

name: \_\_\_\_\_

date: \_\_\_\_\_

class: \_\_\_\_\_

Welcome, teachers, to your guide for successful student completion of the GMO Student-Led Assignment, a webquest designed to help your students become more aware of the science behind GMOs (genetically modified organisms). Your students will want to save a copy of this assignment to a cloud storage platform, flash drive or computer. They will follow your directions for submission of their assignment.

Before students begin this activity, they will need a computer with internet access and a writing utensil. Students will complete the assignment by visiting each of the linked items and answering the following questions.

### Activity 1: Understand the science, part 1

This activity will introduce you to DNA Structure/Biotechnology and give you necessary background information about the topic: **Is There DNA in there?** ([grownextgen.org/workspace/uploads/files/dna-extraction.pdf](http://grownextgen.org/workspace/uploads/files/dna-extraction.pdf))

**Planning tip: you may consider having kits for students to take home to complete this lab, as not all students may have access to these materials at home. If completing in class, be sure to make the DNA extraction buffer solution for the group using the instructions below:**

#### Extraction buffer

##### Materials (100 ml)

- 10 ml clear shampoo or dishwashing liquid detergent
- 1.5 g table salt
- Distilled H<sub>2</sub>O

##### Procedure (modify amount depending on the size of a class)

1. Mix 90 ml of distilled water and 1.5 g of salt.
2. Add shampoo/detergent until solution volume is 100 ml. Stir slowly to avoid foaming of the shampoo.
3. Divide for students.

**You will want to provide direction for students on where to find answers for these questions.**

#### Prelab questions

1. What do you think the DNA will look like?

**Answers will vary.**

2. Where is DNA found?

**Cell nucleus**

#### Conclusion and analysis

1. Matching questions

**A: 1; B: 3; C: 2; D: 4**

2. What did the DNA look like? Describe it.

**Answers will vary.**

Relate what you know about the chemical structure of DNA to what you observed today.

**It was tightly bound and very closely stored.**

### Activity 2: Understand the science, part 2

Students need some background before doing this step! They should have a text reading or access to definitions of terms.

Watch the **Bozeman video explaining restriction enzymes** ([youtube.com/watch?v=yYIZgS-L5Sc](http://youtube.com/watch?v=yYIZgS-L5Sc)).

As you watch, complete the following questions:

1. What event allowed scientists to manipulate DNA?

**Discovery of Taq and Taq polymerase**

2. How does the analogy of a ransom note apply to DNA manipulation?

***Cutting out letters to make something new is similar to cutting genes and moving them to where we want them to be.***

3. Describe how each of the following apply to DNA manipulation:

- Scissors

***Restriction enzymes***

- Glue

***Hydrogen bonds***

- Ruler

***Gel electrophoresis***

- Copier

***Polymerase Chain Reaction***

- Reader

***DNA sequencing***

4. What words did you hear that you need to look up?

***Answers will vary.***

Try it out! Use the two DNA sequences found below to complete this activity.

Use the HindIII (A'AGCTT) restriction enzyme to cut both sets of DNA. You need to cut the DNA so the gene to make the soybeans resist the effects of glyphosate can be inserted.

1. Soybean DNA sequence:

A T T C G A T G A A T T C G A T A A G C T T G A A T T C A G A C A G A C A G A G A A T T C T A A  
T A A G C T A C T T A A G C T A T T C G A A C T T A A G T C T G T C T G T C T C T T A A G A T T

2. Bacterium DNA sequence containing the gene that provides resistance to glyphosate (Round-Up Ready gene):

A T T C G A T G A A G C T T A T A T G C T T G A A G C T T G A C A G A C A G A G A A T T C G A A  
T A A G C T A C T T C G A A T A T A C G A A C T T C G A A C T G T C T G T C T C T T A A G C T T

Paste the Round Up Ready Gene into the DNA of the soybean sequence using the “sticky ends.” Ligase is used to permanently seal these fragments together. Congratulations! You have just performed your first experiment in genetic engineering!

### **Activity 3: Explore the concept**

Complete the “**What Do You Know About GMOs?**” e-learning course (<http://elearning.grownextgen.org/>) to improve your background knowledge about this topic. This course describes the role of genetically modified organisms in modern agriculture and will help you understand some of the ways the agriculture industry is working to meet this growing demand for safe, affordable healthy food.

After completing the e-learning course, answer the following questions:

1. Record five things you learned from the e-learning course:

***Answers will vary.***

2. In what ways has agricultural science helped the world to prepare for feeding 9 billion people by 2050? Use specific examples from the e-learning course.

***Answers will vary, but could include: ability to have crops more efficiently grown due to selection of desirable traits, ability to apply chemical directly on plants for prevention of pests, molds, weeds, etc.***

3. What would you tell a consumer about GMOs after completing the e-learning course?

***Answers will vary.***

4. Did your opinion change after completing the e-learning course? Why or why not? Be specific.

***Answers will vary.***