Logbook

Invention Logbook

Grades K-2

Teaching Edition

Whole-Class Version

ANDREWS UNIVERSITY STEM
Science | Technology | Engineering | Math

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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

The class will choose a problem and create an invention to solve that problem. Everyone will collaborate as a team to solve the problem together. As they progress through the project, you will complete one Logbook for the class. The Logbook will keep the work organized and provide simple 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 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 instead of the workbook version. If you choose to do that, use the digital version of the Logbook as an outline.

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 student think of a favorite Bible story, character, or a verse that relates to the 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.

At the K-2 level, we have two options for teaching this project – you can either do it as a whole class or in small groups. Choose the option that best fits your teaching style. This version of the Logbook is for the whole-class option, but if you need the small-group version, you can find that on our website. Please note that the whole-class option is not eligible for entry into the NAD-wide invention fair, but it is a good introduction to engineering and prepares students to participate in the future.

Project Guidelines

These guidelines apply to the small-group invention projects, but you may find them useful for your whole-class invention as well, especially if you decide to do small-group projects next year.

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.
  This point is flexible at the K-2 range. Students should be encouraged to find original solutions but it is more important that they learn the process than stress about originality.
- All group members must sign the originality statement promising that the design ideas in the Logbook follow the originality requirements. *Signature page removed from whole-class version.*
- 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:

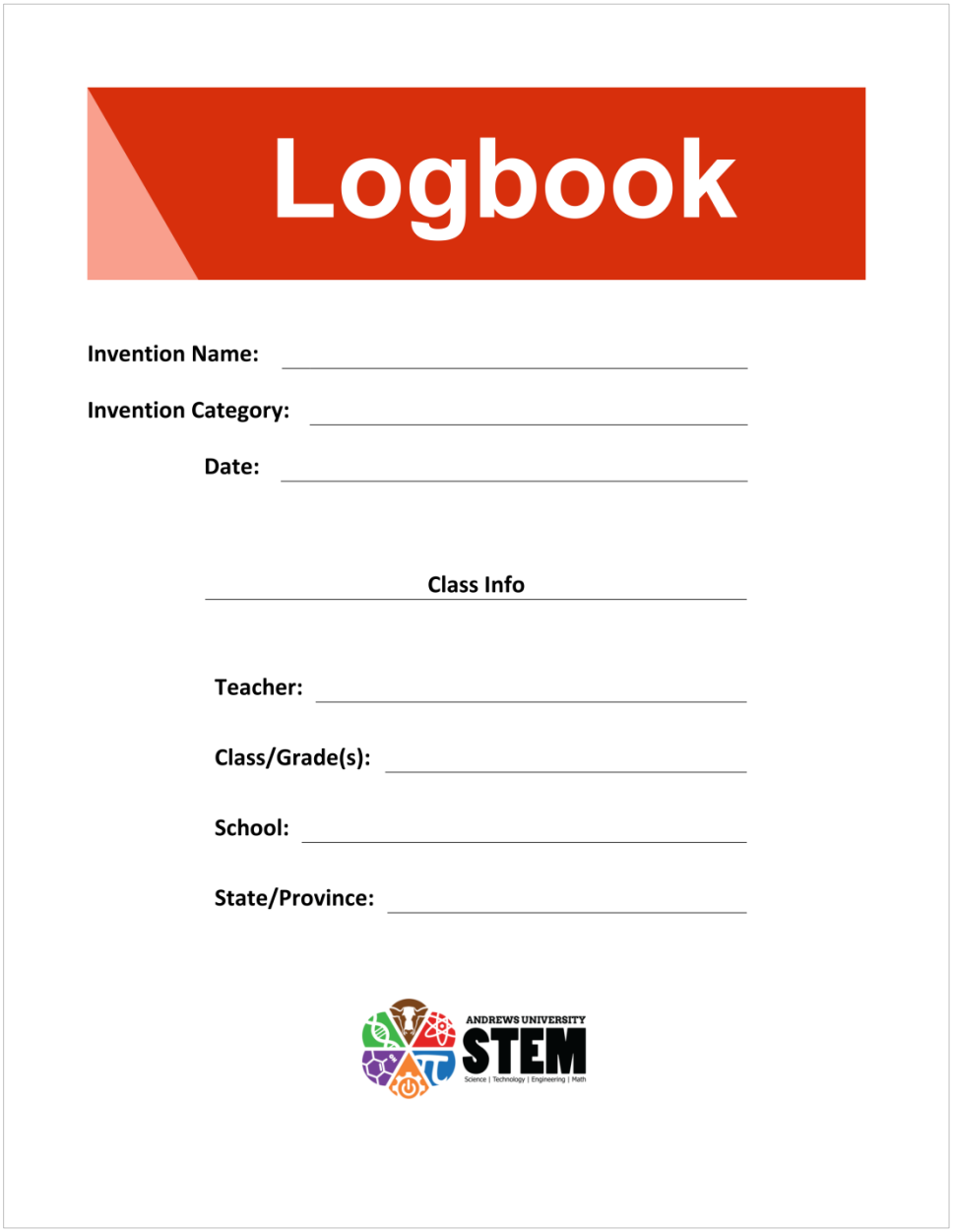
- Animals may not be brought to the final presentation at the invention event. If the design is for animals or uses animals in any way, you must find a way to demonstrate its function without the animal present.
- Inventions may not use wall outlet electricity (110V or higher) unless you are only using 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.

Cover Page

Invention Name:
Come up with a fun and creative name that describes your class invention. Write it here on the cover page and use it in your presentation.

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

Invention Category:
Choose the invention category that best describes the class invention and write it here on the cover page.
See the Invention Categories handout for more information.



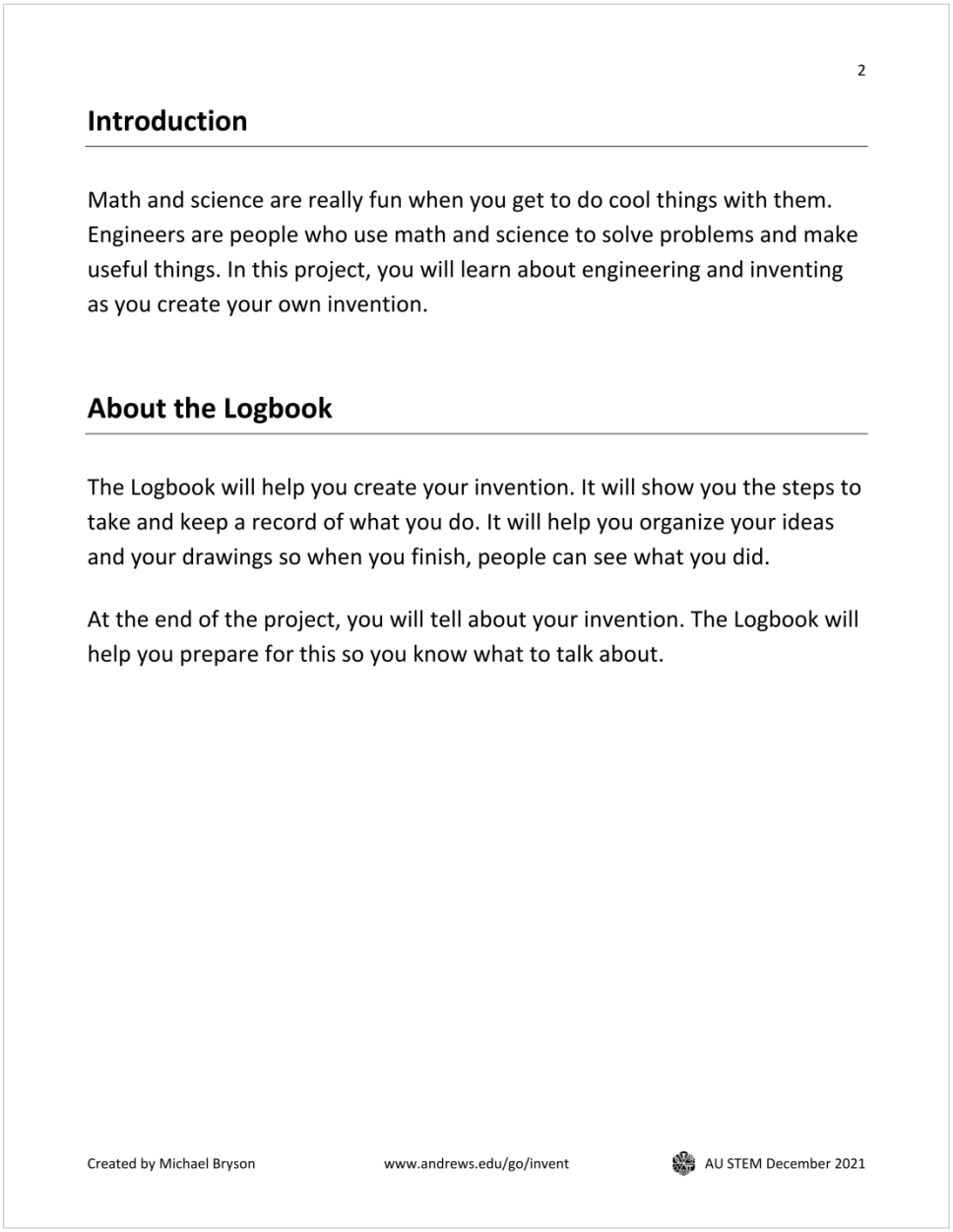
If you decide to use a composition notebook or other blank notebook instead of the provided Logbook, include the information from this page on the cover or first page of the notebook.

Even though you aren't participating in the NAD event, you should still keep a record of the work your class did. This can serve as an example for next year too!

Logbook Introduction

Read the introduction to your students or summarize it when you start the project.

Do not read the About the Logbook section to your students since you will be filling it out for the class.



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Introduction

Math and science are really fun when you get to do cool things with them. Engineers are people who use math and science to solve problems and make useful things. In this project, you will learn about engineering and inventing as you create your own invention.

About the Logbook

The Logbook will help you create your invention. It will show you the steps to take and keep a record of what you do. It will help you organize your ideas and your drawings so when you finish, people can see what you did.

At the end of the project, you will tell about your invention. The Logbook will help you prepare for this so you know what to talk about.

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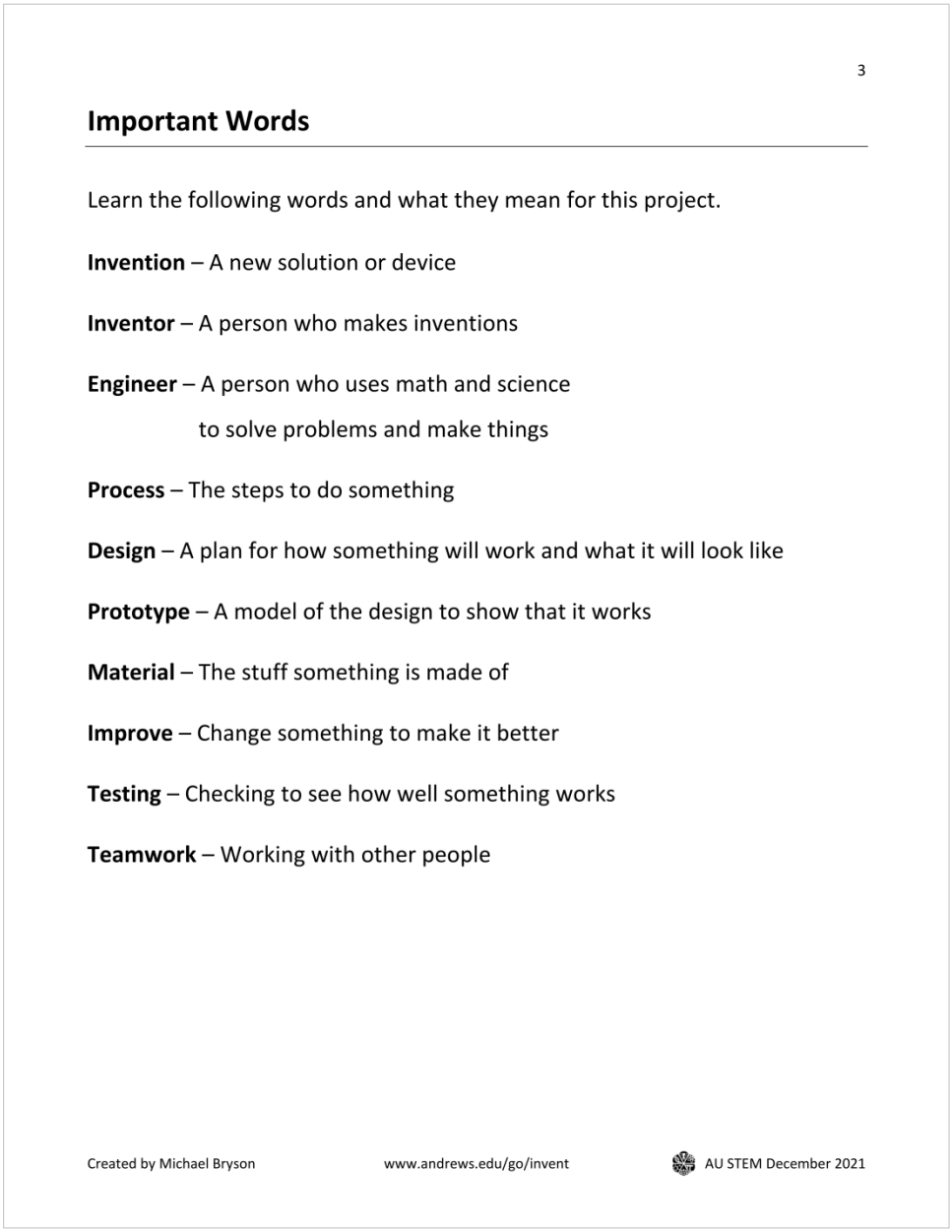
Vocabulary

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 Words

Learn the following words and what they mean for this project.

Invention – A new solution or device

Inventor – A person who makes inventions

Engineer – A person who uses math and science to solve problems and make things

Process – The steps to do something

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

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

Material – The stuff something is made of

Improve – Change something to make it better

Testing – Checking to see how well something works

Teamwork – Working with other people

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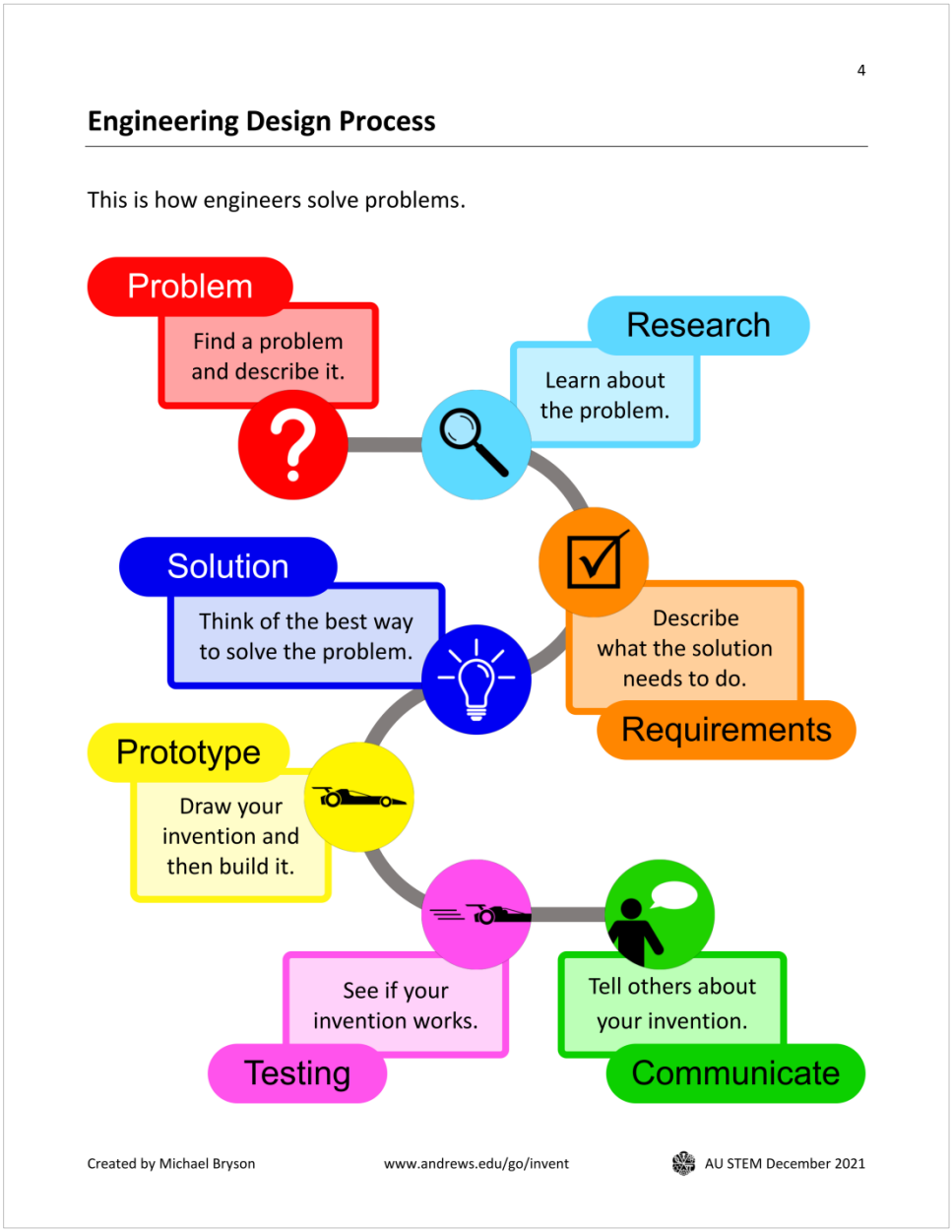
Engineering Design Process

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 you to follow as your class develops the invention.

This engineering design process diagram is also available as a separate document you can print or refer to in class. In addition, we have a simplified version that leaves off the descriptions.

Problem

Find a Problem:
Start by choosing a problem to solve as a class. You can either pick the problem yourself or ask the class for suggestions.

If you decide to find a problem together, start with a class discussion. Use the prompts to help your students identify problems or challenges to solve with an invention (something they can build).

- What problems can you find around your home, school, etc.?
- Ask your parents or grandparents.
- Do your pets have any problems?
- What things are difficult for you or others to do?
- What problems can you find in nature?

Take it a step further by having students ask their family and look for problems at their house (worksheets available for Kindergarten & Grades 1-2).

Choose & Describe the Problem:
Once your class has generated a good list of problems, pick the problem you think has the best chance of success and that your students are most excited about. Describe the problem in the class Logbook.

Research

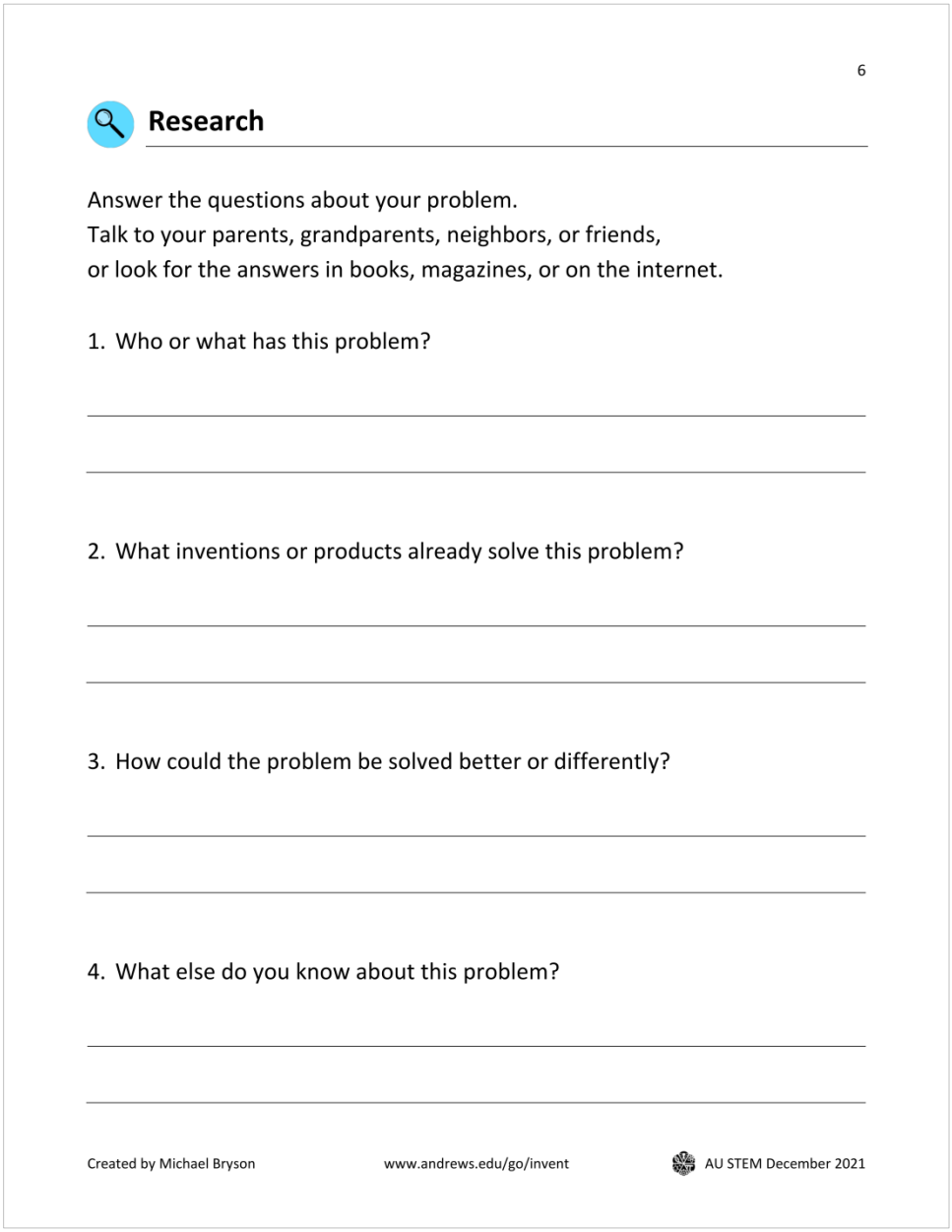
Do the Research:
Research can be covered in a simplified manner with younger students.

Research means finding the important details about a topic. It is important for this project because it helps you learn what you need to solve the problem.

Here are several ways you might complete this step with your students:

1. The teacher does some research about the problems and presents the findings to the students.
2. The students interview people about the problem (worksheet available).
3. Non-fiction picture books can be read aloud to learn more.

As a teacher, you might find other fun and creative ways of doing this step.



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Research

Answer the questions about your problem.
Talk to your parents, grandparents, neighbors, or friends,
or look for the answers in books, magazines, or on the internet.

1. Who or what has this problem?

2. What inventions or products already solve this problem?

3. How could the problem be solved better or differently?

4. What else do you know about this problem?

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Document your Findings:
Once the class has found the answers to the research questions, write the answers in the class Logbook.

Requirements

Listing the requirements is an important step in the process because they help you know what the solution needs to do.

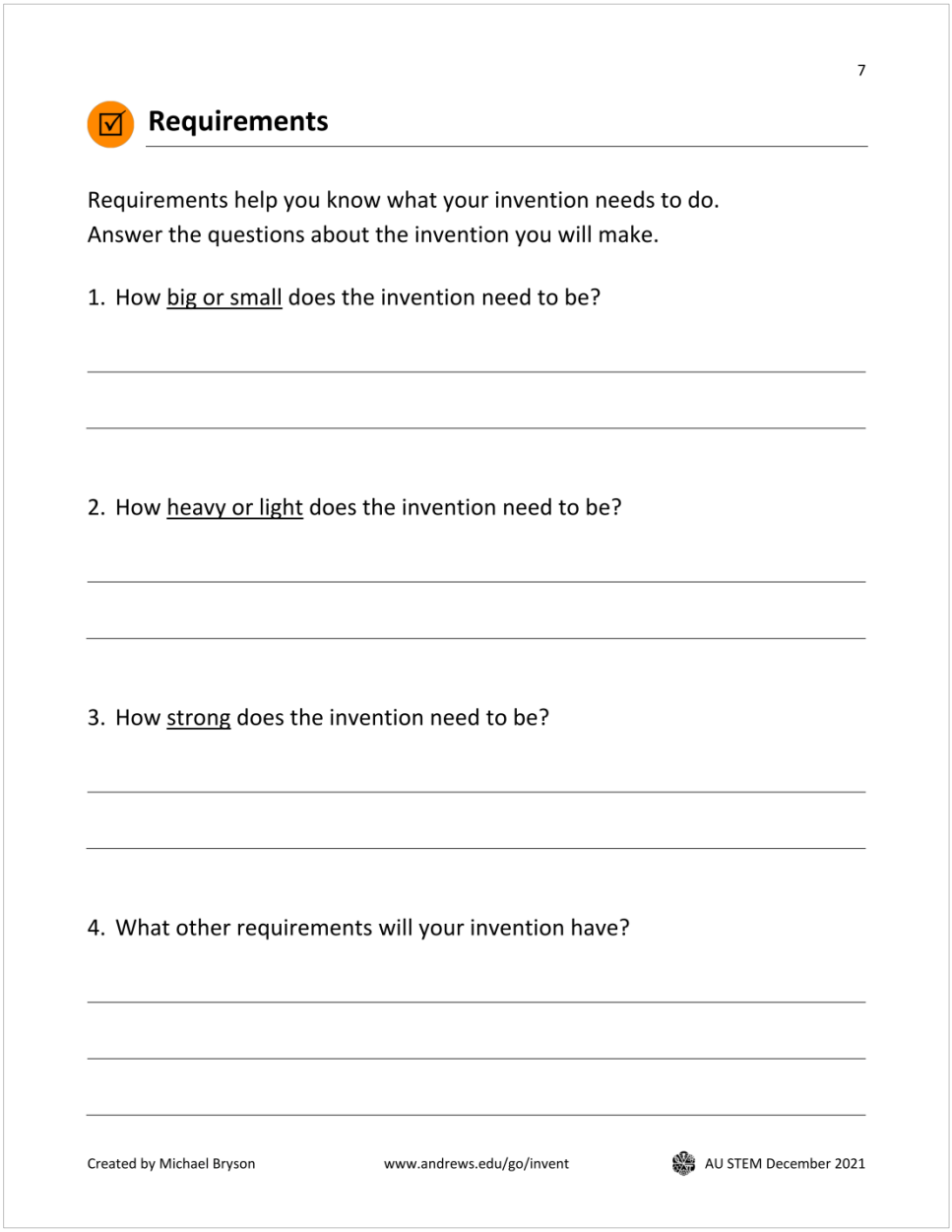
Example:
Suppose you or your friend keep falling off a bike.

You might have requirements such as:

- It must keep you from getting hurt badly.
- It must keep you from falling so much.
- It must be easy to use.
- It must work with any bicycle.

List the Requirements:
Discuss the problem and brainstorm together to identify the requirements for your solution, but don't choose a solution yet.

Start by answering the general questions for size, weight, and strength. Then think about any other requirements.



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Requirements

Requirements help you know what your invention needs to do.
Answer the questions about the invention you will make.

1. How big or small does the invention need to be?

2. How heavy or light does the invention need to be?

3. How strong does the invention need to be?

4. What other requirements will your invention have?

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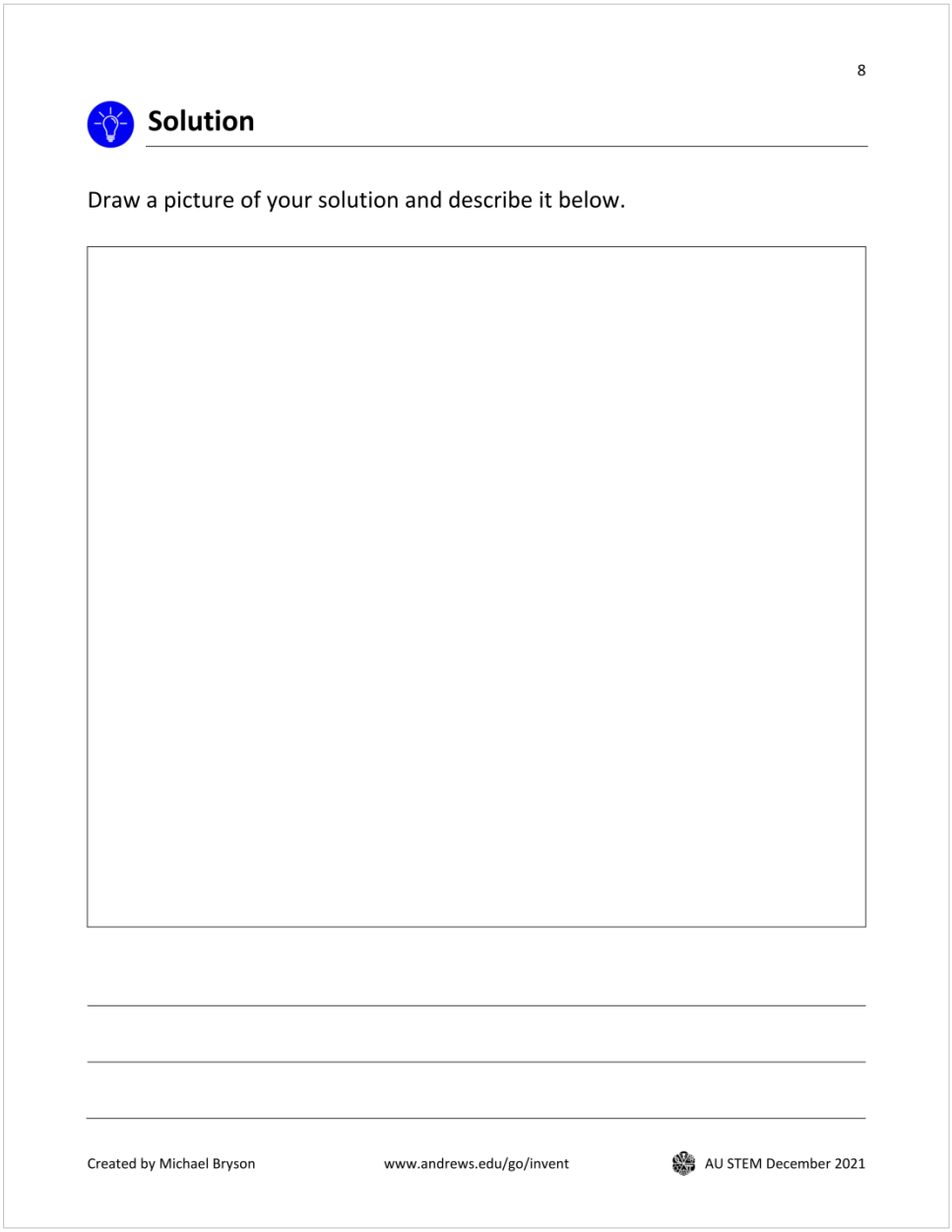
Other Requirements:
Size, weight, and strength apply to most problems, but there will be other requirements unique to your problem. Talk with the class and think about other things your invention will need to do. It may help to consider an extreme case. For example, the bike problem could be solved by wrapping yourself up in tons of bubble wrap, but obviously that isn't very practical! Instead, you might specify that it should be easy to use.

Solution

Find & Choose a Solution: When finding solutions, it is good to consider as many ideas as possible. There really are no bad ideas, because even a weird idea can help you think of something better.

1. Give the students some paper (or the provided worksheet) and have them each draw at least 1 solution to the class problem. Remind them that it should be something they can build.
2. Have the students share their ideas with the class or in small groups.

Example (from pg. 7): Encourage them to think of new solutions. With the bike problem, you wouldn't want to invent a padded box for your head or small pillows for your knees because helmets and knee pads already exist. Try to make something new.

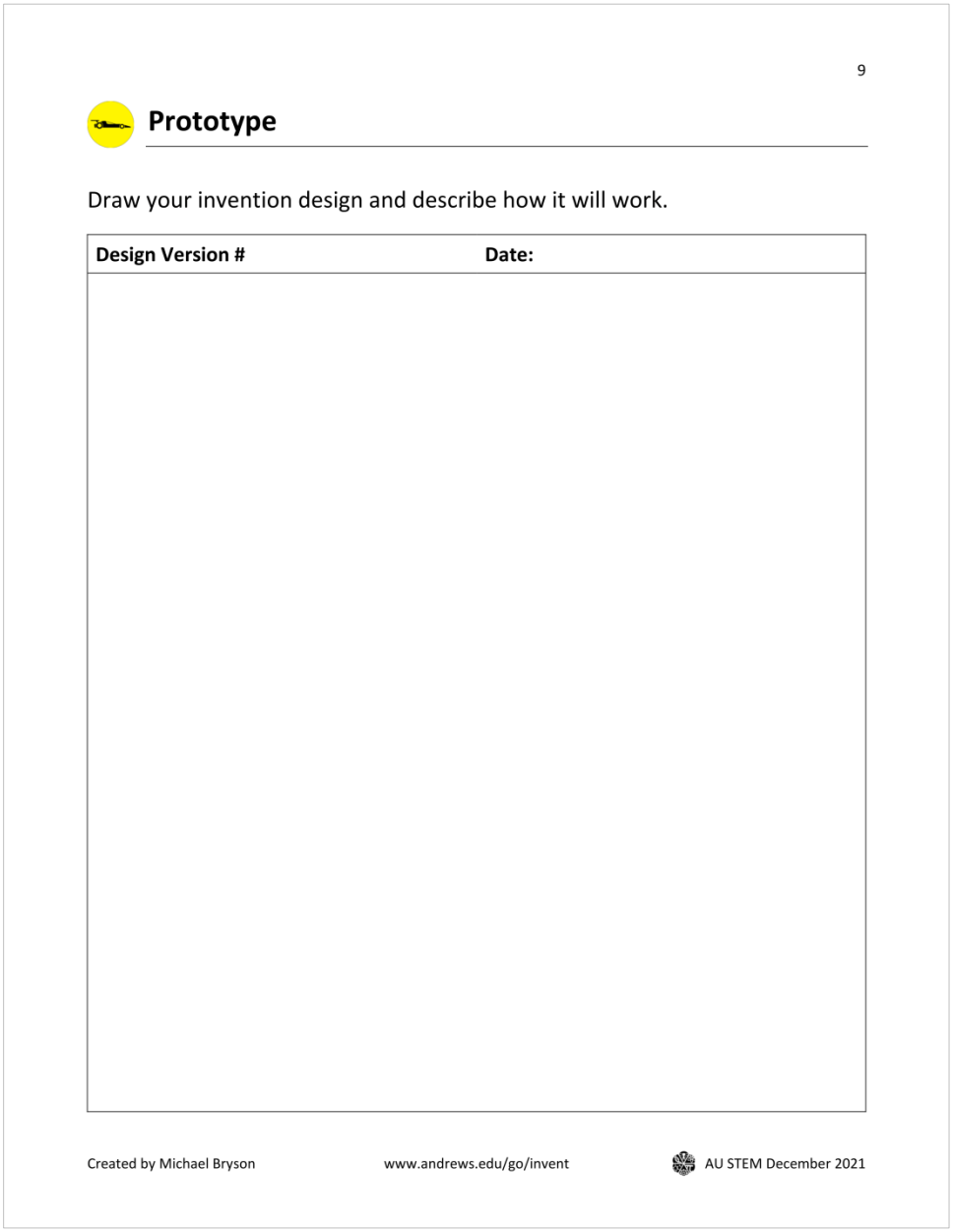


3. Discuss the proposed solutions. How are they similar or different? Which are the most practical? Can you combine ideas to make something better? Do they meet the requirements (pg. 7)?
4. Choose the solution you think is best (most practical, meets requirements, etc.). This can be one of the original ideas, a new idea, or a combination of ideas.
5. Draw the solution in the Logbook and write a brief description.

Prototype

Design the Prototype:
By this time, your students will be eager to start building the prototype, but first they need to design it. At the K-2 level, this may be very similar to the solution step, but you still need a detailed design of what the prototype will look like and how it will work.

1. Give the students some paper (or the provided worksheet) and ask them to sketch a design of the chosen solution. Use the questions on the next page to guide them.
2. Share the designs with the class and discuss as you did in the solution step. You could draw them on the board as you go.
3. Choose the best design or combine elements from different designs.
4. Draw the design in the Logbook and answer the questions on the next page.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Prototype

Draw your invention design and describe how it will work.

Design Version #	Date:

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Design Version:
In the box at the top, fill in the Design Version # and Date. This will distinguish between each version of the design. If you change the design or switch to a new design later on, print another copy of the prototype pages (worksheet available) and increase the version number (#2, #3, etc.).

Prototype (continued)

Design (continued):
As the students sketch their designs, prompt them with these questions and any others you feel are relevant. They should be free to draw as they imagine it, but asking them questions may help direct the process.

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

Narrow the Focus:
If the project becomes too large or complicated, you might scale it back a little or only build part of the design.

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

Remember: The prototype is only a model. It doesn't have to work perfectly.

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Prototype

Design Version #	Date:

1. How will your invention work?

2. What materials will you use to build it?

3. Will you need special tools to build it? YES NO

4. Will you need lots of room to build it? YES NO

5. Are there any other details you should include?

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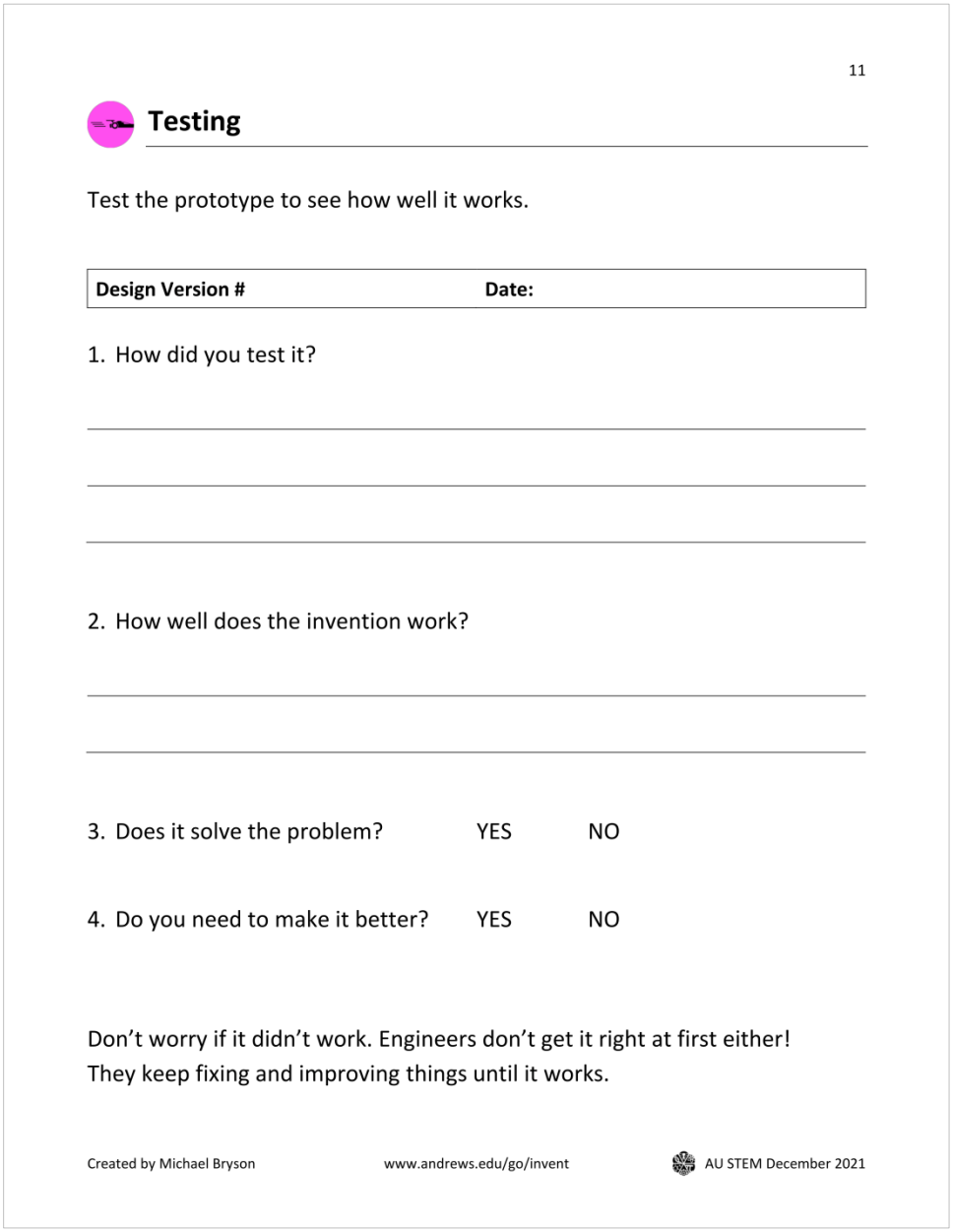
Build the Prototype:
Provide the students with inexpensive materials such as cardboard, paper, tape, glue, etc. (raid the recycle bin or the craft closet). Divide the tasks among the students (cutting, gluing, taping, etc.) and direct the process as they work together. Challenge them to think outside the box and find creative solutions as they build the invention. If the class is large, you may want to divide them into smaller groups of 3-4 and have each group build the same invention.

Testing

Test the Prototype:
Testing is important because it tells you if you succeeded or if you need to change things. At the K-2 level, testing can be as simple as making the invention do what it's supposed to do and see what happens. Did it work? If not, what needs to change?

Use the provided questions to help your students assess the prototype and find areas for improvement. Write the answers in the Logbook.

Fill in the Design Version # and Date at the top to keep track of which version the test was for. If you change the design or switch to a new design, you will need to test it again. Print another copy of the testing page (worksheet available) and write the new design version number.



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Testing

Test the prototype to see how well it works.

Design Version #	Date:

1. How did you test it?

2. How well does the invention work?

3. Does it solve the problem? YES NO

4. Do you need to make it better? YES NO

Don't worry if it didn't work. Engineers don't get it right at first either! They keep fixing and improving things until it works.

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Improvement:
After testing, you will likely need to fix things. Remind the students 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 you change the design, remember to increase the Design Version number (#2, #3, etc.).

Communicate

Prepare to Present:
Your students are not required to present at an event, but it is still a valuable experience for them to present their work to an audience. This can be done at a school assembly, science fair, invention fair, parent night, etc.

Answer the questions (shown here) to use as an outline for the class presentation.

During the presentation, the students should answer the questions about the class project. You might let them explain on their own or you could ask the questions interview style.

In addition to the verbal presentation, you may want to prepare a tri-fold board or similar display to showcase the class project.

While you are not required to follow the Presentation Guidelines, you may find them useful as you prepare for the class presentation.


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Communicate

1. What was the problem?

2. What was your solution?

3. How did you make your invention?

4. How does it work?

5. Did it solve the problem? YES NO

6. What Bible lesson did you learn from this? (stories, people, or lessons)

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Biblical Connection:
If your students have not already thought of a biblical connection to the project, encourage them to think of their favorite Bible story, character, or a verse that comes to mind. This biblical connection should relate to the project in some way (theme, lesson, etc.). Alternatively, you could choose one for the class, but the students may benefit more from finding one themselves. For examples, see the Biblical Connection section in the Teacher Resources on our website.