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# PROTECT THE POLLINATORS

Challenge Guide

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## Challenge Rationale

Pollinator populations are shrinking, and several factors are contributing to this disturbing global trend. There are growing concerns as to what the impact will be on food production. Through this challenge, students will become more aware of the important role pollinators play in our daily lives and how to help protect the various populations. After thoughtful research, students will design, test and demonstrate a solution that will sustain or improve pollinator well-being.

# Establishing The Challenge

## Identify a Challenge

More than 90 species of U.S. specialty crops require pollination, and various animals, including bees, butterflies, moths, bats, and birds, are a critical part of the pollinator-plant ecosystem.<sup>1</sup> Pollinators affect 35 percent of the world's crop production.<sup>2</sup> There have been concerns regarding pollinator populations for decades. According to the United Nations, it's estimated there will be nearly 10 billion people on Earth by 2050.<sup>3</sup> Pollinators play an important role in food production that's essential to feeding the human population.

<sup>1</sup> United Nations, Department of Economic and Social Affairs. (2017, June 21). World population projected to reach 9.8 billion in 2050, and 11.2 billion in 2100. Retrieved from <https://www.un.org/development/desa/en/news/population/world-population-prospects-2017.html>

<sup>2</sup> United Nations, Food and Agriculture Organization. (2016, February 26). Pollinators vital to our food supply under threat. Retrieved from <https://www.fao.org/newsroom/detail/Pollinators-vital-to-our-food-supply-under-threat/>

<sup>3</sup> University of California, Berkley. (2006, October 25). Pollinators help one-third of world's crop production, says new study. Retrieved from [https://www.berkeley.edu/news/media/releases/2006/10/25\\_pollinator.shtml](https://www.berkeley.edu/news/media/releases/2006/10/25_pollinator.shtml)

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# Establishing The Challenge

## Challenge Question

What can we do to sustain or improve pollinator well-being?

### THIS SOLUTION MUST ADDRESS THE FOLLOWING NEEDS:

- Determine what might be causing the decline in the number of pollinators
- Provide a solution to maintain or sustain the population of a chosen species of pollinators

### SUCCESS WILL BE DETERMINED BY:

- Constructing a plan that incorporates methods to maintain or increase the population of a chosen pollinator population
- Estimating how sustaining or increasing the pollinator population will help feed a growing human population
- Producing and sharing a presentation that communicates knowledge gained

# Standards Addressed

## Next Generation Science Standards

[nextgenscience.org](http://nextgenscience.org)

- 5-LS2-1 Develop a model to describe the movement of matter among plants, animals, decomposers, and the environment.
- 5-ESS3-1 Obtain and combine information about ways individual communities use science ideas to protect the Earth's resources and environment.
- MS-ETS1-1 Define the criteria and constraints of a design problem with sufficient precision to ensure a successful solution, taking into account relevant scientific principles and potential impacts on people and the natural environment that may limit possible solutions.
- MS-ETS1-2 Evaluate competing design solutions using a systematic process to determine how well they meet the criteria and constraints of the problem.
- MS-ETS1-3 Analyze data from tests to determine similarities and differences among several design solutions to identify the best characteristics of each that can be combined into a new solution to better meet the criteria for success.
- MS-ETS1-4 Develop a model to generate data for iterative testing and modification of a proposed object, tool, or process such that an optimal design can be achieved.
- MS-PS1-3 Gather and make sense of information to describe that synthetic materials come from natural resources and impact society.
- MS-LS2-1 Analyze and interpret data to provide evidence for the effects of resource availability on organisms and populations of organisms in an ecosystem.
- MS-LS2-3 Develop a model to describe the cycling of matter and flow of energy among living and nonliving parts of an ecosystem.
- MS-LS2-4 Construct an argument supported by empirical evidence that changes to physical or biological components of an ecosystem affect populations.
- MS-LS2-5 Evaluate competing design solutions for maintaining biodiversity and ecosystem services.
- MS-ESS3-3 Apply scientific principles to design a method for monitoring and minimizing a human impact on the environment.
- MS-ESS3-4 Construct an argument supported by evidence for how increases in human population and per-capita consumption of natural resources impact Earth's systems.
- HS-ETS1-1 Analyze a major global challenge to specify qualitative and quantitative criteria and constraints for solutions that account for societal needs and wants.
- HS-ETS1-2 Design a solution to a complex real-world problem by breaking it down into smaller, more manageable problems that can be solved through engineering.

# Standards Addressed

## Next Generation Science Standards (cont.)

### [nextgenscience.org](http://nextgenscience.org)

- HS-ETS1-3 Evaluate a solution to a complex real-world problem based on prioritized criteria and trade-offs that account for a range of constraints, including cost, safety, reliability, and aesthetics, as well as possible social, cultural, and environmental impacts.
- HS-LS2-7 Design, evaluate, and refine a solution for reducing the impacts of human activities on the environment and biodiversity.
- HS-ESS3-1 Construct an explanation based on evidence for how the availability of natural resources, occurrence of natural hazards, and changes in climate have influenced human activity.
- HS-ESS3-2 Evaluate competing design solutions for developing, managing, and utilizing energy and mineral resources based on cost-benefit ratios.
- HS-ESS3-4 Evaluate or refine a technological solution that reduces impacts of human activities on natural systems.
- RST.11-12.9 Synthesize information from a range of sources (e.g., texts, experiments, simulations) into a coherent understanding of a process, phenomenon, or concept, resolving conflicting information when possible.

## Common Core Standards

### [corestandards.org/mathematics-standards](http://corestandards.org/mathematics-standards)

- CCSS.MATH.CONTENT.5.OA Write and interpret numerical expressions.
- CCSS.MATH.CONTENT.5.NBT Perform operations with multi-digit whole numbers and with decimals to hundredths
- CCSS.MATH.PRACTICE.MP2 Reason abstractly and quantitatively.
- CCSS.MATH.PRACTICE.MP4 Model with mathematics.

### [corestandards.org/english-language-arts-standards/](http://corestandards.org/english-language-arts-standards/)

- CCSS.ELA-LITERACY.W.5.7 Conduct short research projects that use several sources to build knowledge through investigation of different aspects of a topic.
- CCSS.ELA-LITERACY.W.5.9 Draw evidence from literary or informational texts to support analysis, reflection, and research.
- CCSS.ELA-LITERACY.W.6.2 Write informative/explanatory texts to examine a topic and convey ideas, concepts, and information through the selection, organization, and analysis of relevant content.

# Standards Addressed

## Common Core Standards (cont.)

[corestandards.org/english-language-arts-standards/](https://corestandards.org/english-language-arts-standards/)

- CCSS.ELA-LITERACY.W.7.2 Write informative/explanatory texts to examine a topic and convey ideas, concepts, and information through the selection, organization, and analysis of relevant content.
- CCSS.ELA-LITERACY.W.8.2 Write informative/explanatory texts to examine a topic and convey ideas, concepts, and information through the selection, organization, and analysis of relevant content.
- CCSS.ELA-LITERACY.SL.9-10.4 Present information, findings, and supporting evidence clearly, concisely, and logically such that listeners can follow the line of reasoning and the organization, development, substance, and style are appropriate to purpose, audience, and task.
- CCSS.ELA-LITERACY.W.9-10.7 Conduct short as well as more sustained research projects to answer a question (including a self-generated question) or solve a problem; narrow or broaden the inquiry when appropriate; synthesize multiple sources on the subject, demonstrating understanding of the subject under investigation.
- CCSS.ELA-LITERACY.W.11-12.7 Conduct short as well as more sustained research projects to answer a question (including a self-generated question) or solve a problem; narrow or broaden the inquiry when appropriate; synthesize multiple sources on the subject, demonstrating understanding of the subject under investigation.



# Guiding The Challenge

Each Purple Plow Challenge can be implemented in a variety of methods, time frames, and programs. Follow the steps below to help determine how this challenge will best fit the current situation and educational environment.

1. **REVIEW** the Purple Plow “Design Process” (next page) and the “Lesson Packet” documents. Note that the lessons are encouraged but not required.
2. **EXAMINE** the suggested timeline to determine ways to integrate the challenge and lessons to fit your needs.
3. With the time frame in mind, **USE THE GUIDANCE PROVIDED** in this section to help students progress through the challenge. This guidance includes suggested student prompts, guiding questions for students, signs of step completion, and journaling opportunities. The student prompts, guiding questions, and journal prompts are found in the “Student Guide.” Facilitators or students may determine the method by which they record their research and discoveries found for these prompts and journal reflection questions.

## SUGGESTED TIMELINE

This sample pacing guide is created for a 20-day calendar with a 45-minute class. It is important to remember that timing may vary on student’s pace, as well as how much time you dedicate to each of the steps listed below. Your students may return to certain steps and repeat the process, no journey is the same!

DESIGN PROCESS STEP	TIMELINE
Identify	1-6 hours
Imagine	1-5 hours
Design	1-5 hours
Create	1-8 hours
Test & Improve	1-8 hours
Share	1-4 hours



# Challenge Design Process



## IMAGINE

Brainstorm solutions to the problem. List all ideas – don't hold back! Discuss and select the best possible solution.

## CREATE

Follow the design plan and build the prototype.

## SHARE

Communicate what was learned. Share the design, data, and conclusions. Present results.

## IDENTIFY

Define the problem and how it is affecting life globally, nationally, and locally. Research and consider how others have approached solving the problem. Describe why this problem needs a solution. Determine constraints (e.g., time, space, resources, etc.).

## DESIGN

Diagram the prototype. Identify the materials needed to build the prototype. Write out the steps to take. Describe the expected outcomes.

## TEST & IMPROVE

Test the design and collect quantitative and qualitative data. Discuss results and compare with the expected outcomes. Seek areas of improvement and make changes where needed.



# Materials list

## Suggested Materials list

The items listed below are suggested materials needed to conduct the challenge. Facilitators and students are encouraged to be creative and inventive in acquiring the materials needed to complete the challenge (e.g., purchased, recycled, donated, etc.).

MATERIALS REQUIRED	SUGGESTED MATERIAL OPTIONS
<ul style="list-style-type: none"><li>• Computer with internet access</li><li>• Microsoft Word</li><li>• Calculator</li><li>• Construction supplies</li><li>• Selected plant species</li><li>• Plant holding materials</li><li>• Creative supplies</li><li>• Water source</li></ul>	<ul style="list-style-type: none"><li>• Printer</li><li>• Variety of paper (e.g., poster board, presentation board, construction paper, etc.)</li><li>• Creative materials (e.g., scissors, glue, etc.)</li><li>• Lumber, saw, hammer, drill, nails</li><li>• Seeds, plants, or plugs</li><li>• Pots, beds, flats, containers</li><li>• Paper, cardboard, scissors, glue, coloring supplies</li><li>• Hose, sprinkling system</li></ul>

# STEP ONE

## 1 | IDENTIFY



### Purpose of Step

Define the problem and how it is affecting life globally, nationally, and locally. Research and consider how others have approached solving the problem including how people have addressed this problem historically. Describe why this problem needs a solution. Determine constraints (e.g., time, space, resources, etc.).

### Student Prompts and Guiding Questions:

- What is pollination?
- Which species pollinate?
- How are pollinators beneficial?
- What are the requirements for a healthy pollinator population?
- What are the factors impacting pollinator health?
- What is the importance of maintaining a diverse food supply?
- What are the government or other institutions doing to protect pollinators?
- What types of habitat do pollinators live in?

### Signs of Step Completion

Students will present a description of the challenge to the facilitator. They should include how this problem affects communities globally, nationally, and locally. The description should also include ways in which others have addressed finding a solution and constraints to be considered (e.g., time, space, resources, etc.).

**AT THE COMPLETION OF THIS STEP, DIRECT STUDENTS TO THE REFLECTION QUESTIONS IN THE "PROTECT THE POLLINATORS" STUDENT GUIDE.**

# STEP TWO

## 2 | IMAGINE



### Purpose of Step

Brainstorm solutions to the challenge. List all of your ideas – don't hold back!  
Discuss and select the best possible solutions.

### Student Prompts and Guiding Questions:

- What do plants need to grow?
- What space is available to grow plants?
- What materials can be used to build a pollinator habitat?
- What types of materials are unique to the local community?
- What plants are native to our community?
- Which pollinators are common in our community?

### Signs of Step Completion

Students will present a list of possible solutions to the identified challenge to the facilitator.

**AT THE COMPLETION OF THIS STEP, DIRECT STUDENTS TO THE REFLECTION QUESTIONS IN THE "PROTECT THE POLLINATORS" STUDENT GUIDE.**

# STEP THREE

## 3 | DESIGN



### Purpose of Step

Develop a possible solution and identify the materials needed to provide evidence for why the solution is creative, unique, and sustainable. Write out the steps to take and describe the expected outcomes.

### Student Prompts and Guiding Questions:

- What pollinator species do I want to help protect?
- Design a structure that meets the Challenge requirements.
- Determine what specific materials would be used in the construction.
- Create a supply list and budget.
- What specific materials will be used to build the growing structure?
- How will materials be obtained?
- What is the cost of these materials?
- In what ways will my solution be measured?
- What will need to be observed (qualitative data)?
- What information can be put into a chart or graph (quantitative data)?

### Signs of Step Completion

The students will present a detailed description of the solution as well as a written plan of how it could be carried out. Look for the following in the plan: a materials list with budget (if building a physical model or conducting lab research), detailed directions, and expected outcomes.

**AT THE COMPLETION OF THIS STEP, DIRECT STUDENTS TO THE REFLECTION QUESTIONS IN THE "PROTECT THE POLLINATORS" STUDENT GUIDE.**

# STEP FOUR

## 4 | CREATE



### Purpose of Step

Follow the design plan and construct the solution.

### Student Prompts and Guiding Questions:

- Use all research, knowledge gained, and the design plan to create the solution.
- Repeat any of the previous steps should issues arise during the building process.
- Consider the parameters of the challenge and what needs to be accomplished for a successful challenge.

### Signs of Step Completion

The students will construct the solution and share with the facilitator.

**AT THE COMPLETION OF THIS STEP, DIRECT STUDENTS TO THE REFLECTION QUESTIONS IN THE "PROTECT THE POLLINATORS" STUDENT GUIDE.**

# STEP FIVE

## 5 | TEST & IMPROVE



### Purpose of Step

Test the design and collect qualitative and quantitative data. Discuss results and compare with the expected outcome. Seek areas of improvement and make changes where needed.

### Student Prompts and Guiding Questions:

- How costly is your solution for pollinator well-being?
- How successful is your solution in addressing the well-being of pollinators?
- What suggestions did you receive for improvements on your solution?
- What changes will you make to your design, based on feedback from your peer reviewers?
- How does your design address budgetary constraints, timeline issues or other challenges?

### Signs of Step Completion

The students will keep records of all test trials and share data with the facilitator. Entries should include both qualitative and quantitative data. The students will also share recordings of any improvements made to the solution and the effect they had on the outcome.

**AT THE COMPLETION OF THIS STEP, DIRECT STUDENTS TO THE REFLECTION QUESTIONS IN THE "PROTECT THE POLLINATORS" STUDENT GUIDE.**



# STEP SIX

## 6 | SHARE



### Purpose of Step

Communicate what was learned throughout the challenge. Share the design process, data, and conclusions on how the solution answers the challenge question.

### Student Prompts and Guiding Questions:

- Develop a presentation including knowledge gained, design plans, materials used to create the structure, testing completed during challenge, and data analysis.
- How is your design approach an appropriate, innovative solution that realistically responds to the precise design competition problem?
- How does your design address budgetary constraints, timeline issues or other challenges?
- How successful was your solution in addressing the well-being of pollinators?
- Describe and/or demonstrate what you learned from this Challenge.

### Signs of Step Completion

The students will present what was learned through the design process, including sharing how the solution addresses the problem, key aspects of design, data from test trials, and end results.

**AT THE COMPLETION OF THIS STEP, DIRECT STUDENTS TO THE REFLECTION QUESTIONS IN THE "PROTECT THE POLLINATORS" STUDENT GUIDE.**

# Additional Resources



The resources listed below are links to additional information to help you and your students complete the Protect the Pollinators. In addition, be sure to check out the supplemental lessons on the Purple Plow website.

## Curriculum

Xerces Society – Educational Resources Disposal

<https://xerces.org/education>

The Ohio State University Department of Entomology – Pollination Links for Educators

<https://u.osu.edu/beelab/pollinator-links-for-educators/>

U.S. Fish and Wildlife Service – Educational Materials

<https://www.fws.gov/library/categories/educational-material>

Native Pollinators in Agriculture Project – Pollinator Related Educational Materials

[http://www.agpollinators.org/source\\_docs/educational\\_materials\\_appendix.pdf](http://www.agpollinators.org/source_docs/educational_materials_appendix.pdf)

## Build a Pollinator Garden

U.S. Fish and Wildlife Service – How to Build a Butterfly and Pollinator Garden in Seven Steps

<https://www.fws.gov/story/how-build-pollinator-garden>

USDA Forest Service – Gardening for Pollinators

<https://www.fs.usda.gov/managing-land/wildflowers/pollinators/gardening>



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