Name_____

Toxic Beans – Sample Project

Purpose

Earlier, you learned how John Deere used the engineering design process to develop a moldboard that efficiently plowed the soil. People use the engineering design process to solve problems in agricultural mechanics to develop new and improved materials, tools, and machines that make complex or time-consuming tasks easier to accomplish. The process requires communication and teamwork to come up with the best solution.

When you encounter a problem, how can you use the engineering process to solve a problem while working as a team?

Materials

Per group of four students:

- (2) Cans, coffee
- Dry beans
- Hula hoop
- Inner tube, bike tire, 18”
- (8) Clothesline pieces, 4’
- Device with timer

Per student:

- Pencil
- *Agriscience Notebook*
- *APT Engineering Report Template*

Procedure

Use the engineering design process to develop a tool to complete a simple task in a challenging environment. Use your creativity and communicate with your team to complete the challenge and solve the problem.

Part One – The Challenge

A container of beans with a highly toxic chemical has contaminated an area. The container holding the beans is not stable and cannot hold the contaminated beans. The beans have contaminated an area that includes a two-foot radius around the container. You cannot enter this area on the ground or in the air without being contaminated. Luckily, there is a container in the toxic zone that can safely hold the beans. This container will prevent any more contamination from occurring. Your team’s job is to use the materials provided to develop a tool that can lift the container of beans and pour them into the safe container.

Your instructor will review the *APT Engineering Report Template* and *APT Engineering Evaluation Rubric* outlining the expectations of this project.

Remember the following limitations.

- You can only use the materials provided to you by your instructor.
- You cannot physically go into or over the contaminated zone at any time.
- You must use the design process with your team to complete the project.
- You have only five minutes to complete the task once your tool is in the contaminated area.
- Use the engineering design process with your team to complete the project

Part Two – Using the Engineering Process

1. The first part of the process is to identify the problem. Record the problem you and your team identify on the *APT Engineering Report Template*.
2. Next, your team must agree on the requirements to solve the problem. Discuss the requirements your design must meet and record them in the space provided on the *APT Engineering Report Template*.
3. You and your teammates need to develop solutions that meet the requirements. Sketch and describe your solution to this problem on the *APT Engineering Report Template*. You will share your idea in the next step. You can use the following materials.
    - 18-inch inner tube bike tire
    - 8 four-foot pieces of clothesline
4. Discuss your solution with your team to decide on a design. Discuss all team member's ideas with your teammates and determine your prototype features.
5. Draw and describe the prototype your team will be constructing, including a list of materials on the *APT Engineering Report Template*.
6. Once you have decided on a prototype, have your teacher approve it and provide you with the materials you listed.
7. Build the prototype with your team and record the procedure for construction.
8. Set up the scenario with the hula-hoop marking the contaminated area along with the container of toxic beans and the safe empty container placed in the center of the hula-hoop, as seen in Figure 1.

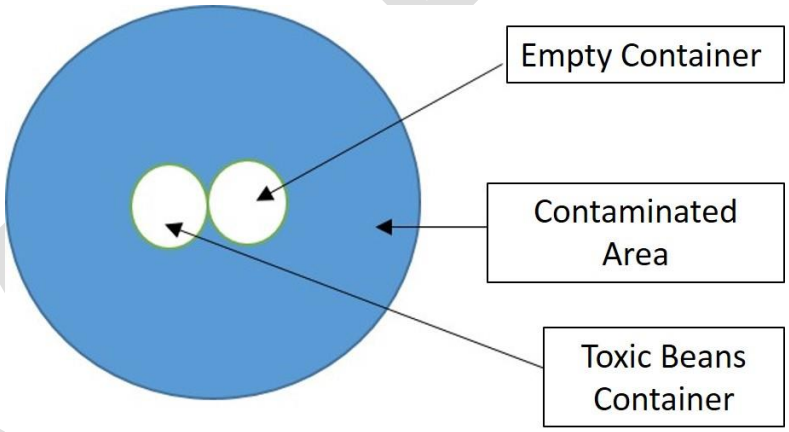

Figure 1. Scenario Setup

9. Test your prototype to see if it meets all requirements. Use the stopwatch to measure the time it takes your team to complete the task. Record the time it takes for you to complete the task.
    - Time:_____
10. Discuss with your team how well the prototype worked. Decide what changes your team should make to improve your prototype.
11. Make and record those changes on the *APT Engineering Report Template*.
12. Test your team's prototype again and record the time it takes to complete the task and how well your tool works.
    - Time:_____
13. Return all materials as instructed by your teacher.
14. Use the *APT Engineering Report Template* to write a final report for your team's design. Your final report is due in two days.

Name_____

APT Engineering Report Template

Title

What is the name or title of the problem for your report?

Problem

What is the problem you are trying to solve? How will the solution be measured?

Criteria

What requirements are needed to determine if you have solved the problem?

Solution

What is your solution to the problem? Describe your prototype.

Materials for Prototype

- List the supplies need to construct the prototype.

Procedure for Building Prototype

1. List the steps for constructing your prototype here.

Test and Evaluation

Explain how you will test your prototype to determine if it meets your criteria.

Analysis and Results of Tests

Explain your results of testing your prototype. Compare your results to the criteria. Be descriptive and complete in your discussion.

Conclusion

Based on the results, what inferences can you make? Describe how your prototype did or did not meet your set criteria. What were the possible sources of error? What new design problems or solutions arise based on your results?

Sample Teacher Notes

Students practice using the engineering design process to develop a tool to lift a container of beans and pour them into another container while meeting specific criteria.

Teacher Preparation

1. Before class, cut the clothesline into forty 4′ lengths.
2. Students use hula-hoops to mark a contaminated zone they cannot enter. If you do not have hula-hoops to mark the contaminated zone, you can use masking tape.
3. Assign students to groups of four to complete the project.

Student Performance

Part One

Students review the *APT Engineering Report Template* before starting. Set the scenario and limitations for completing this task.

- Students can only use the materials you provide.
- Students cannot physically go into or over the contaminated zone at any time.
- Students have only five minutes to complete the task once their tool is in the contaminated area.
- Students use the engineering design process with their team to complete the project.

Part Two

Emphasize the engineering design process during the project. Students use the *APT Engineering Report Template* to record their notes and draw their prototypes. Do not provide the materials to the groups until you approve a design.

Once you have approved the design, students construct and test their design. They have one chance to improve their design. You should explain that the redesign process is continuous, but for this project, they only get one chance for improvement. The first design serves as the prototype.

Results and Evaluation

The solutions for this project vary. The tool needs to lift and tip the container to spill the beans into the empty container. Students can use the tire tube like a rubber band to compress around the container by attaching ropes to the tire tube and stretching it with the ropes. They could also fold the tube into smaller circles until it is smaller than the container and then use the ropes to stretch the tube around the container. Students can maneuver the ropes tied to the tube to tip the container over and pour the beans into the empty container. Figure 2 shows a possible solution.

Figure 2. Example Toxic Beans Solution

After the students have completed the project, they complete a report using the *APT Engineering Report Template*.

Sample Project

This sample is a modified version of *Project 1.1.5 Toxic Beans* from the CASE 4 Learning *Ag Power and Technology* (APT) curriculum. For more information about the course visit **www.case4learning.org**. The sample has been modified for time and material simplification to fit a workshop format and is not for resale or profit. Teachers are permitted to use this sample in their classroom without certification.

Contact **CASE 4 Learning** to receive permission to use this sample at a teacher professional development.

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Mission

To design industry-leading, inquiry-based curriculum and teacher education to create lifelong learners and prepare students for the future of agriculture.

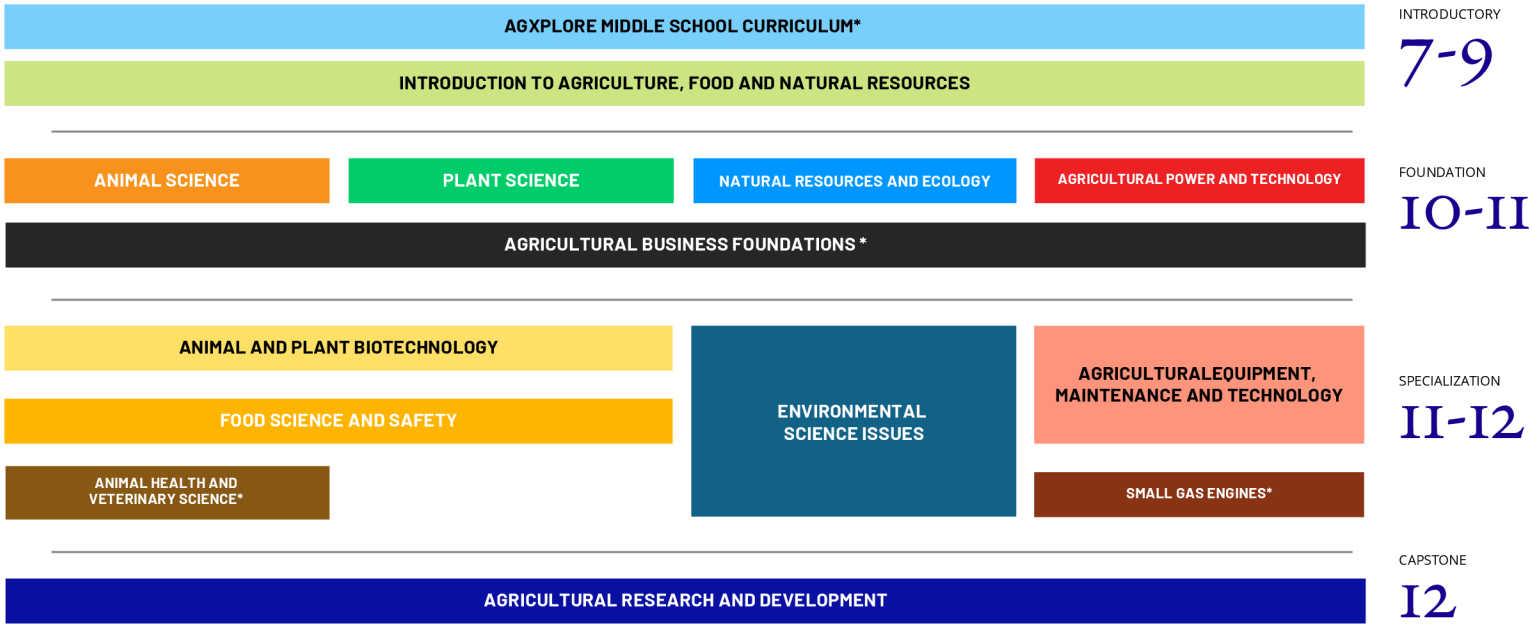
Purposeful Curriculum

CASE has sequenced courses at four levels that enhance the delivery of agricultural education through inquiry-based learning and technical skills.

Standards Aligned

CASE develops curriculum with industry feedback and aligns courses to National Agriculture, Food, & Natural Resources and Career & Technical Education standards.

Courses and Instruction Levels



Professional Development and Lifetime Certification

CASE 4 Learning enhances agricultural education with inquiry and project-based learning to prepare the next generation of the agricultural workforce through teacher certification and professional development.

CASE Institutes

Professional development events preparing teachers to implement full-year CASE courses. Institutes provide teachers the content and skills needed to use CASE curricula in their classroom. CASE Institutes range from five to eight days in a hybrid, in-person, or virtual format.

BriefCASEs *

Professional development for shortened CASE courses or modules. BriefCASEs range from one to three days.

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Corporate sponsors and donors throughout the agriculture industry support CASE teachers through funding material implementation grants and professional development scholarships. Teachers are eligible to apply in the fall to fund their programs in the following year.

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Teachers attend the entire training at the host site.

Virtual
Teachers attend the entire training online. Teachers will receive materials via mail, and are responsible for their lab space.

Hybrid
Teachers receive training both virtually and in-person based on the course.

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AGRICULTURAL POWER AND TECHNOLOGY

Course Description

Agricultural Power and Technology (APT) introduces students to mechanical and engineering career opportunities in the world of agriculture.

Students experience hands-on activities related to shop safety, project planning, design, fabrication, energy, machines, and structures. While enrolled in APT, students acquire the basic skills to operate, repair, engineer, and design agricultural structures and equipment. Throughout the course, students will apply physical science and engineering principles to agricultural mechanics.

Equipping teachers

- Specialization course
- Full year course
- Inquiry and project based instructional practices
- CASE Institute professional development

Engaging students

- Practice the engineering design process
- Develop a technical manual for tools and equipment
- Explore mechanical and engineering careers and technical skills.
- Demonstrate shop safety and tool operation
- Use science, technology, engineering, and math, to solve problems.

Instructional Units

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- Safety and Measurement
- Material Properties
- Fabrication
- Energy
- Machines and Structures
- Mechanical Applications

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CASE provides a comprehensive professional development experience, in addition to a work-life balance so teachers can best educate their students. Course work is adaptable and customizable based on teacher preference to fit all geographies and communities.

> "As an agriculture teacher, I'm always looking for new labs, units, and activities for my students. CASE does a great job of combining agriculture and science to explore why the world works the way that it does. The labs scaffold students from being introduced to a concept to solving problems independently."
>
> **- Mattie Mink, Kentucky**

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Engaging Students

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