

# Designing Bioplastics

## Grades 6–8 Engineering Design Challenge



Welcome to the Engineering Design Challenge!

This **Engineering Journal** is designed to guide you as you work through the challenge. Your teacher will let you know which parts you will do at home and which you will do at school.

**Learners, please read through the journal** and be prepared to gather materials if necessary. You can print part or all of the journal or use blank paper to complete the activities.

Caregivers, when supporting your learner at home, besides helping with materials, setup, and safety, consider talking about what they are doing and asking questions about their ideas. We will be celebrating the work students are doing. Consider taking pictures and videos of the work your learner is doing and posting them on social media. Be sure to tag @museumofscience and @eie\_org and use the hashtags #MassSTEMWeek or #SeeYourselfInSTEM. You can search using the hashtags to find other Massachusetts engineers' posts. If you want additional ideas for posting, check out the STEM Week Choice Board.

Follow us and use the hashtag #MassSTEMWeek.



S	T	E	M
Post about how you are using <b>science knowledge</b> during this Design Challenge!	Draw and share a <b>plan</b> for your design.	Learn from <b>failure</b> . Post your best design failure!	Post about how you are using <b>math knowledge</b> during this Design Challenge!
Show us your <b>materials</b> .	<b>Imagine multiple solutions</b> and show us at least two!	What does an <b>engineer</b> look like? You!  Post a photo to let us know "I Look Like an Engineer!"	Demonstrate how you <b>decomposed</b> the design challenge into smaller tasks.
<b>Communicate</b> what you learned about the properties of your materials.	<b>Improve</b> the design. Post about how you've improved your design!	Post about what field of engineering most interests you. <b>"I want to be a....engineer."</b>	Capture data while you are <b>testing</b> your design!
Learn about the <b>Sustainable Development Goals</b> .  Post your findings.	Research technologies designed by <b>female engineers</b> !  Share who you learn about.	<b>Investigate</b> your future!  Research and share about engineering schools in MA!	Share any <b>patterns</b> you discovered in your data.

You can also encourage your engineers to record short videos sharing their thoughts and experiences to be posted to **Flipgrid**. Visit [flipgrid.com/mosstem](https://flipgrid.com/mosstem). The Student Username is G6Engineer, G7Engineer, or G8Engineering, depending on your learner's grade level. Select your grade level topic before recording. For helpful information, [watch a Flipgrid tutorial video](#).

Have fun engineering!

## Lesson 1

## Goal

**Identify** the challenge of reducing plastic waste and **investigate** different kinds of conventional plastic.



## Pre-Work

Watch the [Plastics 101](#) video. Think and talk with family members about the ways you use plastic. Write or draw your ideas.

Activity

In the table below, record plastic technologies you find. For each technology, record its function and the beneficial properties that enable that function.

Plastic Technology	Function	Beneficial Properties
Example: Spoon	Example: Hold non-solid food	Example: Hard, curved

**Share Your Learning (optional)**

1. Record a video on Flipgrid to share the plastic technologies you found.
2. With an adult, choose a topic from the STEM Choice Board and post online. Be sure to tag @museumofscience and @EiE\_org and use the hashtag #MassSTEMWeek or #SeeYourselfInSTEM.

Lesson 2

Goal

**Investigate** how different processes produce different bioplastic properties.



Pre-Work

Watch the [Special Report Video](#) from 3:24 to 5:14 to become familiar with how materials from living things can create bioplastics. Talk with family members about common materials made from plants that might be useful for making bioplastics. Record your ideas in the table below.

<b>Plant</b>	<b>Material</b>
Example: Corn	Example: Cornstarch

### Activity

Follow these instructions to try out a process for making bioplastic.

1. Choose one of the following recipes to try:
  - a. 2 Tablespoons cornstarch, 4 Tablespoons water, 1 teaspoon glycerin
  - b. 2 Tablespoons cornstarch, 2 Tablespoons water, 1 teaspoon glycerin
  - c. 2 Tablespoons cornstarch, 2 Tablespoons water
  - d. 1 Tablespoon agar, 6 Tablespoons water, 1 teaspoon glycerin
  - e. 1 Tablespoon agar, 4 Tablespoons water, 1 teaspoon glycerin
  - f. 1 Tablespoon agar, 6 Tablespoons water
2. Add each of the ingredients from the recipe to a paper bowl and stir the mixture until all the ingredients are dissolved.
3. Pour the mixture onto the ceramic plate.
4. Put a paper towel down in the microwave and carefully place the plate on top of it. Turn on the microwave for 30 seconds. Carefully monitor it to make sure it does not burn.
5. Let the bioplastic air-dry for 15 minutes.
6. Gently turn over the bioplastic.
7. Microwave the bioplastic sample again for 10 seconds. Label the plate with your group's name and the ingredients on a piece of masking tape.
8. Let the bioplastic air dry overnight.

*Process Record*

Use the following table to record the materials you used for making a bioplastic sample.

Material	Amount

Write or draw your observations of the bioplastic sample after it dried overnight.

**Share Your Learning (optional)**

1. Record a video on Flipgrid to share your bioplastic process.
2. With an adult, choose a topic from the STEM Choice Board and post online. Be sure to tag @museumofscience and @EiE\_org and use the hashtag #MassSTEMWeek or #SeeYourselfInSTEM.

Lesson 3

Goal

**Investigate** results, **imagine** possible bioplastic designs, then **plan** and **create** one design.



Pre-Work

Watch the [Special Report Video](#) from 5:30 to 8:08 to become familiar with the concept of **criteria** for a bioplastic technology.

Process Results

Material	Effects of Using More or Less of the Material in a Bioplastic Process



Activity

List three technologies from page 4 that you could make out of bioplastic.

- 1.
- 2.
- 3.

Choose one technology that you will make out of bioplastic. Record it here.



Record criteria and constraints for your bioplastic technology.

<b>Criteria</b> the things a successful design needs to do or have	<b>Constraints</b> limits on a design

Plan a process to create your bioplastic technology. Record the materials in the following table.

Material	Amount

Use words or pictures to explain how you will shape your bioplastic technology.

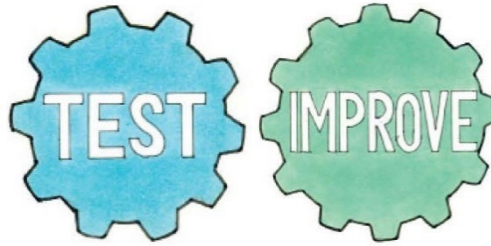
**Share Your Learning (optional)**

1. Record a video on Flipgrid to share your plan for making a bioplastic technology.
2. With an adult, choose a topic from the STEM Choice Board and post online. Be sure to tag @museumofscience and @EiE\_org and use the hashtag #MassSTEMWeek or #SeeYourselfInSTEM.

Lesson 4

Goal

**Test** the bioplastic’s function and biodegradability. **Improve** the design.



Pre-Work

Watch the [Special Report Video](#) from 8:41 to 9:32 to become familiar with methods of testing bioplastic technology and the concept of testing to failure.

Record the function of your bioplastic technology here.



Think of ways to test your bioplastic technology’s function. Use words or pictures to record them here.

Activity

Record the results of your test here.



Explain how you want to change the properties of your bioplastic technology.

Explain how you will change your bioplastic process to change these properties.

Record the results of your second test here.

**Share Your Learning (optional)**

1. Record a video on Flipgrid to share the results of your test.
2. With an adult, choose a topic from the STEM Choice Board and post online. Be sure to tag @museumofscience and @EiE\_org and use the hashtag #MassSTEMWeek or #SeeYourselfInSTEM.

## Lesson 5

## Goal

**Communicate** about bioplastic technologies.



## Pre-Work

Watch [Biotechnology Careers](#) to learn about careers in biotechnology.

Talk with a family member about what you've learned.

## Activity

Record the audience you want to inform about bioplastics.



Record the medium you will use to reach this audience.



Write or draw what your message will be.

**Share Your Learning (optional)**

1. Record a video on Flipgrid to share your message about bioplastic.
2. With an adult, choose a topic from the STEM Choice Board and post online. Be sure to tag @museumofscience and @EiE\_org and use the hashtag #MassSTEMWeek or #SeeYourselfInSTEM.