

Exploring Genetics

Analyze Genetic Modifications

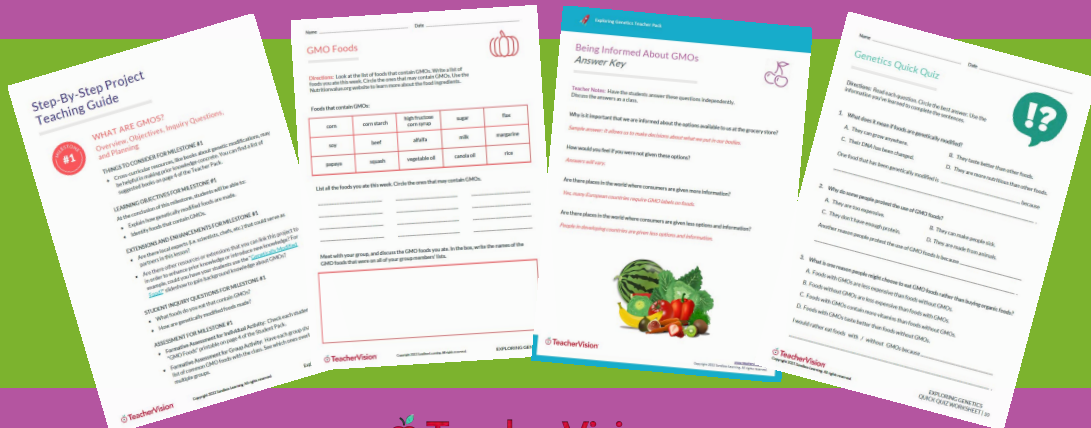


Science Project-Based Learning Grades 6-8

Learn About GMO Foods

Analyze Pros and Cons of Genetic Modifications

Present Your Findings and Analysis



Lesson Plan: Exploring Genetics

ABOUT THIS PROJECT-BASED LESSON

This project-based learning unit is designed to teach and reinforce the concepts in a grades 6-8 Science unit on Genetics and can be used in conjunction with existing curriculum materials.

The project is divided into 5 Milestones; each Milestone includes a self-contained student project activity. Done in sequence, the Milestones connect to enable students to produce a comprehensive capstone activity.

The minimum suggested duration for completing this project is 5 class periods. However, it is completely flexible and can be lengthened or shortened as necessary, based on available class time and interest level.

HOW TO USE THIS TEACHING GUIDE

Each Milestone for this project-based learning unit includes detailed daily activities presented in step-by-step order, with teaching notes, instructional guidance, and page references to resources and materials included in the Teacher Pack and Student Pack.

Daily activities are organized for you as follows:

- **Prepare (Bell-ringer/opener activity)**
Use these short opening activities at the beginning of class.
- **Present (Lecture/model)**
Use this portion of the lesson to deliver new subject material and project information, and to model any instructions or activity required for Produce or Participate elements.
- **Produce (Student project work)**
Use this portion of the lesson to allow students to work independently or in small groups on activities and other project elements.
- **Participate (Student/group share)**
Use this portion of the lesson to allow students to share out any project, research, or presentation materials.
- **Practice (Homework/assessment/independent)**
Use this optional portion of the lesson, if desired, to give students homework activities.

Step-By-Step Project Teaching Guide



WHAT ARE GMOS?

Overview, Objectives, Inquiry Questions, and Planning

THINGS TO CONSIDER FOR MILESTONE #1

- Cross-curricular resources, like books about genetic modifications, may be helpful in making prior knowledge concrete. You can find a list of suggested books on page 4 of the Teacher Pack.

LEARNING OBJECTIVES FOR MILESTONE #1

At the conclusion of this milestone, students will be able to:

- Explain how genetically modified foods are made.
- Identify foods that contain GMOs.

EXTENSIONS AND ENHANCEMENTS FOR MILESTONE #1

- Are there local experts (i.e. scientists, chefs, etc.) that could serve as partners in this lesson?
- Are there other resources or extensions that you can link this project to in order to enhance prior knowledge or introduce new knowledge? For example, could you have your students use the "[Genetically Modified Food?](#)" slideshow to gain background knowledge about GMOs?

STUDENT INQUIRY QUESTIONS FOR MILESTONE #1

- What foods do you eat that contain GMOs?
- How are genetically modified foods made?

ASSESSMENT FOR MILESTONE #1

- **Formative Assessment for Individual Activity:** Check each student's "GMO Foods" printable on page 4 of the Student Pack.
- **Formative Assessment for Group Activity:** Have each group share their list of common GMO foods with the class. See which ones overlap in multiple groups.

- **Summative Assessment:** Have the students complete the response printable on page 5 of the Student Pack for the Inquiry Question, “How are genetically modified foods made?”

Student Pack

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Teacher Pack

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Project Activities for Milestone #1: What Are GMOs?

PREPARE (Bell-ringer/opener activity)

Ask the students, “Did you eat any GMO foods today?” Use the article “[GMOs Facts for Kids](#)” on the Easy Science for Kids website to introduce the students to GMOs, or Genetically Modified Organisms.

PRESENT (Lecture/model)

Give the students the “What Is a Genetically Modified Food?” printable on page 3 of the Student Pack. Show them the video “[What Is a Genetically Modified Food?](#)” from Scientific American. Have them answer the questions. Use the “What Is a Genetically Modified Food? Answer Key” on page 5 of the Teacher Pack to discuss the answers.

PARTICIPATE (student/group share, group activity)

Give the students the “GMO Foods” printable on page 4 of the Student Pack. Have the students list the foods they’ve eaten this week and circle the ones that might contain GMOs. They should use the website [Nutritionvalue.org](#) to find the ingredients in the things they've eaten recently to determine if any of the foods they consumed could contain GMOs.

Put the students into groups of 2 or 3. Have them discuss the foods they’ve eaten that most likely contained genetically modified foods. At the bottom of the page, they should make a list of common GMO foods by listing things they all ate.

Formative Assessment: Have each group share their list of common GMO foods with the class. See which ones overlap in multiple groups.

PRACTICE (Homework/independent work/extensions)

Give each student the writing response template on page 5 of the Student Pack and ask them to write an answer to the inquiry question for this Milestone: “How are genetically modified foods made?”

ASSESSMENT

Formative Assessment for Individual Activity: Check each student’s “GMO Foods” printable on page 4 of the Student Pack.

Formative Assessment for Group Activity: Have each group share their list of common GMO foods with the class. See which ones overlap in multiple groups.

Summative Assessment: Have the students complete the response printable on page 5 of the Student Pack for the Inquiry Question, “How are genetically modified foods made?”



ARE GMOS GOOD OR BAD?

Overview, Objectives, Inquiry Questions, and Planning

THINGS TO CONSIDER FOR MILESTONE #2

- You will need two types of corn chips for this lesson. You can find a complete list of the materials needed for the projects in this unit on page 3 of the Teacher Pack.
- Be sure to check for food allergies before doing the taste test.

LEARNING OBJECTIVES FOR MILESTONE #2

At the conclusion of this milestone, students will be able to:

- Explain why some people think GMOs are good while others think they are bad.
- Match statements to show what people think of GMOs.
- Explain their own opinion about whether GMOs are helpful or harmful.

EXTENSIONS AND ENHANCEMENTS FOR MILESTONE #2

- Could you have your students interview an adult at their house to see what they know about GMOs? Give them the “GMO Interview” printable on page 6 of the Student Pack. After completing the interview, have them bring it back to school, and discuss the answers in Milestone 3.

STUDENT INQUIRY QUESTIONS FOR MILESTONE #2

- What are some reasons that people think GMOs are good?
- What are some reasons that people think GMOs are bad?
- Do you think GMOs are helpful or harmful? Why?

ASSESSMENT FOR MILESTONE #2

- **Formative Assessment for Individual Activity:** Check each student’s “What’s the Deal with Genetically Modified Food?” printable on page 7 of the Student Pack. Use the “What’s the Deal with Genetically Modified Food Answer Key” on page 6 of the Teacher Pack to check the answers.
- **Formative Assessment for Group Activity:** See which students matched the cards with the correct categories.
- **Summative Assessment:** Have the students complete the response printable on page 12 of the Student Pack for the Inquiry Question, “Do you think GMOs are helpful or harmful? Why?”

Student Pack

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Teacher Pack

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Project Activities for Milestone #2: Are GMOs Good or Bad?

PREPARE (Bell-ringer/opener activity)

Have a taste test. Give each student two corn chips – one without GMOs, like Garden of Eatin', and the other with GMOs, like Tostitos. Allow the students to sample each and turn and talk about their taste. See if they can guess which one contains GMOs (without looking at the bags/labels).

PRESENT (Lecture/model)

Give the students the “What’s the Deal with Genetically Modified Food?” printable on page 7 of the Student Pack. Show them the video “[What’s the Deal with Genetically Modified Food?](#)”. Use the “What’s the Deal with Genetically Modified Food? Answer Key” on page 6 of the Teacher Pack to discuss the answers.

PARTICIPATE (Student/group share, group activity)

Tell the students that people have different opinions about GMOs. Give them the “GMO: Friend, Foe or I Don’t Know” printable on pages 8-11 of the Student Pack. Have them cut apart the cards and sort them into the three categories.

Print the “Friend,” “Foe,” and “I Don’t Know” signs from pages 7-9 of the Teacher Pack. Hang them on different walls around your classroom. Call on a student to read one of the cards. Have all of the students walk to the sign that matches the category where they put that card. Discuss the correct category of the statement, and move on to the next statements, repeating the process until all of the cards have been read.

Formative Assessment: See which students matched the cards with the correct categories.

PRACTICE (Homework/independent work/extensions)

Give each student the writing response template on page 12 of the Student Pack and ask them to write an answer to the inquiry question for this Milestone: “Do you think GMOs are helpful or harmful? Why?”

ASSESSMENT

Formative Assessment for Individual Activity: Check each student’s “What’s the Deal with Genetically Modified Food?” printable on page 7 of the Student Pack. Use the “What’s the Deal with Genetically Modified Food Answer Key” on page 6 of the Teacher Pack to check the answers.

Formative Assessment for Group Activity: See which students matched the cards with the correct categories.

Summative Assessment: Have the students complete the response printable on page 12 of the Student Pack for the Inquiry Question, “Do you think GMOs are helpful or harmful? Why?”



COMPARING COSTS

Overview, Objectives, Inquiry Questions, and Planning

THINGS TO CONSIDER FOR MILESTONE #3

- For the “Mealtime Math” activity, the students should assume that any food not labeled as “Organic” or “non-GMO” contains genetically modified foods or by-products.

LEARNING OBJECTIVES FOR MILESTONE #3

At the conclusion of this milestone, students will be able to:

- Calculate the cost of a meal using only organic foods.
- Calculate the cost of a meal using foods with GMOs.
- Explain whether they would spend the extra money to buy organic foods for their families.
- Explain why organic foods cost more than foods with GMOs.

EXTENSIONS AND ENHANCEMENTS FOR MILESTONE #3

- Could you have your students create their own menu for a meal and compare the cost of buying all organic foods with the cost of buying foods with GMOs? Give them the “Meal Planning” printable on page 13 of the Student Pack.

STUDENT INQUIRY QUESTIONS FOR MILESTONE #3


- How much does a meal cost if you only use organic foods?
- How much does a meal cost if you use foods with GMOs?
- What foods would you choose for your family and why?
- Why do you think organic, or non-GMO foods, cost more than foods with GMOs?


ASSESSMENT FOR MILESTONE #3

- **Formative Assessment for Individual Activity:** Check each student’s “Mealtime Math” printable on page 14 of the Student Pack.
- **Formative Assessment for Group Activity:** Listen to the groups’ discussions as they talk about whether the higher prices of organic foods are worth it or not.
- **Summative Assessment:** Have the students complete the response printable on page 15 of the Student Pack for the Inquiry Question, “Why

do you think organic, or non-GMO foods, cost more than foods with GMOs?”

- **Summative Assessment:** Have the students complete the “Genetically Modified Foods Quick Quiz” on page 10 of the Teacher Pack. Use the “Genetically Modified Foods Quick Quiz Answer Key” on page 11 of the Teacher Pack to correct the quizzes prior to starting Milestone #4.

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 **Teacher Pack**
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Project Activities for Milestone #3: Comparing Costs

PREPARE (Bell-ringer/opener activity)

Tell the students that many consumers do not know what GMOs are, why they should potentially avoid them (or not), and where they are found. If you had the students complete the extension activity from Milestone 2, have them share the answers from their interviews.

PRESENT (Lecture/model)

Tell the students that consumers constantly need to make decisions about the products they are purchasing and whether or not the product is worth its price. Foods labeled “Non-GMO” are typically organic, and have a higher price tag at the store. Explain that today students are going to calculate the price of purchasing food for a basic meal using all organic/non-GMO labeled foods versus foods not labeled as organic/non-GMO.

PARTICIPATE (Student/group share, group activity)

Give the students the “Mealtime Math” printable on page 14 of the Student Pack. Have the students use an online grocery store, like Walmart.com, Target.com, or Safeway.com, to find the prices of the food items listed on the worksheet. The students should complete their calculations and the reflection question at the end.

Put the students into groups of 3 or 4. Have them discuss their response to the reflection question at the bottom of the “Mealtime Math” worksheet.

Formative Assessment: Listen to the groups’ discussions as they talk about whether the higher prices of organic foods are worth it or not.

PRACTICE (Homework/independent work/extensions)

Give each student the writing response template on page 15 of the Student Pack and ask them to write an answer to the inquiry question for this Milestone: “Why do you think organic, or non-GMO foods, cost more than foods with GMOs?”

ASSESSMENT

Formative Assessment for Individual Activity: Check each student's "Mealtime Math" printable on page 14 of the Student Pack.

Formative Assessment for Group Activity: Listen to the groups' discussions as they talk about whether the higher prices of organic foods are worth it or not.

Summative Assessment: Have the students complete the response printable on page 15 of the Student Pack for the Inquiry Question, "Why do you think organic, or non-GMO foods, cost more than foods with GMOs?"

Summative Assessment: Have the students complete the "Genetically Modified Foods Quick Quiz" on page 10 of the Teacher Pack. Use the "Genetically Modified Foods Quick Quiz Answer Key" on page 11 of the Teacher Pack to correct the quizzes prior to starting Milestone #4.



GENETICALLY MODIFIED FOODS PROJECT

Overview, Objectives, Inquiry Questions, and Planning

THINGS TO CONSIDER FOR MILESTONE #4

- Your students will need some art supplies to make their projects in this milestone. Look on page 3 of the Teacher Pack for a full list of suggested materials.

LEARNING OBJECTIVES FOR MILESTONE #4

At the conclusion of this milestone, students will be able to:

- Create a project to show what they've learned about GMOs.
- Choose the strongest argument for GMOs and the strongest argument against GMOs.

EXTENSIONS AND ENHANCEMENTS FOR MILESTONE #4

- Could you have the students use the "[GMO Wheel of Chance](#)" to learn more about GMOs and their effects in different industries and environments? They could use it to gather more facts before working on their projects. Give them the "Wheel of Chance Facts" printable on page 16 of the Student Pack. Have them write at least 8 things they learn.

STUDENT INQUIRY QUESTIONS FOR MILESTONE #4

- How can you create a project to show what you've learned about GMOs?
- What do you think is the strongest argument for GMOs? What do you think is the strongest argument against them?

ASSESSMENT FOR MILESTONE #4

- **Formative Assessment for Individual Activity:** Check each student's "Project Planning" printable on page 18 of the Student Pack.
- **Formative Assessment for Group Activity:** Meet with the students and discuss their plans for the project.
- **Summative Assessment:** Have the students complete the response printable on page 19 of the Student Pack for the Inquiry Question, "What do you think is the strongest argument for GMOs? What do you think is the strongest argument against them?"

Student Pack

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Project Activities for Milestone #4: Genetically Modified Foods Project

PREPARE (Bell-ringer/opener activity)

Show the students two posters about GMOs. The first one from the [Forbes website](#) shows the benefits of GMOs. The second one from [Infographics Mania](#) shows the negative effects of GMOs. Have the students turn and talk about how the two posters are the same and different. Call on students to share their answers.

PRESENT (Lecture/model)

Give the students the “Genetically Modified Foods Project Guidelines” on page 17 of the Student Pack. Go over the project requirements with the students.

PARTICIPATE (Student/group share, group activity)

Give the students the “Project Planning” printable on page 18 of the Student Pack. Have them answer the questions. Then, provide the resources (Internet, paper, markers, etc.) they will need to create their projects. Have them work independently.

Formative Assessment: Meet with the students and discuss their plans for the project.

PRACTICE (Homework/independent work/extensions)

Give each student the writing response template on page 19 of the Student Pack and ask them to write an answer to the inquiry question for this Milestone: “What do you think is the strongest argument for GMOs? What do you think is the strongest argument against them?”

ASSESSMENT

Formative Assessment for Individual Activity: Check each student’s “Project Planning” printable on page 18 of the Student Pack.

Formative Assessment for Group Activity: Meet with the students and discuss their plans for the project.

Summative Assessment: Have the students complete the response printable on page 19 of the Student Pack for the Inquiry Question, “What do you think is the strongest argument for GMOs? What do you think is the strongest argument against them?”



PROJECT PRESENTATIONS

Overview, Objectives, Inquiry Questions, and Planning

THINGS TO CONSIDER FOR MILESTONE #5

- You may want to collect the students' projects after their presentations so you can use the rubric to assess them.

LEARNING OBJECTIVES FOR MILESTONE #5

At the conclusion of this milestone, students will be able to:

- Explain why it's important to be informed about GMOs.
- Present their projects for the class.
- Explain why many people don't know about GMOs and suggest ways to better inform them.

EXTENSIONS AND ENHANCEMENTS FOR MILESTONE #5

- Could you invite other classes to listen to your students' presentations and learn about GMOs? You could also display the projects around the school so other classes can learn about the pros and cons of eating genetically modified foods.

STUDENT INQUIRY QUESTIONS FOR MILESTONE #5

- Why is it important to be informed about GMOs?
- Why do you think so many people don't know what a GMO is? What could we do to better inform them?

ASSESSMENT FOR MILESTONE #5

- **Formative Assessment for Individual Activity:** Check the students' "Being Informed About GMOs" printable on page 20 of the Student Pack. Use the "Being Informed About GMOs Answer Key" on page 12 of the Teacher Pack to check their answers.
- **Summative Assessment for Group Activity:** Use the "Exploring Genetically Modified Foods Project Rubric" on page 15 of the Teacher Pack to assess the students' projects and presentations.
- **Summative Assessment:** Have the students complete the response printable on page 21 of the Student Pack for the Inquiry Question, "Why do you think so many people don't know what a GMO is? What could we do to better inform them?"

- **Summative Assessment:** Give the students the “Genetically Modified Foods Summative Assessment” on page 13 of the Teacher Pack. Use the “Genetically Modified Foods Summative Assessment Answer Key” on page 14 of the Teacher Pack to correct the assessments.

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Teacher Pack

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Project Activities for Milestone #5: Project Presentations

PREPARE (Bell-ringer/opener activity)

Show the students the video “[What’s a GMO?](#)” Give the students the “Being Informed About GMOs” printable on page 20 of the Student Pack. Have them work independently to answer the questions. Use the “Being Informed About GMOs Answer Key” on page 12 of the Teacher Pack to discuss the answers as a whole class.

PRESENT (Lecture/model)

Tell the students that they will be presenting their projects for the class.

PARTICIPATE (Student/group share, group activity)

Give the students a few minutes to put the finishing touches on their projects and set up for their presentations.

Call students one at a time to present their projects.

Summative Assessment: Use the “Exploring Genetically Modified Foods Project Rubric” on page 15 of the Teacher Pack to assess the students’ projects and presentations.

PRACTICE (Homework/independent work/extensions)

Give each student the writing response template on page 21 of the Student Pack and ask them to write an answer to the inquiry question for this Milestone: “Why do you think so many people don’t know what a GMO is? What could we do to better inform them?”

ASSESSMENT

Formative Assessment for Individual Activity: Check the students’ “Being Informed About GMOs” printable on page 20 of the Student Pack. Use the “Being Informed About GMOs Answer Key” on page 12 of the Teacher Pack to check their answers.

Summative Assessment for Group Activity: Use the “Exploring Genetically Modified Foods Project Rubric” on page 15 of the Teacher Pack to assess the students’ projects and presentations.

Summative Assessment: Have the students complete the response printable on page 21 of the Student Pack for the Inquiry Question, “Why do you think so many people don’t know what a GMO is? What could we do to better inform them?”

Summative Assessment: Give the students the “Genetically Modified Foods Summative Assessment” on page 13 of the Teacher Pack. Use the “Genetically Modified Foods Summative Assessment Answer Key” on page 14 of the Teacher Pack to correct the assessments.