# 5E LESSON PLAN

## TOPIC

Recycling of Meal, Ready-to-Eat Meal Bags

## TITLE

**Let's RIP IT – Recycling in Plastics (RIP)**

## GRADE LEVEL

9th Grade

## NGSS AND COMMON CORE STANDARDS

### Science and Engineering Practices

**HW-PS2-5 -** Plan and conduct an investigation individually and collaboratively to produce data to serve as the basis for evidence, and in the design: decide on types, how much, and accuracy of data needed to produce reliable measurements and consider limitations on the precision of the data (e.g., number of trials, cost, risk, time), and refine the design accordingly.

**2-PS1-2** Analyze data from tests of an object or tool to determine if it works as intended to determine which materials have the properties that are best suited for an intended purpose.

**G.CO.12** Make formal geometric constructions with a variety of tools and methods (compass and straightedge, string, reflective devices, paper folding, dynamic geometric software, etc.).

**N.Q.A.1** Use units as a way to understand problems and to guide the solution of multi-step problems; choose and interpret units consistently in formulas; choose and interpret the scale and the origin in graphs and data displays.

**N.Q.A.2** Define appropriate quantities for the purpose of descriptive modeling.

**N.Q.A.3** Choose a level of accuracy appropriate to limitations on measurement when reporting quantities.

**CCSS.ELA-LITERACY.SL.9-10.1.C** Propel conversations by posing and responding to questions that relate the current discussion to broader themes or larger ideas; actively incorporate others into the discussion; and clarify, verify, or challenge ideas and conclusions.

**CCSS.ELA-LITERACY.SL.9-10.1.D** Respond thoughtfully to diverse perspectives, summarize points of agreement and disagreement, and, when warranted, qualify or justify their own views and understanding and make new connections in light of the evidence and reasoning presented.

**SET UP: PLACE AND TIME**

The activity will take place at U.S. Army Natick Soldier Research Development and Engineering Center, Center for Advanced Materials and Polymers (CAMP) and it will take1.0 Hours.).

**CAMP Lab with Extruders for the students to use**

**BACKGROUND**

Recycling materials is an age old concept dating back to ancient times, when the citizens of Rome and other empires would conserve and reuse their goods to give more to the soldiers. While this habit of saving goods continued through wartime, there was never a big movement to recycle all the time until the late 1960's, when people became more conscious of the environment and realized that all the waste we were using could be harming the environment. Now, Americans are doing a much better job recycling and caring about the environment. In 2009, Americans recycled 34 percent of waste, which is leaps and bounds better than the 8 percent recycled in 1991.

Plastics recycling is harder than recycling bottles and cans, and because of that only 2 million tons of plastic were recycled, out of the 30 million tons of waste created. To recycle plastics, first companies must sort the different types of plastic containers based on their chemical properties. After that, the containers are ground up and turned into tiny flakes of plastic, which are then thoroughly cleaned by big machines. The plastic is then dried, melted, and turned into pellets.

These pellets are raw recycled plastic, and can be sold to companies who want to recycle and make products from recycled plastics.

**JUSTIFICATION**

I chose this lesson because it gives students an opportunity to perform a variety of hands on activities, solve a challenge and apply many different STEM skills in a laboratory that can apply to their responsibility to the environment. Recycling of plastics is a way to decrease solid waste for the consumer and the military. . This lesson gives students the opportunity to learn about plastics, recycling and comprehend the value of recycling for our environment.

This lesson integrates Math, Science, Engineering and Technology. Students will be learning about the plastics that are currently being recycled. They will learn the different numbers and learn terms that relate to recycling. They will measure thickness of films that will be used in deteriming the tear strength of pure and recycled films. They will also be able to grind some Meal, Ready-to-Eat mailbags, then use the regrind. Students will also be using calculators and spreadsheets.

**OBJECTIVES**

- To learn about plastics (polymers) and the processes used to recycle and reuse them.
- Rip typical plastic films to see if one is harder to rip than others.
- Students will observe the extrusion melt process of plastic formulations containing recycled plastic.
- Work with recycled films and determine their performance properties.

**MEASURED OBJECTIVES**

- Measure thickness of films and take averages
- Perform testing of samples with tear tester and record data
- Calculate the tear resistance of films from the data
- Determine whether recycled plastic have better properties

**MATERIALS**

**Materials:** Plastic pellets - formulations containing regrind

Plastic films – formulations containing regrind

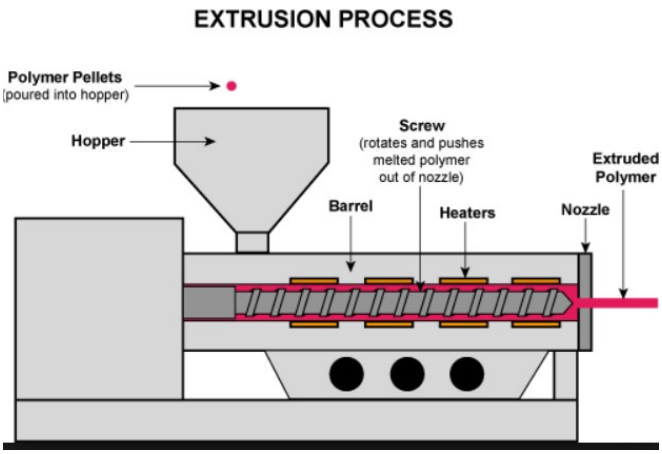
Examples of plastics items that can be recycled

**Tools and Equipment:** calculator, micrometer, grinder, cast film extruder, tear tester

**ENGAGE**

Students will be asked if they recycle at home. If so, they will be asked what they recycle. Give background information.

**Extrusion** is a process used to create objects of a fixed cross-sectional profile. A material is pushed or pulled through a die of the desired cross-section.




**Extrusion Processing Line** **Used to create all kinds of shapes**

**Similar to a Play-Doh fun factory…**


**Plastic recycling** is the process of recovering scrap or waste **plastic** and reprocessing the material into useful products, sometimes completely different in form from their original state. Re-grind is the waste plastic re-melted and used with other plastic to produce products.



**Polymer Recycling Symbols**

To ensure students' understanding of what has been presented, I will ask them look at different plastic items and identify which plastic it is by the number on the bottom of the bottle. Also, they must briefly describe how they recycle at home. I will bring up natural recycling (composting) especially if some students do this at home. Finally, each student must go home and get some plastics from their home that they would recycle. (try to obtain numbers 1-7)

I will then proceed to separate into 4 groups. By doing so each group of students will be assigned a specific area to be explored.

As they go around to the different station, I will ask students to observe their surroundings for a brief discussion when they get back together to discuss the results.

I will ask them the following questions:

- Do you recycle?
- Why do you recycle?
- What happens to your recycled materials?
- What are some of the uses for recycled plastic?
- Do recycled plastics or pure plastics have better performance properties?

The Army may not want to use recycled plastic in soldier's uniforms. For example – when polyester is exposed to high heat ( in a fire situation) it melts and drips - molten plastic could melt into your skin causing an increase in burn injury –basically reversing the process (tying it into the processing temperatures) which makes polyester recyclable in the first place. Maybe a discussion of why recycled plastic may be applicable to food but not clothing in the military. Is the military using recycled materials? How much? Since cost is always a factor for the military perhaps it may be worthwhile to have a brief discussion on the costs of recycled materials not just from an environmental standpoint but in dollars or cleaner emissions in processing (?) etc.

**EXPLORE**

Students will be divided into 4 groups of 5. Group 1 will go to the Rip It and Measuring Station where they receive 5 plastic films. The films contain either 0, 25, 50 75 or 100% regrind (recycled plastic). The students get to

Bales of soda bottles "regrind"

Ground up plastic

**From THIS….** **…..To THIS…..**


**….and Finally THIS!!**

**Procedure:** You will be given 5 different films with, one pure and 4 with varying percentages of re-grind. Through what you learn during the workshop at Stations 1-4, and your own testing and analysis, you will determine the percentage of re-grind used in each of the five films. You will visit each station, take notes and report your results to the class.

**Station 1** Overview: Recycling of Polymers - RIP IT Station

**Station 2** Regrind: Preparing Items for Recycling - Grinding Plastic Meal Bags from MREs

**Station 3** Extrusion: Processing Recycled Materials - Extrude MREs with pure plastic

**Station 4** Testing: Analysis of Recycled Material's Properties

# Data Log

**Team Name:**

**Station 1 Notes**

**Station 2 Notes**

**Station 3 Notes**

**Station 4**

**Sample Thickness Measurements –** measure each sample in 4 locations

| **Sample ID** | **Thickness (inch)** | | | | |
|---|---|---|---|---|---|
| | ***1*** | ***2*** | ***3*** | ***4*** | ***Average*** |
| **A** | | | | | |
| **B** | | | | | |
| **C** | | | | | |
| **D** | | | | | |
| **E** | | | | | |

**NOTES:**

**Tear Strength Properties of Films**

Below are the tear strength values for each of the films. Calculate the average tear strength for each sample, and use this data to help determine which percentage of re-grind is in each film.

| Sample ID | Tear Strength (g-force) | | |
|---|---|---|---|
| | 1 | 2 | Average |
| A | 119.4 | 122.6 | 121.0 |
| B | 73.4 | 81.6 | 77.5 |
| C | 105.6 | 101.8 | 103.7 |
| D | 153.7 | 159.1 | 156.4 |
| E | 129.6 | 128.3 | 128.9 |

**NOTES:**

**Physical observation of the films. Make any notes on differences in the way the films feel or look.**

| Sample ID | Observations |
|---|---|
| A | Opaque |

| | |
|---|---|
| | |
| **B** | *Opaque* |
| **C** | *Opaque* |
| **D** | *Transparent* |
| **E** | *Opaque* |

**NOTES:**

**Make conclusions on %regrind that is in each film based on the results you have recorded above.**

| **Sample ID** | ***% Regrind (0, 25, 50, 75, 100%)*** |
|---|---|
| **A** | *50* |
| **B** | *100* |

| | |
|---|---|
| **C** | *75* |
| **D** | *Pure* |
| **E** | *25* |

**NOTES:**

**Remember: REDUCE, RESUSE, RECYCLE**

**EXPLAIN**

Each group has gathered all the data from measuring the thickness and ripping the plastic films. They can now use these results to calculate the tear resistance.

Students will have to create a table, in which they will input the collected data and make all the new calculations.

**ELABORATE/EXTEND**

The Elaborate can be a terrific place to have them apply their knowledge. Relate the results to recycled plastics as described in the objectives to solve a challenge that requires students to think critically.

Once the groups have their final results, I will lead a class discussion for them to further analyze these results and hear from each team on their rationale. I will ask the groups to compare their values and identify which plastic films had the highest and lowest amount of regrind. I want them to compare and contrast the amounts of regrind and if these values vary depending on the regrind content. Also, identify if there's any correlation between these amounts with regrind. They must also consider if there are any other factors that influence the performance properties (i.e. temperature of extrusion, cooling rate)

**EVALUATE**

Formative Assessment in the form of observation (Dirksen, 2011) will be conducted throughout the module.

Grade sheet should include the following topics:

Topics they should know something about

Extrusion

Recycling

Regrind

Tear and Tear Resistance

Types of Plastics used in recycling

The numbers associated with plastic recycling

How to operate tear tester

How to operate micrometer

Need to talk with the students to me determine if the objectives of the lesson were met and determine what they learned.

Recall that when we assess students, we need to make sure we align to our measureable objectives and standards.

They must remember to use the right units and if necessary they must make conversions. They should follow the link below.

## STUDENT'S PROCEDURE AND RECORDING SHEET

**Group Members:**_____

## REFERENCES


- "Recycling for Kids with Waste Management's Mr. Cool Can 2009, Web. 6 July 2009. https://www.youtube.com/watch?v=629clJ5VZFc

- "Recycle Symbols & Numbers on Plastics"
  Web. 27 Oct. 2015. https://www.youtube.com/watch?v=VPLD5EzTlW0

- “Extrusion: Managing Regrind” Plastics Technology, Frankland, J. Web 21 Dec. 2015, https://www.ptonline.com/columns/extrusion-managing-regrind
-


>