Logbook

Invention Logbook

Grades K-2

Teaching Edition

Small-Group 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

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 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 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.

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.

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 small-group option, but if you need the whole-class option, you can find that on our website.

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.
  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.
- 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.

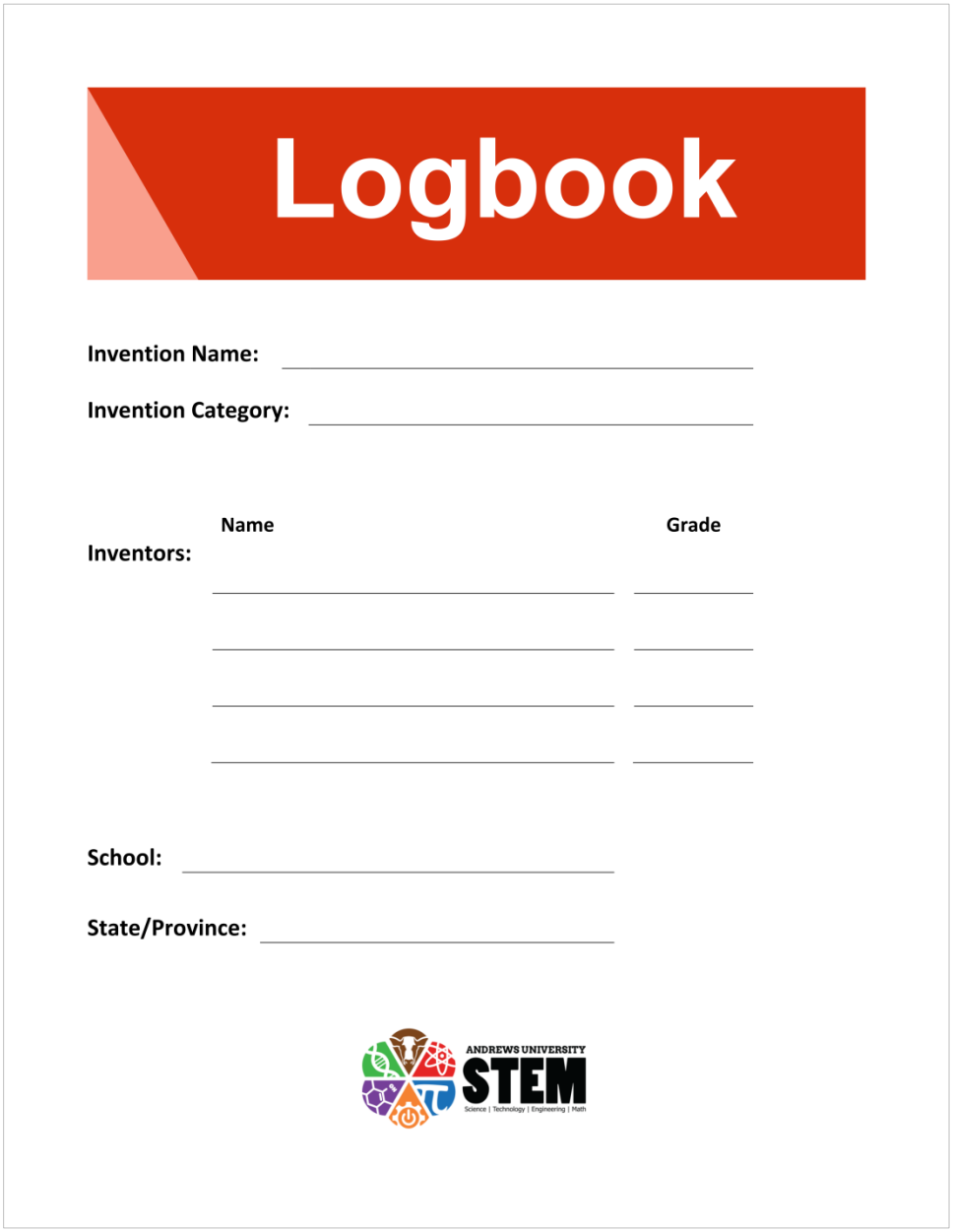
If you have any questions about the project guidelines or feel that the project deserves an exception to the above Requirements & Restrictions, the teacher may contact us at stemconnect@andrews.edu.

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:
Help your students 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

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. Then at the end, you will turn in the Logbook for grading.

Signatures

Statement of Originality:
Students are encouraged to identify original/unique invention ideas for their project. This is emphasized more at the higher grade levels, but you can still introduce it with your students.

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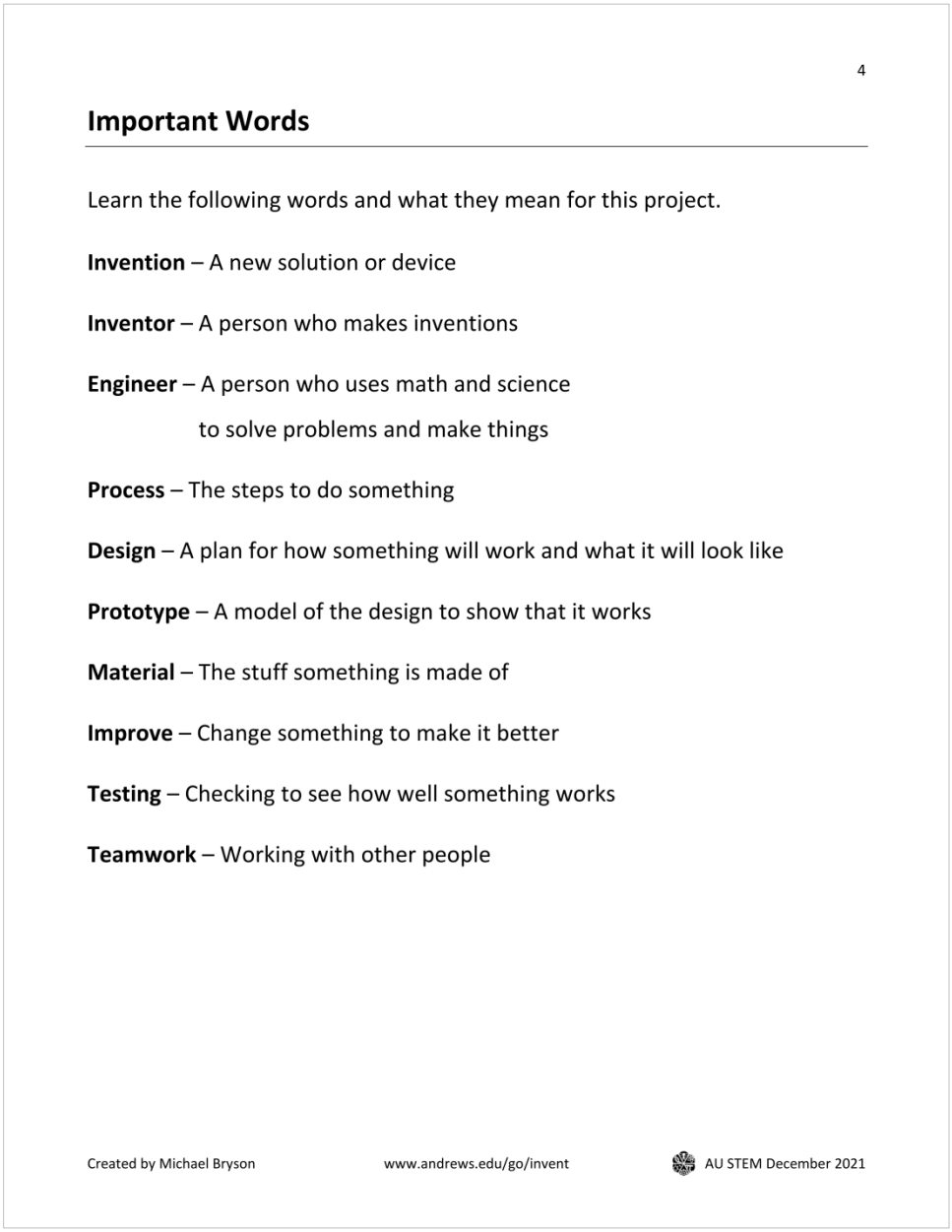
Teacher's Signature:
Once your students choose a solution to their problem, discuss it with them to make sure it meets the Project Guidelines (pg. iii). Once you are satisfied, sign off on the idea. You may need to check again after they build the prototype and whenever they revise the design.

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 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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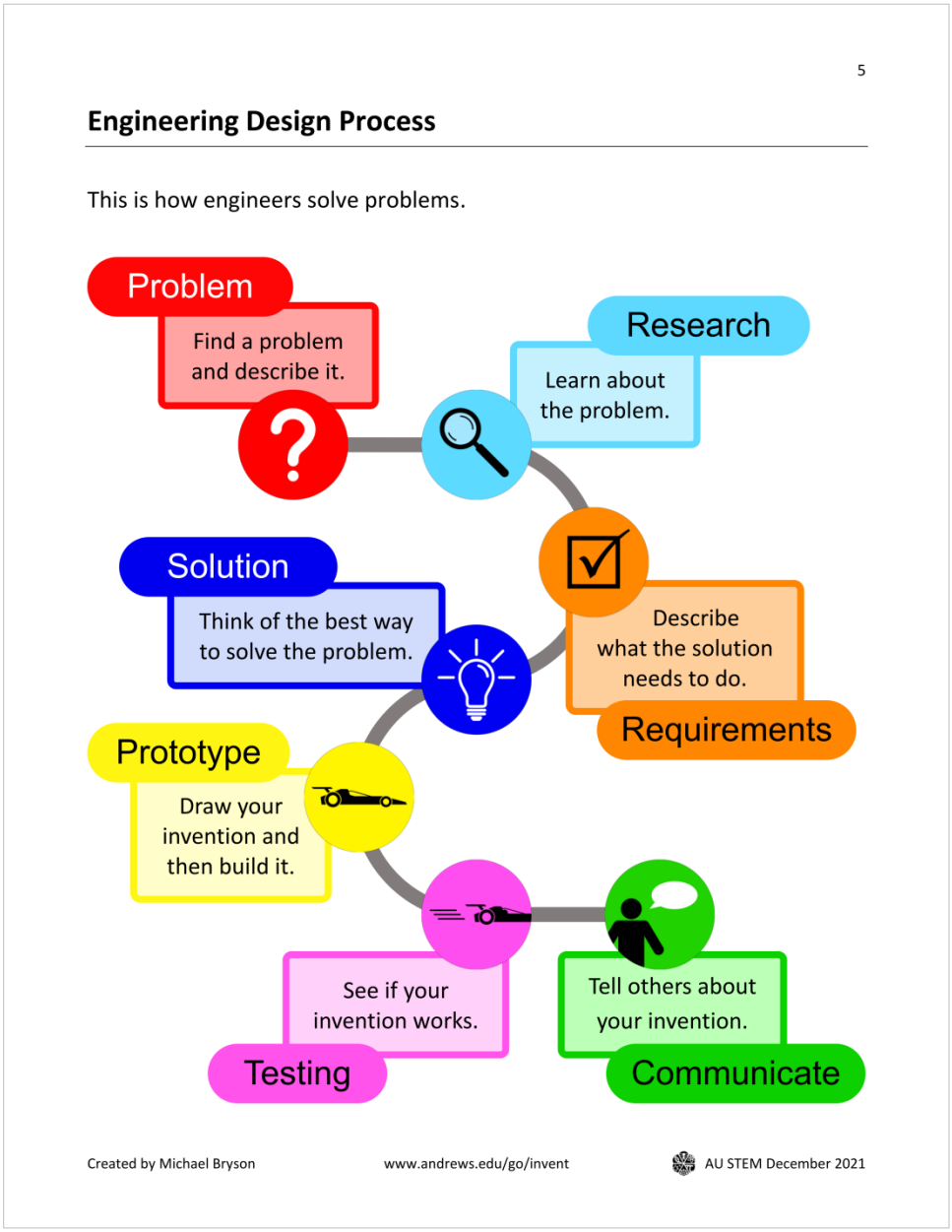
Engineering Design Process

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 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. In addition, we have a simplified version that leaves off the descriptions.

Problem

Find a Problem:
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?

We recommend you complete this step as a class. You might have a class discussion and list the problems on the board.

It may help if the students find problems on their own first. They can ask their family and look for problems at their house (worksheets available for Kindergarten & Grades 1-2). Have them share what they found with the class.

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

Divide the class into groups of 3-4 and assign the problems or let the groups choose one from the list (each group needs a different problem). Help the students describe their problem in the Logbook. The students will stay in these groups for the rest of the project.

Research

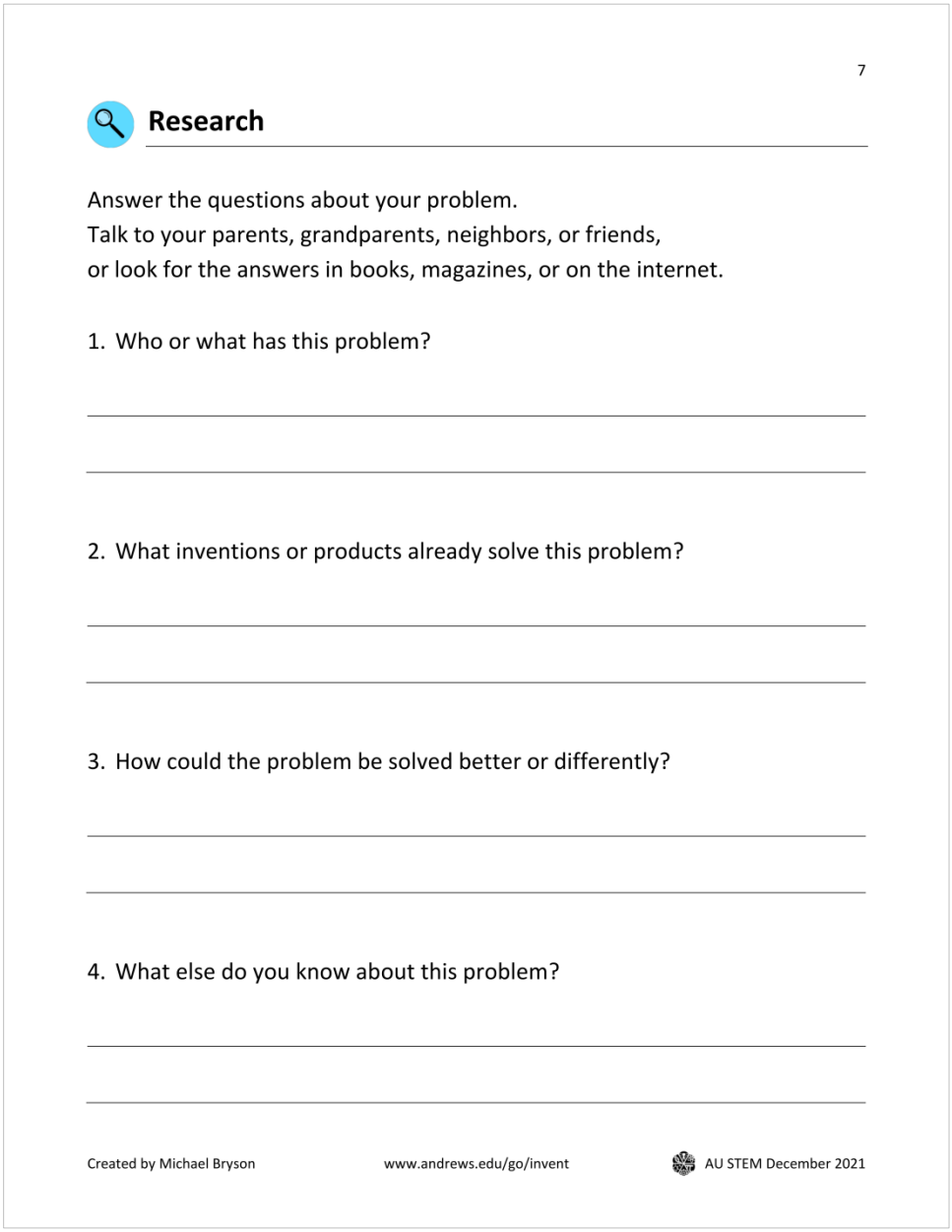
Do the Research:
Research can be covered in a simplified manner with younger students.

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 provides 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 your students have the answers to the research questions, help them write the answers in their Logbook.

Requirements

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

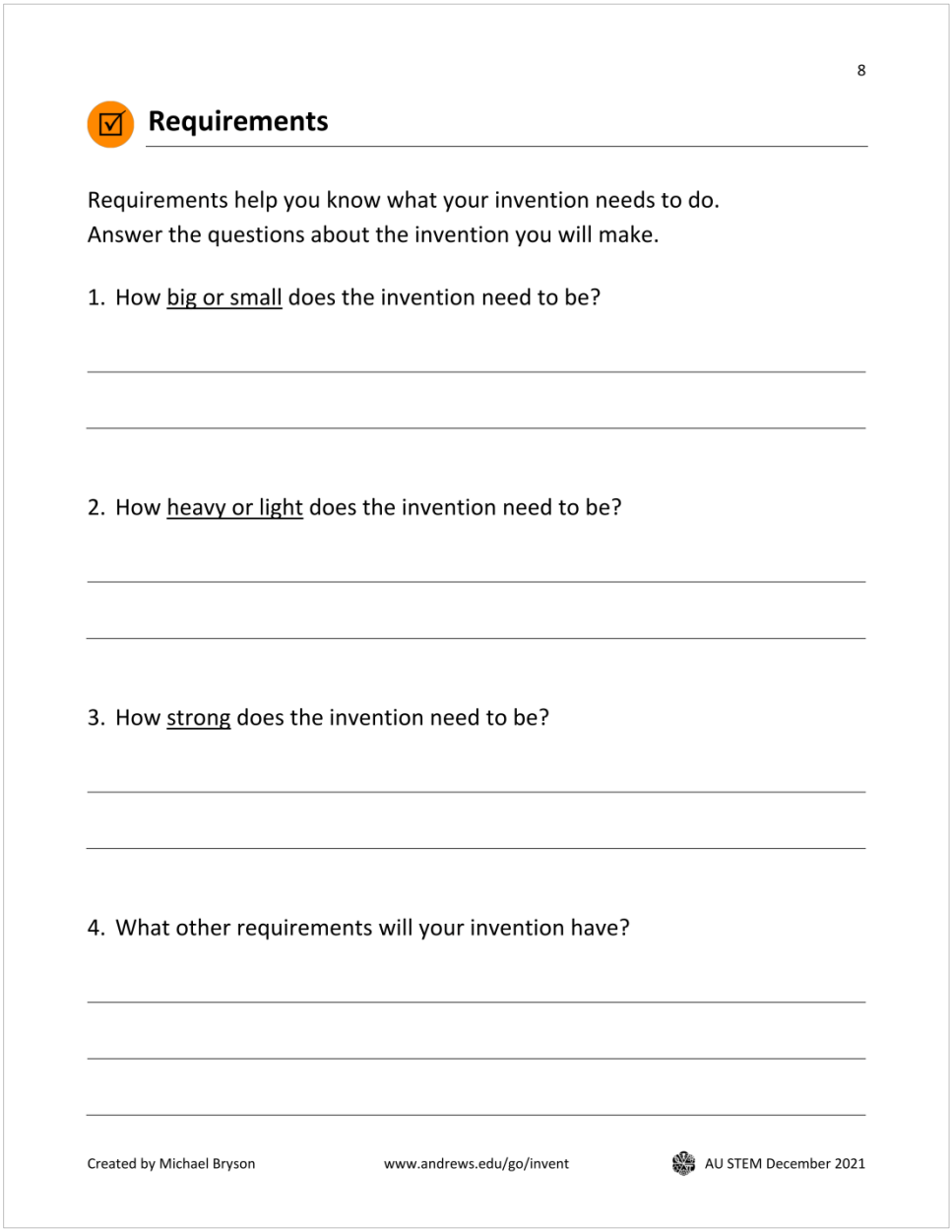
Example:
Suppose you or your friend keep falling off a bike.

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:
Talk with your students together as a class or let them talk in their groups.

Help your students answer the questions to list the requirements for each problem. Then, help them write the answers in their Logbook.



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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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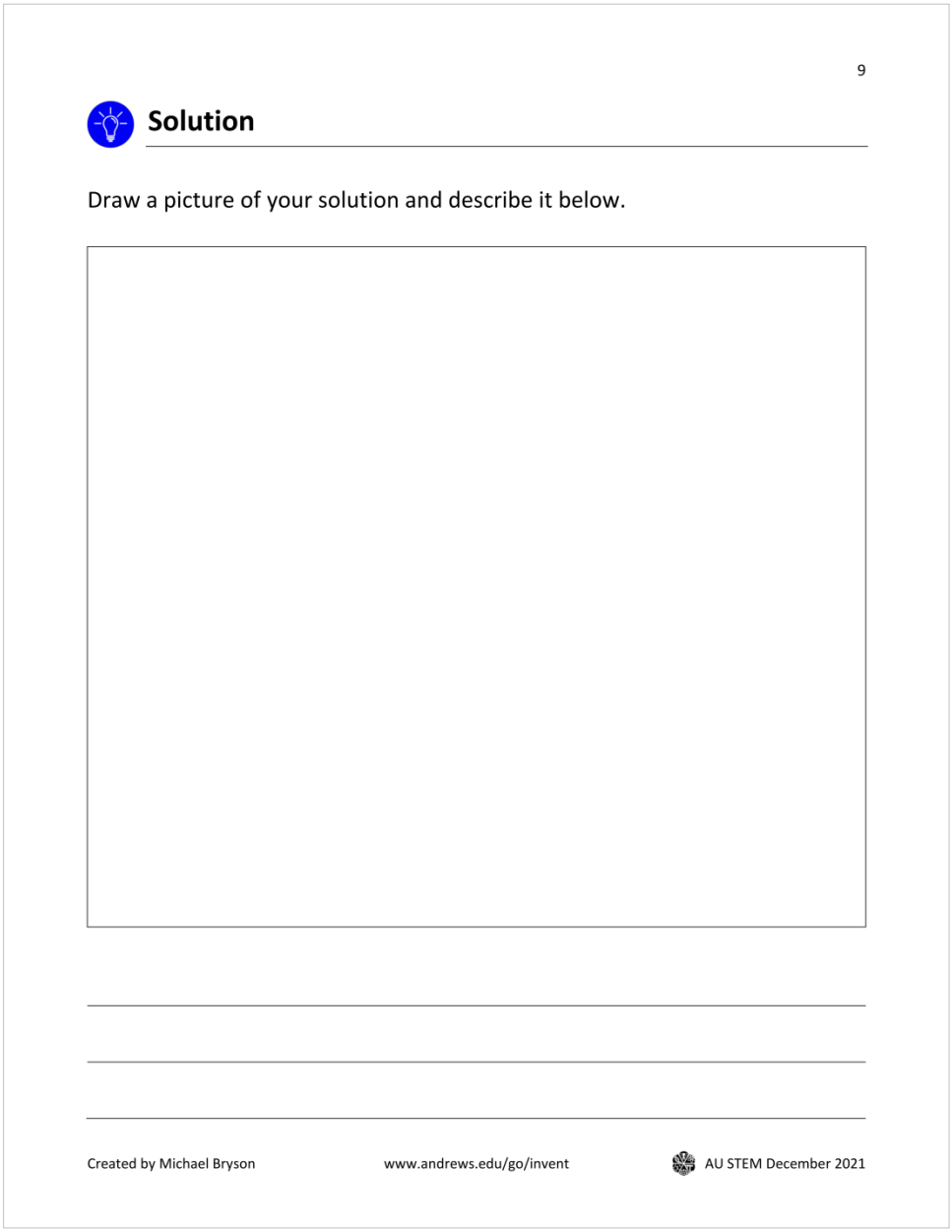
Other Requirements:
Size, weight, and strength apply to most problems, but there will be other requirements unique to each problem. Help your students think about the important things their invention will need to do, without choosing a design just yet. It may help to consider an extreme case. For example, 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: By now, your students should understand their problem and the sort of questions they need to ask. Let them start working independently in their groups.

1. Give the students some paper (or the provided worksheet) and have them each draw at least 1 solution to their group's problem. Remind them that it should be something they can build.
2. Have the students share their ideas with their teammates. There are no bad ideas at this point.

Example (from pg. 8): 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.



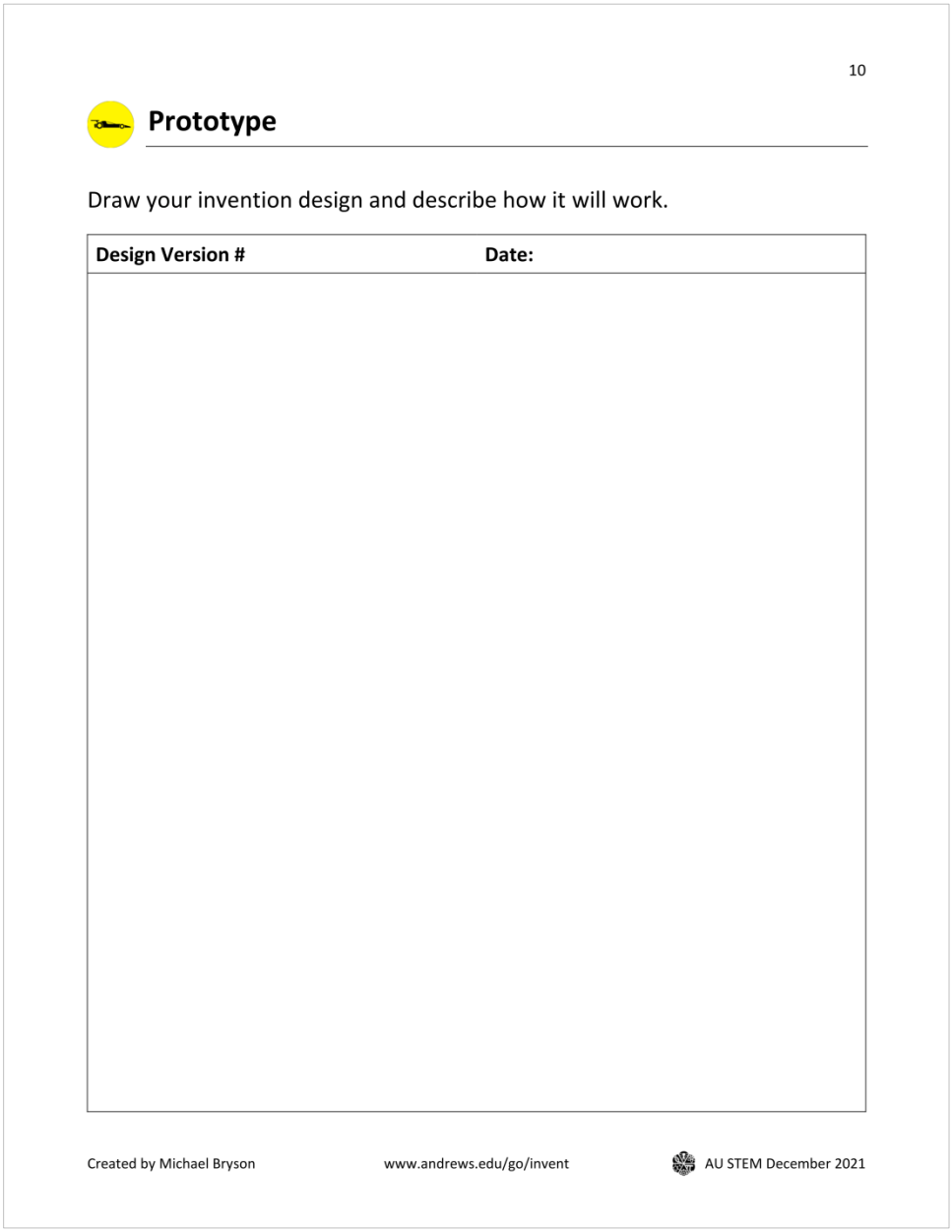
3. Ask each group to choose a solution together. This can be one of their original ideas, a new idea, or a combination of ideas. The solution they choose needs to meet their requirements (pg. 8).
4. Have each group draw their chosen solution in the Logbook and help them write a brief description.
5. Compare each group's solution with the Project Guidelines (pg. iii) and sign on page 3 to approve it.

Prototype

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

Depending on how collaborative your students are, here are some ways you might do this step:

1. Have the students work in their groups to create their invention design. Each group should make a single plan and drawing together in their Logbook.
2. Have each student sketch their own design of the solution their group chose (worksheet available), share it with their group, discuss, and then combine their ideas as in option 1.



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 the students change their design or switch to a new design, print another copy of the prototype pages (worksheet available) and increase the version number (#2, #3, etc.).

Prototype (continued)

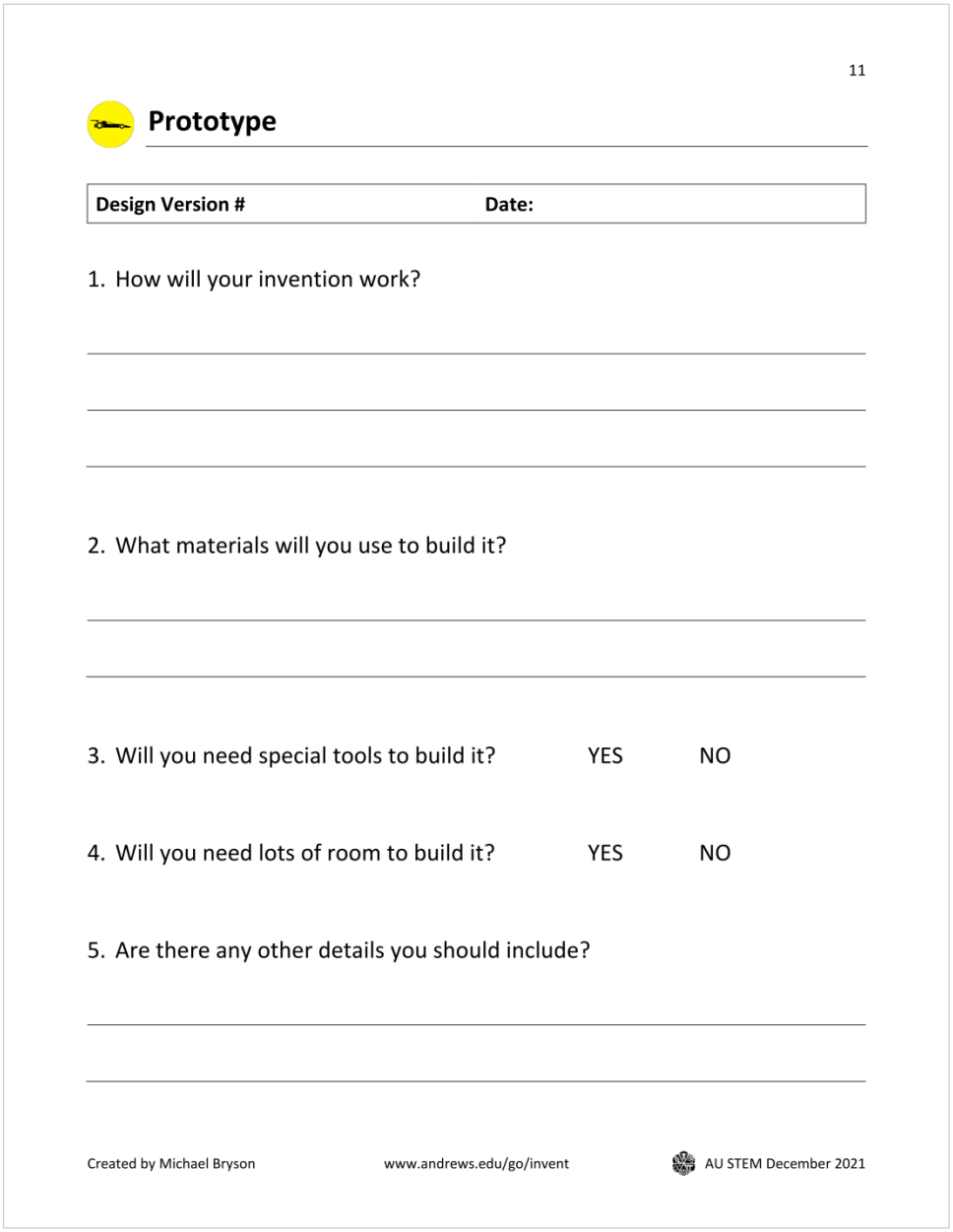
Design (continued):
As the students plan, prompt them with these questions and any others you feel are relevant. They should do as much as possible on their own, but asking them questions may help direct the process.

After they finish, help them write the answers in their Logbook.

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:
Students may attempt something too big or complex. Don't limit their creativity, but if they are struggling, you might help them scale it back a little.

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



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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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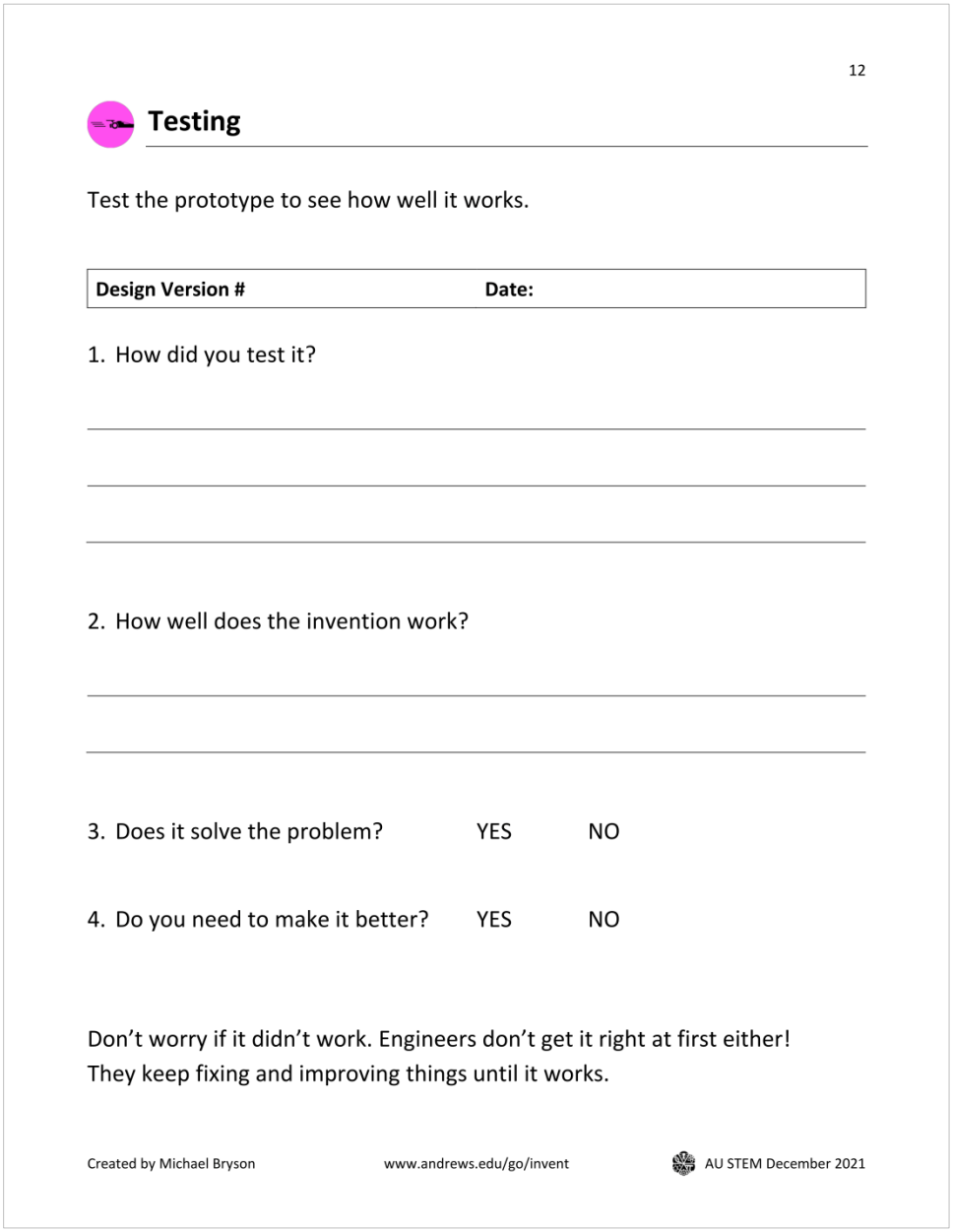
Build the Prototype:
Students should work in their group to build their invention. Remind them that the prototype is only a model. It doesn't have to be perfect or even fully functional. Provide them with inexpensive materials such as cardboard, paper, tape, glue, etc. (raid the recycle bin or the craft closet). If they want to use other materials, that's fine as long as they meet the Project Guidelines. Challenge them to think outside the box and find creative solutions as they build their inventions.

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 their prototype and find areas for improvement. Help them fill out the answers in their Logbook.

Fill in the Design Version # and Date at the top to keep track of which version the test was for. If the students change their design or switch to a new design, they 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, 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.).

Communicate

Prepare to Present:
Each group will need to 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. *See the Presentation Guidelines handout for more information.*

For the verbal presentation, help your students answer the questions (shown here) about their project. These will form the outline for their verbal presentation. *See the Presentation Guidelines handout for more information.*

During the presentation, the students should be prepared to answer the questions about their project. You can either let the students explain the project on their own (following the provided outline) or you can ask them the questions interview style.

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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 their project, encourage them to think of their favorite Bible story, character, or a verse that comes to mind. This biblical connection should relate to their project in some way (theme, lesson, etc.).

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