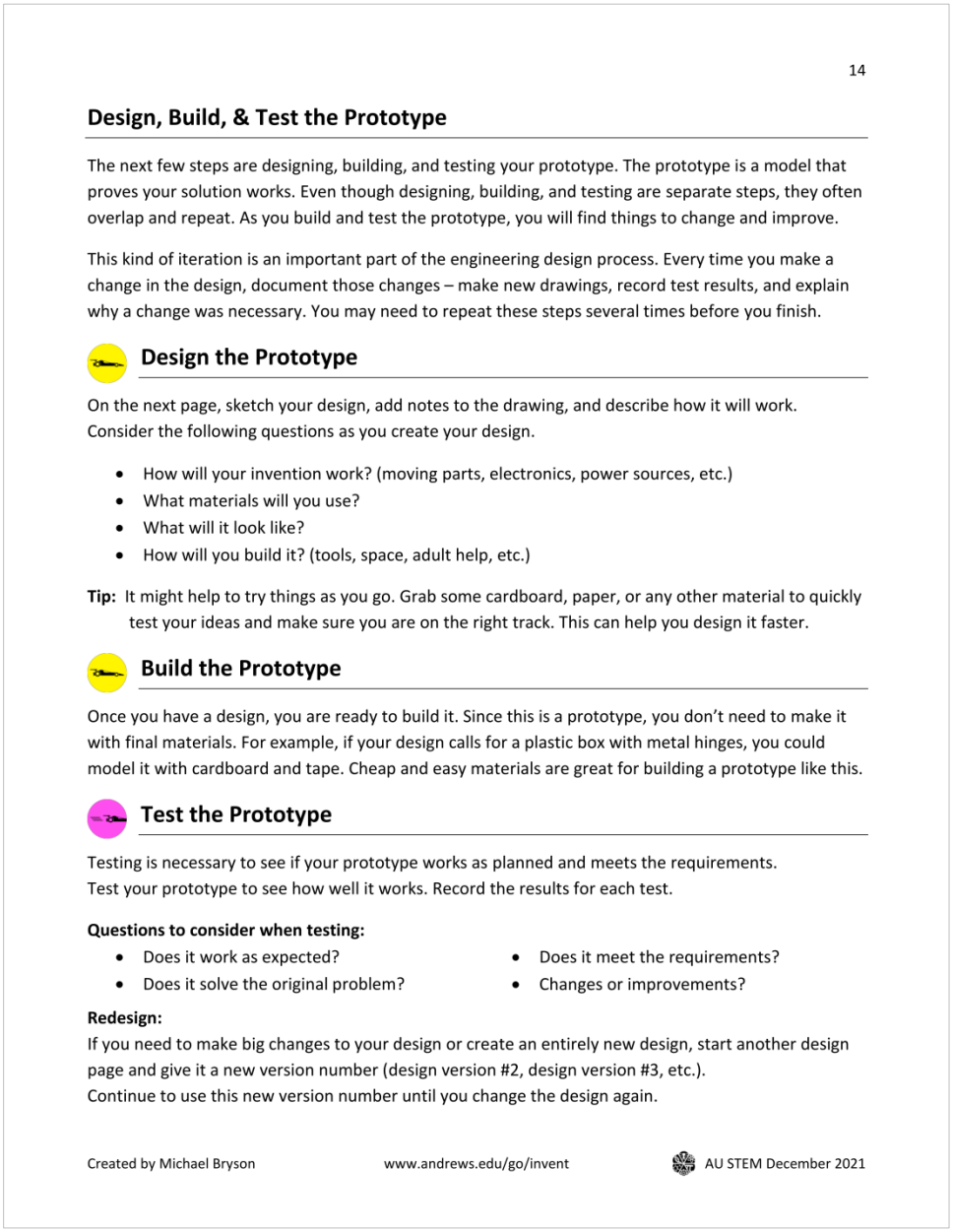
Design, Build, & Test the Prototype

Reminder:
Review and sign off on each group's invention idea.

Make an Invention:
The students will now design, build, test, and improve their prototype. As they encounter challenges, they may need to go back, repeat steps, and do things out of order. Iteration is a normal and important part of the process.

This teaches students to persevere, to think outside the box, and to become better problem solvers, not to mention the technical skills and experience they learn along the way.

Narrow the Focus:
Students may attempt something too big or complex. Don't limit their creativity, but if they are struggling or running out of time, you might help them scale it back a little. For example, they might build part of the design or solve part of the problem and continue it next year.



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Design, Build, & Test the Prototype

The next few steps are designing, building, and testing your prototype. The prototype is a model that proves your solution works. Even though designing, building, and testing are separate steps, they often overlap and repeat. As you build and test the prototype, you will find things to change and improve.

This kind of iteration is an important part of the engineering design process. Every time you make a change in the design, document those changes – make new drawings, record test results, and explain why a change was necessary. You may need to repeat these steps several times before you finish.

Design the Prototype

On the next page, sketch your design, add notes to the drawing, and describe how it will work. Consider the following questions as you create your design.

- How will your invention work? (moving parts, electronics, power sources, etc.)
- What materials will you use?
- What will it look like?
- How will you build it? (tools, space, adult help, etc.)

Tip: It might help to try things as you go. Grab some cardboard, paper, or any other material to quickly test your ideas and make sure you are on the right track. This can help you design it faster.

Build the Prototype

Once you have a design, you are ready to build it. Since this is a prototype, you don't need to make it with final materials. For example, if your design calls for a plastic box with metal hinges, you could model it with cardboard and tape. Cheap and easy materials are great for building a prototype like this.

Test the Prototype

Testing is necessary to see if your prototype works as planned and meets the requirements.
Test your prototype to see how well it works. Record the results for each test.

Questions to consider when testing:

- Does it work as expected?
- Does it solve the original problem?
- Does it meet the requirements?
- Changes or improvements?

Redesign:
If you need to make big changes to your design or create an entirely new design, start another design page and give it a new version number (design version #2, design version #3, etc.).
Continue to use this new version number until you change the design again.

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Plan Enough Time!
Plan enough time for designing, building, testing, and improving the prototype. These steps will take the most time during the project.

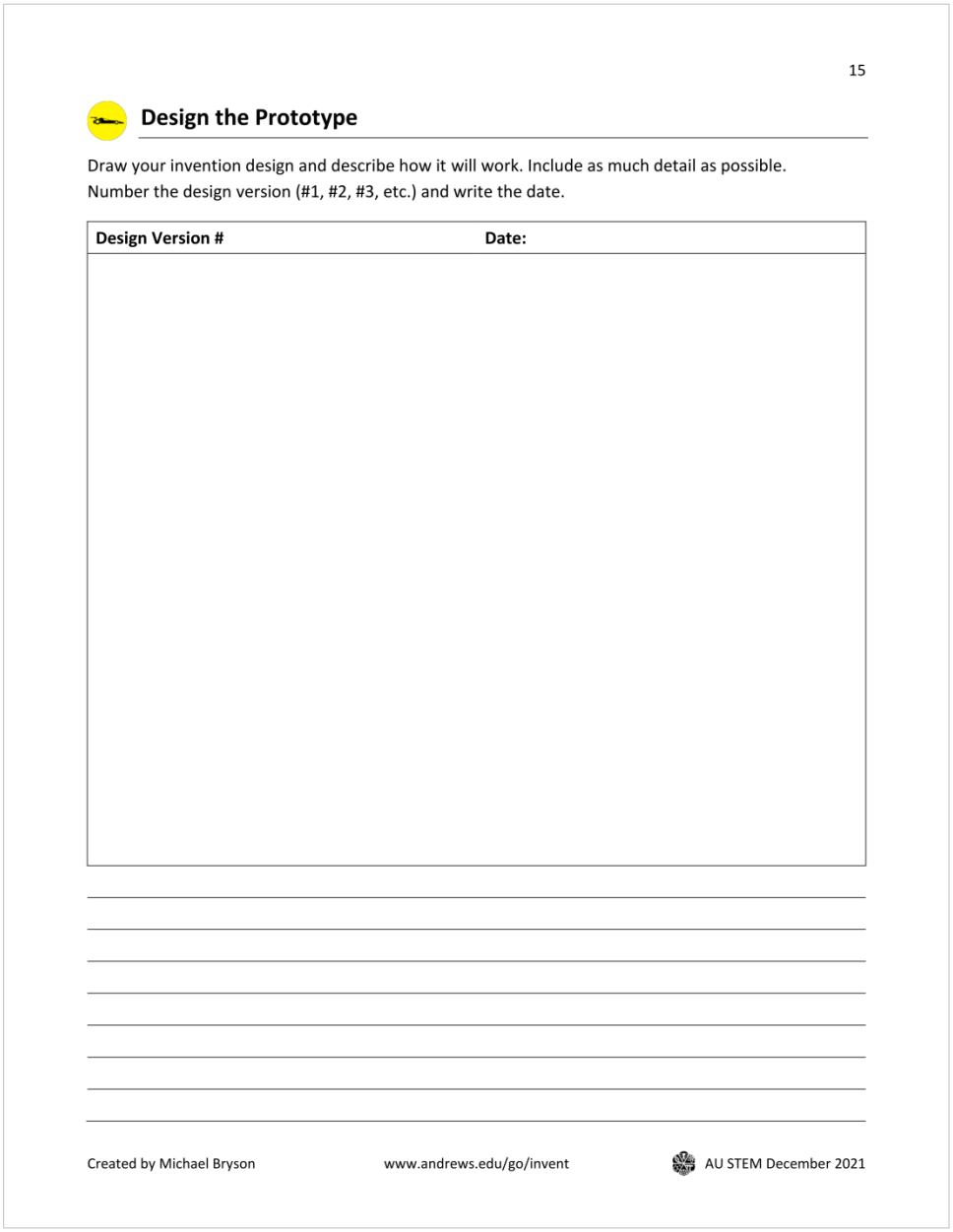
Design the Prototype

Design:
Before building the prototype, a design must be drawn up based on the chosen solution. This is a detailed plan showing how the invention will work, what it will look like, materials to be used, etc.

Students will work in their groups to do the following:

- Discuss and plan
- Draw their design
- Describe the design
- Write the Version # and Date at the top (Version # will be 1 until they revise it)

Hands-on Design:
Students may benefit from experimenting as they plan. Trying things as you go is a good way to visualize the design and solve the problem faster.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Design the Prototype

Draw your invention design and describe how it will work. Include as much detail as possible.
Number the design version (#1, #2, #3, etc.) and write the date.

Design Version #	Date:

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Revision:
After the students have built and tested the prototype, they may need to come back and revise their design. If they update the design, print a new copy of the design pages, and increase the version number (#2, #3, etc.).

Build the Prototype

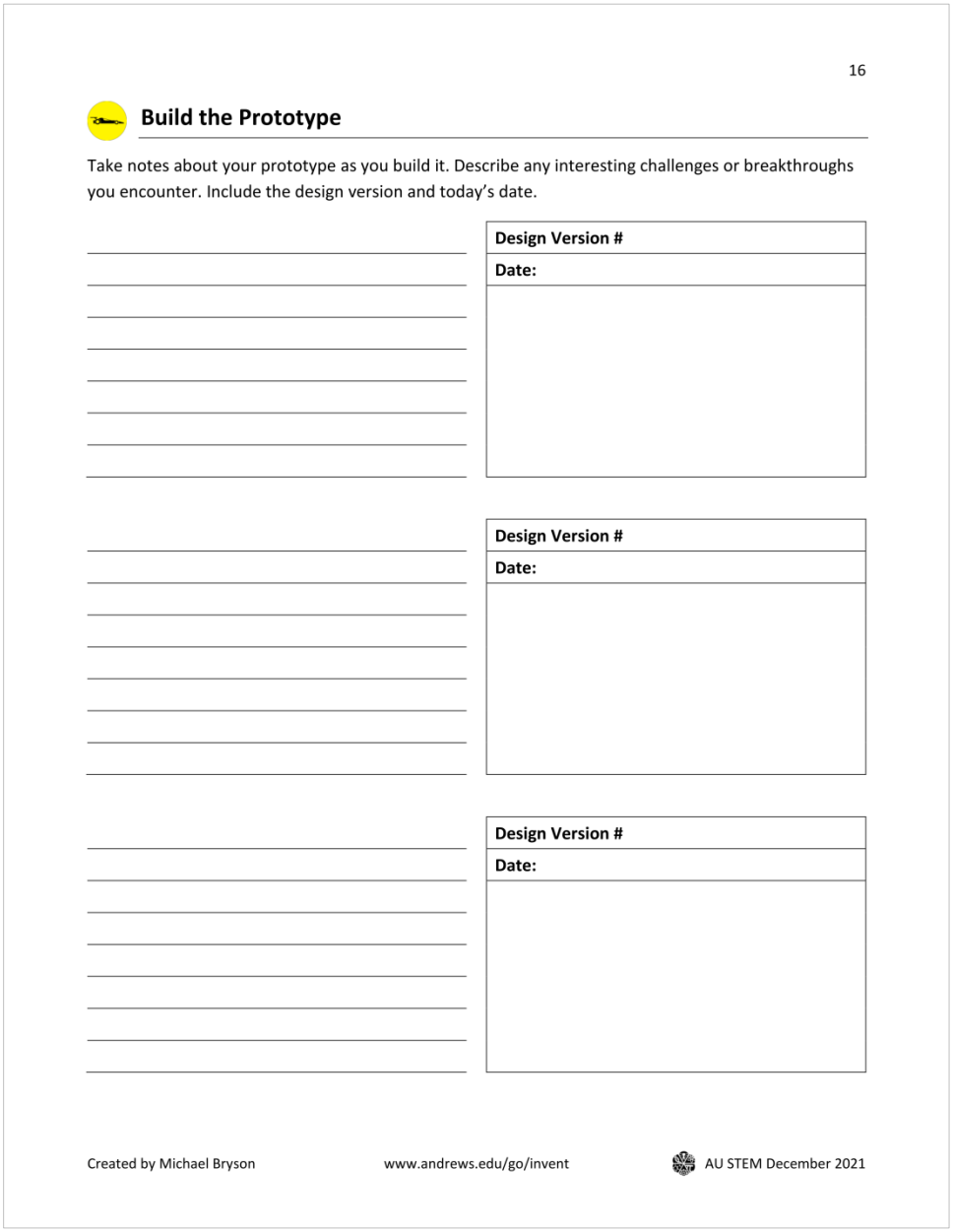
After drawing their design, the students will work with their team to build the prototype.

Provide them with inexpensive materials such as cardboard, paper, tape, glue, etc. (raid the recycle bin or the craft closet). If they want to use other materials, that's fine as long as they meet the Project Guidelines.

If their design calls for higher quality materials, they can still model it inexpensively. For example, a plastic box with metal hinges could be modeled using cardboard and tape.

The prototype is only a model of their design so it doesn't have to work perfectly. If they can make it functional that would be great, but even a static model can demonstrate how the invention works.

Challenge them to think outside the box and find creative solutions as they build their inventions.



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Build the Prototype

Take notes about your prototype as you build it. Describe any interesting challenges or breakthroughs you encounter. Include the design version and today's date.

Design Version #
Date:

Design Version #
Date:

Design Version #
Date:

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Take Notes:

As the students work on their prototype, they should describe any challenges, decisions, etc. They will write the Version # for the design they are building and the current date. Print additional build pages as needed.

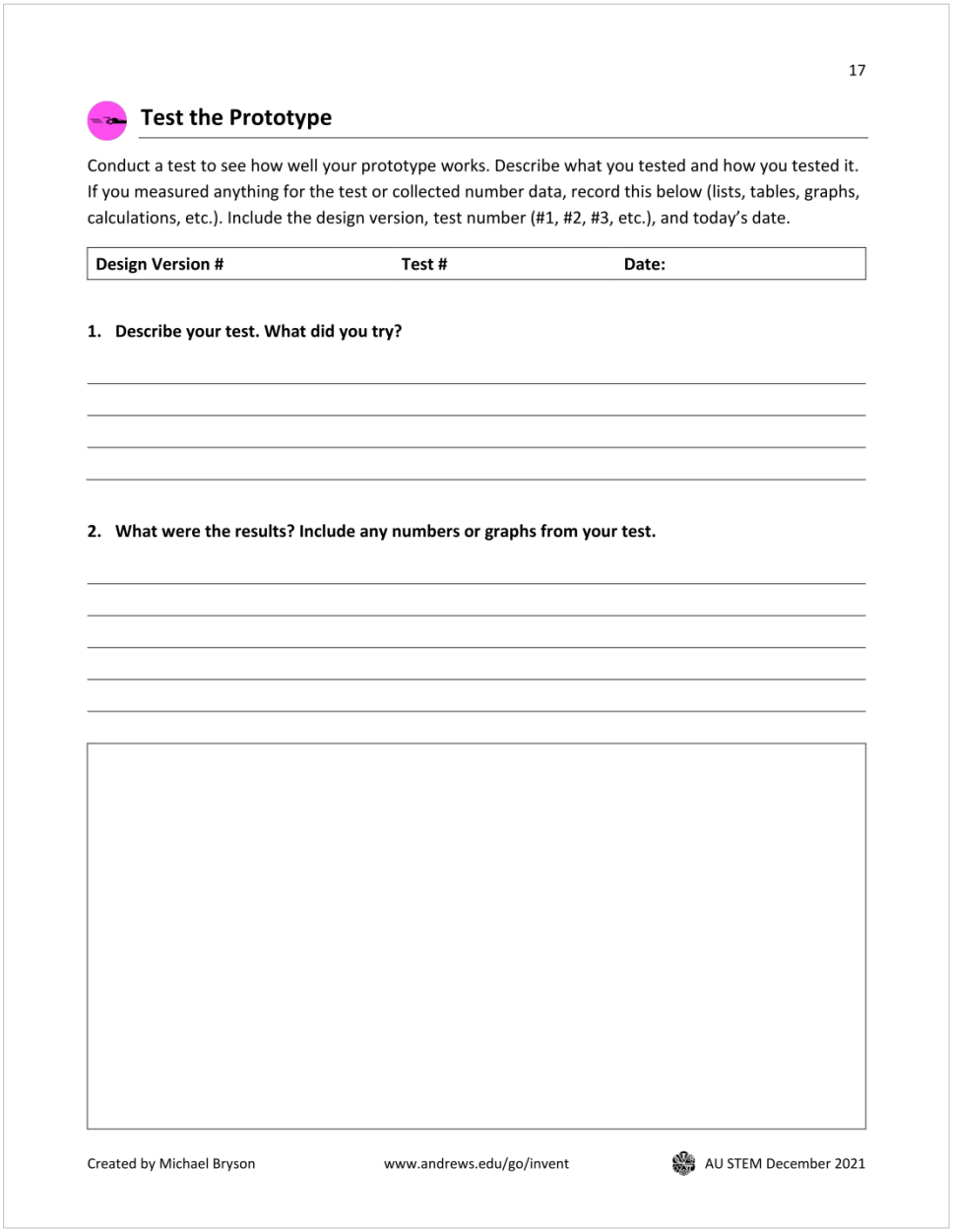
Test the Prototype

Testing is important because it tells you if you succeeded or if you need to change things.

After building the prototype (or even while they are building), the students will test their prototype to see how well it works.

In general, the prototype should be tested by using it and seeing what happens. If there are things to be measured, that should be part of testing. If the invention will be used by a certain person or group, the students can let them try it and evaluate their experience.

Afterwards, the students will answer the questions to assess how well the prototype performed and find areas for improvement.



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Test the Prototype

Conduct a test to see how well your prototype works. Describe what you tested and how you tested it. If you measured anything for the test or collected number data, record this below (lists, tables, graphs, calculations, etc.). Include the design version, test number (#1, #2, #3, etc.), and today's date.

Design Version #	Test #	Date:

1. **Describe your test. What did you try?**

2. **What were the results? Include any numbers or graphs from your test.**

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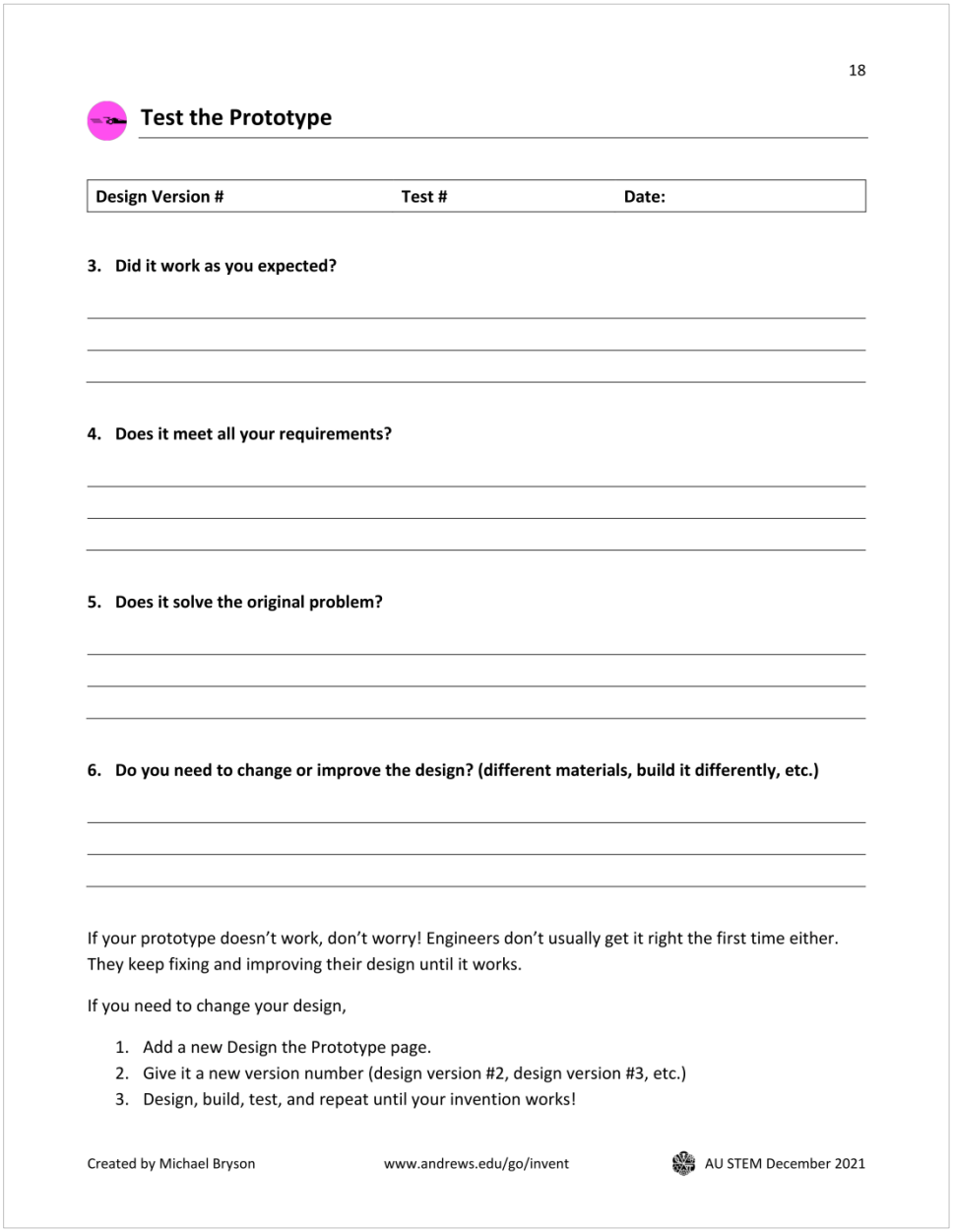
Numbers & Graphs:
Students can record any numerical data from their tests in the box on this page. This is a great opportunity to incorporate math concepts with appropriate tables and graphs.

Test the Prototype (continued)

Fill in the Design Version # and Date at the top of each testing page to keep track of which version the test was for. If they perform multiple tests on the same version, they can number the tests.

Test it Again:
If the students change their design or switch to a new design, they will need to test the prototype again. Print another copy of the [testing pages] and write the new design number.



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Test the Prototype

Design Version #	Test #	Date:

3. **Did it work as you expected?**

4. **Does it meet all your requirements?**

5. **Does it solve the original problem?**

6. **Do you need to change or improve the design? (different materials, build it differently, etc.)**

If your prototype doesn't work, don't worry! Engineers don't usually get it right the first time either. They keep fixing and improving their design until it works.

If you need to change your design,

1. Add a new Design the Prototype page.
2. Give it a new version number (design version #2, design version #3, etc.)
3. Design, build, test, and repeat until your invention works!

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Improvement:
After testing, the students will likely need to fix things. Remind them that this is a normal part of the process. They shouldn't be discouraged if it fails the first time (or even the second or third time). Every great inventor fails before they succeed, but they keep trying until it works! If improvements are required, simply go back to the appropriate step and try again. If they change the design, remember to increase the Design Version number (#2, #3, etc.).

Conclusion

At the end of the project, each group will fill out the conclusion page to summarize what they did.

In the first section, the students will summarize their work.

The Biblical Connection relates their project to a Bible story, character, spiritual lesson, or anything from the Bible that connects in some way.

For examples, see the Biblical Connection section in the Teacher Resources on our website.

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Conclusion

Summarize the results of your invention project. Did your invention solve the original problem? What was the biggest challenge you encountered? What changes or improvements could you make in the future? What impact did it have or could it have in the future?

Biblical Connection:

What spiritual lesson did you learn from this project? Does it connect with any Bible principles, stories, characters, or lessons? How does this spiritual lesson apply to your life?

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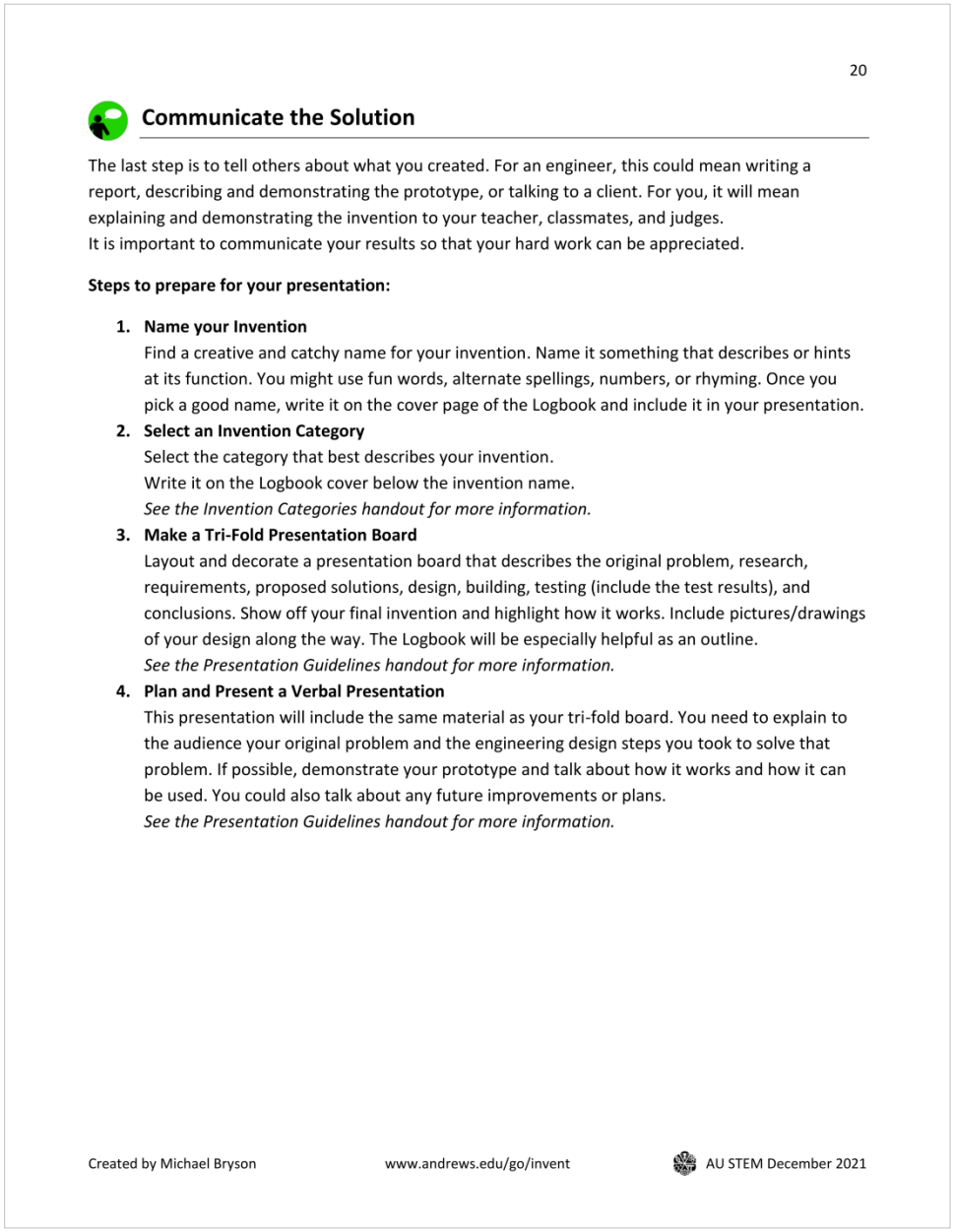
Communicate

Name the Invention:
After the students have finished their prototype, they can choose a catchy name that describes their invention and write it on the cover.

Invention Category:
Help the students choose the appropriate invention category and write it on the cover below the name.
See the Invention Categories handout for more information.

Prepare to Present:
Each group will prepare a tri-fold presentation board and a verbal presentation about their project.

The tri-fold board will follow the engineering design process with one section for each step. The verbal presentation will cover the same material.
See the Presentation Guidelines handout for more information.



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Communicate the Solution

The last step is to tell others about what you created. For an engineer, this could mean writing a report, describing and demonstrating the prototype, or talking to a client. For you, it will mean explaining and demonstrating the invention to your teacher, classmates, and judges.
It is important to communicate your results so that your hard work can be appreciated.

Steps to prepare for your presentation:

1. **Name your Invention**
   Find a creative and catchy name for your invention. Name it something that describes or hints at its function. You might use fun words, alternate spellings, numbers, or rhyming. Once you pick a good name, write it on the cover page of the Logbook and include it in your presentation.
2. **Select an Invention Category**
   Select the category that best describes your invention.
   Write it on the Logbook cover below the invention name.
   See the Invention Categories handout for more information.
3. **Make a Tri-Fold Presentation Board**
   Layout and decorate a presentation board that describes the original problem, research, requirements, proposed solutions, design, building, testing (include the test results), and conclusions. Show off your final invention and highlight how it works. Include pictures/drawings of your design along the way. The Logbook will be especially helpful as an outline.
   See the Presentation Guidelines handout for more information.
4. **Plan and Present a Verbal Presentation**
   This presentation will include the same material as your tri-fold board. You need to explain to the audience your original problem and the engineering design steps you took to solve that problem. If possible, demonstrate your prototype and talk about how it works and how it can be used. You could also talk about any future improvements or plans.
   See the Presentation Guidelines handout for more information.

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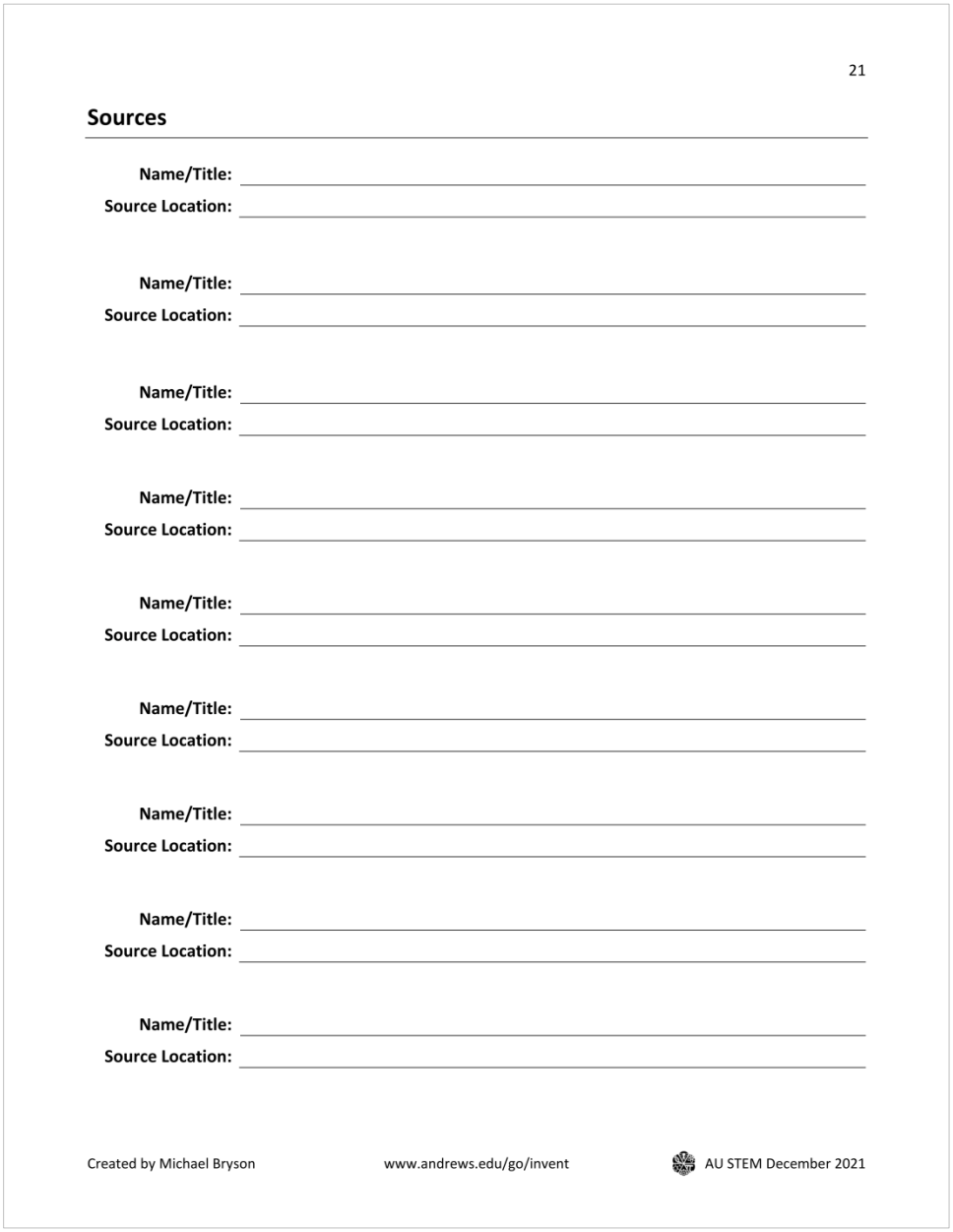
Sources

The students will keep a list of their research sources throughout the project. They should provide a brief citation where they used the information and a detailed citation here.

You can choose how they format the citations and what details to include, but at a minimum they need the name/title of the source and the location where they got it (book, website, interview, etc.). This will help them become accustomed to giving credit for information they use.

The sources in this list will be from the Research step and any other time they researched information for the project. Print additional source pages as needed.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Sources

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