

STUDENT WORKBOOK



WAVE OF PLASTIC

Meaningful Watershed Educational
Experience

LESSON ONE: A PLANET FULL OF PLASTIC

- How do we describe, define, quantify, and communicate about issues related to plastic waste?
- What is per-capita consumption and how do our choices and activities regarding the consumption and disposal of materials contribute to plastic waste?
- What choices are available for reducing our own personal plastic waste? What are the effects of those choices?
- How can we communicate our ideas, inform perspectives, and inspire action?

Student Name: _____

Unit Driving Question:

How do human choices regarding the consumption and disposal of plastics impact ecosystems and our communities and what actions can we take to minimize those impacts?

Wave of Plastic: Meaningful Watershed Educational Experience
Student Workbook: Lesson One – A Planet Full of Plastic

Part 1- Introduction: Building Understanding

Objectives:

- We will ask questions and make observations about how our choices regarding the consumption and disposal of materials contribute to issues of plastic pollution.
- We will conduct inventories of the amount of waste we create in a given day.

DIRECTIONS

1. Monitor the types and amount of waste that you generate in one day.
2. Use the chart below to record items that you used, why you used them, the materials from which they are made (for example: paper, food waste, plastic, cotton, etc.), and what you did with them when you were finished.
3. Answer the questions below.
 1. What was something that surprised you about your inventory? Why?

2. Was this a normal day for you in terms of what you used and threw away? Why or Why not?

3. How do you think your inventory would compare to that of an adult? Why?

4. If you had to keep all your waste for a year (you could not throw anything away), what are some things you might change? Why?

Wave of Plastic: Meaningful Watershed Educational Experience
Student Workbook: Lesson One – A Planet Full of Plastic

My Personal Waste Inventory

Name: _____

Day & Date: _____

Items that I Discarded				
Item	Why was it used?	From what type of material was it made?	What did I do with it when I was finished using it?	Notes
			<input type="checkbox"/> Put it in a garbage bin <input type="checkbox"/> Recycled it <input type="checkbox"/> Reused it <input type="checkbox"/> Composted it <input type="checkbox"/> Other	
			<input type="checkbox"/> Put it in a garbage bin <input type="checkbox"/> Recycled it <input type="checkbox"/> Reused it <input type="checkbox"/> Composted it <input type="checkbox"/> Other	
			<input type="checkbox"/> Put it in a garbage bin <input type="checkbox"/> Recycled it <input type="checkbox"/> Reused it <input type="checkbox"/> Composted it <input type="checkbox"/> Other	
			<input type="checkbox"/> Put it in a garbage bin <input type="checkbox"/> Recycled it <input type="checkbox"/> Reused it <input type="checkbox"/> Composted it <input type="checkbox"/> Other	
			<input type="checkbox"/> Put it in a garbage bin <input type="checkbox"/> Recycled it <input type="checkbox"/> Reused it <input type="checkbox"/> Composted it <input type="checkbox"/> Other	
			<input type="checkbox"/> Put it in a garbage bin <input type="checkbox"/> Recycled it <input type="checkbox"/> Reused it <input type="checkbox"/> Composted it <input type="checkbox"/> Other	
			<input type="checkbox"/> Put it in a garbage bin <input type="checkbox"/> Recycled it <input type="checkbox"/> Reused it <input type="checkbox"/> Composted it <input type="checkbox"/> Other	
			<input type="checkbox"/> Put it in a garbage bin <input type="checkbox"/> Recycled it <input type="checkbox"/> Reused it <input type="checkbox"/> Composted it <input type="checkbox"/> Other	
			<input type="checkbox"/> Put it in a garbage bin <input type="checkbox"/> Recycled it <input type="checkbox"/> Reused it <input type="checkbox"/> Composted it <input type="checkbox"/> Other	
Total Number of Items: _____ Total Number of Plastic Items: _____			Number of items I put in a garbage bin: _____ Number of items I recycled: _____ Number of items I reused: _____ Number of Items I composted: _____ Other: _____	

Wave of Plastic: Meaningful Watershed Educational Experience
Student Workbook: Lesson One – A Planet Full of Plastic

5. Summarize the information that you collected about the number and types of items that you discarded. Complete the table below.

Primary Material	Number of items of that material that I used and discarded
Plastic	
Metal (for example, foil)	
Food	
Paper/cardboard	
Other	
TOTAL NUMBER of ITEMS	

6. Scientists use different types of graphs to display data and communicate findings. A circle graph (also called a pie graph) is a circular chart divided into sections that each represent a percentage of the total.

Create a circle graph to display the proportion of items of each material that were thrown away. (Your teacher will help you choose to create a pie graph of your own data or of the class data.) Copy, paste, or draw your graph below.

7. How many pieces of *plastic* did *you* throw away in one day? _____
8. How many pieces of *plastic* did *your class* throw away in one day? _____
9. Based on the data that you and your classmates collected, *estimate* the number pieces of plastic that the students and teachers *in your school* discards in one day.

Does that number surprise you? Why or why not?

Wave of Plastic: Meaningful Watershed Educational Experience
Student Workbook: Lesson One – A Planet Full of Plastic

Part 2- Investigation: Integrating Information & Ideas

Objectives:

- We will communicate scientific and ideas about issues of plastic pollution orally, graphically, and textually.

DIRECTIONS

Review the resources that your teacher provides and answer the questions below.

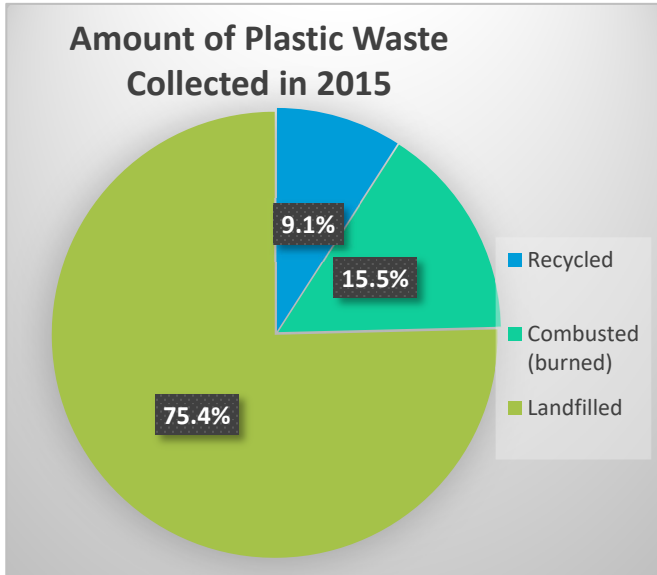
1. Many of the plastic items that we use today either didn't exist or were made from other materials decades ago.

In the table below, describe how and why each type of plastic item is used today. Then, describe how people may have met that need before plastic became common.

Item	How & Why is it used?	Before Plastic
<i>Example: Plastic Straws</i>	<i>Straws help us drink cold beverages from cups with lids.</i>	<i>People may have used paper straws or not used straws at all.</i>
Plastic utensils (forks, spoons, knives)		
Plastic garbage bags		
Plastic water bottles		
Your own example:		

Wave of Plastic: Meaningful Watershed Educational Experience
Student Workbook: Lesson One – A Planet Full of Plastic

The graph and chart below illustrate what happened to the plastic waste in the U.S. in 2015



Plastic Waste Collected in 2015	
MANAGEMENT PATHWAY (What happened to the plastic waste once it was collected)	WEIGHT (In thousands of US tons)
Recycled	3,140
Combusted (burned)	5,350
Landfilled	26,010
TOTAL AMOUNT OF PLASTIC WASTE	34,500

(source: www.epa.gov)

2. According to the graph and chart, what happened to most plastic trash that was collected in 2015?

Why do you think that is?

3. How do you think a graph and chart of the amount of plastic waste collected THIS year would compare to 2015? Explain your answer.

Wave of Plastic: Meaningful Watershed Educational Experience
Student Workbook: Lesson One – A Planet Full of Plastic

4. According to the Chesapeake Bay Program, an estimated *18.2 million people* were living in the Chesapeake Bay watershed in 2017. *By 2040*, experts predict the watershed's population *will grow to 21.1 million people* (source: <https://www.chesapeakebay.net/state/population>).

If we continue to use and dispose of plastic in the way we do now, what impact(s) do you think this population increase could have on the environment and society in the Chesapeake Bay Watershed?

5. What are some ways that society could keep levels of plastic production and waste from increasing with the growing world population? Use words and pictures to explain and illustrate your answer.

Wave of Plastic: Meaningful Watershed Educational Experience
Student Workbook: Lesson One – A Planet Full of Plastic

6. We have options for choosing what items we use, how we use them, and what we do with them when we are finished. Use the chart below to describe what is meant by the options or choices that are listed. Provide an example for each choice or option, then explain how each could help to solve the problem of trash and plastic pollution.

Option/Choice	What it means	Example	How it could help
Reduce			
Refuse			
Reuse			
Recycle			
Other Ideas _____			

Part 3 – Application: Applying What We Learned Through Informed Action

Objectives:

- We will take action by engaging our communities with ‘public service announcements’ in the form of persuasive posters, flyers, or social media posts.

DIRECTIONS

1. Decide which choice for the disposal of plastic trash you think could have the biggest impact on the problem of accumulating trash.
2. Design either *a poster, a flyer, or a social media post* (limit 280 characters) that could persuade others to make that choice more often. Your poster should include a description of the choice and an explanation for why that choice is important.
3. Answer the questions below.
 1. Which choice regarding the consumption and disposal of plastic do you think has the potential to best help reduce the amount of plastic that ends up in landfills?

Why do you think that choice could be the most impactful? Use evidence from the resources you’ve reviewed and your work in this lesson to support your answer.

Who will be the audience for your poster, social media message, or flyer? Explain why you chose that audience. _____

2. What do you hope will happen as a result of sharing your poster, flyer, or social media post with your audience?

Wave of Plastic: Meaningful Watershed Educational Experience
Student Workbook: Lesson One – A Planet Full of Plastic

Part 4- Assessment: Demonstrating Our Understandings

Objectives:

- Students will construct a convincing argument, supported with evidence, that supports or refutes claims for either explanations or solutions.
- Students describe a chain of reasoning that includes increases in the size of the human population or in the per-capita consumption of a given population cause increases in the consumption of natural resources, such as plastics.
- Students will describe choices and impact of the disposal of plastics.

DIRECTIONS

Use the Claim, Evidence, Reasoning model to respond to the question below.

Claim/Evidence/Reasoning Writing Rubric				
	0	1	2	3
Claim – statement or conclusion that answers the original question/problem.	Does not make a claim.	Makes an inaccurate claim.	Makes an accurate but incomplete claim.	Makes an accurate and complete claim.
Evidence – scientific data that supports the claim. The data needs to be appropriate and sufficient to support the claim.	Does not provide evidence.	Only provides inappropriate evidence (Evidence that does not support the claim.).	Provides appropriate, but insufficient evidence to support claim. May include some inappropriate evidence.	Provides appropriate and sufficient evidence to support claim.
Reasoning – justification that links the claim and evidence and includes appropriate and sufficient scientific principles to defend the claim and evidence.	Does not provide reasoning	Only provides reasoning that does not link evidence to claim.	Repeats evidence and links it to some scientific principles, but not completely.	Provides accurate and complete reasoning that links evidence to claim. Includes appropriate and sufficient scientific principles.

★ Construct an argument supported by evidence to describe the connections between the number of people in a society and the amount of plastic waste that they generate.

Wave of Plastic: Meaningful Watershed Educational Experience
Student Workbook: Lesson One – A Planet Full of Plastic



Lined writing area consisting of multiple horizontal lines for student input.

STUDENT WORKBOOK



WAVE OF PLASTIC

Meaningful Watershed Educational
Experience

LESSON TWO: WHAT IS PLASTIC?

- How do we describe, define, quantify, and communicate about the issue of plastic waste?
- What are some of the consequences of the manufacture, use, and disposal of plastic?
- What happens to plastic over time?
- What are some of the alternatives to plastic?
- What properties of plastic influence our everyday choices to use plastic?
- How can we communicate our ideas, inform perspectives, and inspire action?

Student Name:

Unit Driving Question:

How do human choices regarding the consumption and disposal of plastics impact ecosystems and our communities and what actions can we take to minimize those impacts?

Wave of Plastic: Meaningful Watershed Educational Experience
Student Workbook Lesson Two -What is Plastic?

Part 1- Introduction: Building Understanding

Objectives:

- We will obtain, evaluate, and communicate information about the materials used to make plastics, how plastics are made, the changes that plastics undergo as they are used and discarded, and why the manufacture, use, and disposal of plastic can be problematic.

DIRECTIONS

As you review the resources provided by your teacher, use the charts below to help collect, synthesize, organize, and share information about the properties, manufacture, and use of plastic.

1. What are plastics?	
Resources that I used	Notes

2. How are plastics made?	
Resources that I used	Notes

Wave of Plastic: Meaningful Watershed Educational Experience
Student Workbook Lesson Two -What is Plastic?

3. How and why are plastics used?	
Resources that I used	Notes

4. What happens to plastics over time?	
Resources that I used	Notes

5. What are some of the negative consequences for the use and disposal of plastic?	
Resources that I used	Notes

Wave of Plastic: Meaningful Watershed Educational Experience
Student Workbook Lesson Two -What is Plastic?

Part 2- Investigation: Integrating Information & Ideas

Objectives:

- We will gather and make sense of information to describe that everyday items that are made from plastic are synthetic materials made from natural resources and impact society.
- We will investigate alternatives to plastic that may be used to manufacture everyday items.
- We will investigate how types of plastic polymers degrade over time.

DIRECTIONS

Review the resources provided by your teacher and answer the questions below.

1. In your own words, describe what it means for a material to biodegrade.

Then, in the space below, use words, pictures, and symbols to illustrate the difference between an item 'breaking *down*' through biodegradation and an item 'breaking *up*' into smaller pieces.

2. In the space below, use words, pictures, and symbols to illustrate what happens to most types of plastics over time.

“Make Your Own Biodegradable Plastic”

(This page should be completed after students participate in the activity)

1. What materials did you use to make your own plastic? List each material below. Then, identify whether you think the material will biodegrade (or break *down*) in under 100 years.

Material	Will it biodegrade (in under 100 years)?	How do you know?

2. How could bio-plastics potentially impact per-capita consumption and disposal of plastic waste?

3. Describe the potential benefits and drawbacks of bio-plastics plastics on per-capita consumption and disposal of plastic waste.

Benefits	Drawbacks

“Updating Our Personal Waste Inventories”

DIRECTIONS

1. Return to the Personal Waste Inventory that you created in “*Lesson One, A Planet Full of Plastic.*”
2. Choose 5 items that you discarded. In the chart below, make a prediction about how long you think it will take to degrade (break down). Provide evidence to support your prediction (for example, is the item made from synthetic or natural materials). With the support of your teacher, research the actual time that it will take for that item to break down.
3. Then answer the question below.

Item	My prediction: How long it will take to degrade?	Evidence for my prediction: How long it will take to degrade?	Actual Time this item will take to degrade?
1.			
2.			
3.			
4.			
5.			

1. What is something that surprised you about what happens to the items on your list over time. Why was that surprising?

“What Happens to Our Waste?” (extension)

Part 2 (extension) Investigation: Integrating Information & Ideas

Objectives:

- We will explore how and why different waste materials degrade over time.
- We will define and describe the processes of degradation that we investigate.
- We will develop questions to drive the investigation.
- We will use what we understand about biodegradability to make predictions about the effects independent variables (such as water, soil, material type) will have on the intended variables (mass and other observable features) of a variety of waste items.
- We will develop a plan for collecting, recording, and analyzing data that will help answer questions about the degradability of different materials. We will identify and justify appropriate variables and determine the methodologies for collecting data.
- We will use the data collected in our investigation as evidence to support claims about the effects of independent variables (such as water, soil, material type) on the dependent variables (mass and other observable features) of a variety of waste items.
- We will synthesize evidence from our investigation and apply our understandings of biodegradability to draw conclusions about the degradation of different waste materials.

DIRECTIONS

1. Define and describe the processes of degradation that you will investigate.
2. Use what you understand about biodegradability to develop questions and make predictions about the effects of independent variable (such as water, soil, material type) will have on the intended variables (mass and other observable features) of a variety of waste items.

1. What is biodegradation and why is it important?

Wave of Plastic: Meaningful Watershed Educational Experience
Student Workbook Lesson Two -What is Plastic?

2. What items of waste will you and your team choose to investigate? What are your predictions about the effect of exposure to water and soil on the mass and other observable features of each item.

Item	Prediction Describe what evidence of degradation you might observe.	Reasoning Why you think you might observe that evidence of degradation?

DIRECTIONS

1. Plan, implement, and evaluate an investigation that will generate data to provide evidence to support conclusions that you draw.
3. Why do you think we will be looking at mass as a dependent variable in this investigation? What other observable features could you measure? (A dependent variable is one that is being studied and measured as data points).

4. What are the independent variables in your model? How do you think each might affect the dependent variables?

Independent Variable	Predicted Potential Impact

Wave of Plastic: Meaningful Watershed Educational Experience
Student Workbook Lesson Two -What is Plastic?

5. What are the steps in your investigation?

DIRECTIONS

1. Use the data collected in your investigation as evidence to support claims about the effects of independent variable (such as water, soil, material type) will have on the intendent variables (mass and other observable features) of a variety of waste items.

6. How would you describe the results of your investigation?

7. What claims can you make about the effects of independent variables (such as water, soil, material type) on the dependent variables (mass and other observable features) you observed?

8. What conclusions can you draw about the degradation of different types of waste?

Wave of Plastic: Meaningful Watershed Educational Experience
Student Workbook Lesson Two -What is Plastic?

Part 3 – Application: Applying What We Learned Through Informed Action

Objectives:

- We will describe that everyday items that are made from plastic are synthetic materials that come from natural resources and impact society.
- We will design and administer a survey to collect information about the preferences and choices of people in your school community regarding plastic use.
- We will share what we've learned in the lesson investigations and from the survey results.

DIRECTIONS

Review the Plastic-Use Survey that was created by the University of Maryland Center for Environmental Science. Then answer the questions below.

1. Describe connection between personal choices about plastic use and the accumulation of waste in our environment?

2. What are some factors that you think might influence the preferences that people have and the choices that they make when it comes to plastic use?

3. What do you wonder about the choices that people in your community make regarding plastic use?

Wave of Plastic: Meaningful Watershed Educational Experience
Student Workbook Lesson Two -What is Plastic?

4. In the space below, draft questions that you could use in your survey. Then, work with your teacher to create a survey that could be administered to the school community.

Wave of Plastic: Meaningful Watershed Educational Experience
Student Workbook Lesson Two -What is Plastic?

Part 4- Assessment: Demonstrating Our Understandings

Objectives:

- Students will construct a convincing argument, supported with evidence, that supports or refutes claims for either explanations or solutions.
- Students describe a chain of reasoning that describes plastic as a synthetic material derived from natural resources that affects society in positive and negative ways.

DIRECTIONS

Use the Claim, Evidence, Reasoning model to respond to the question below.

Claim/Evidence/Reasoning Writing Rubric				
	0	1	2	3
Claim – statement or conclusion that answers the original question/problem.	Does not make a claim.	Makes an inaccurate claim.	Makes an accurate but incomplete claim.	Makes an accurate and complete claim.
Evidence – scientific data that supports the claim. The data needs to be appropriate and sufficient to support the claim.	Does not provide evidence.	Only provides inappropriate evidence (Evidence that does not support the claim.).	Provides appropriate, but insufficient evidence to support claim. May include some inappropriate evidence.	Provides appropriate and sufficient evidence to support claim.
Reasoning – justification that links the claim and evidence and includes appropriate and sufficient scientific principles to defend the claim and evidence.	Does not provide reasoning	Only provides reasoning that does not link evidence to claim.	Repeats evidence and links it to some scientific principles, but not completely.	Provides accurate and complete reasoning that links evidence to claim. Includes appropriate and sufficient scientific principles.

- ★ Plastic is a synthetic, human-made material derived from natural resources (primarily “fossil fuels” like natural gas, oil, and petroleum).

Describe how the properties of plastic impact communities over time.

Breaking Down Trash:

What is trash and what is biodegradation?

What is trash? Where does it go when we throw it away?

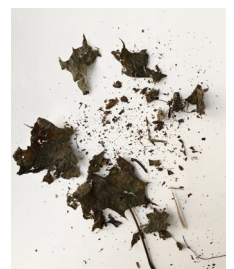
1. Trash is more important than many of us realize. In this article, we will explore what is meant by the word trash, the differences between natural and synthetic materials, and the properties that influence how trash changes over time.
2. How do you define the word “trash?” Many definitions of trash can be subjective or influenced by our own experiences and interpretations of information. The word “trash” is used to refer to items that we put into the garbage or recycling bin because we no longer want or need them. But what exactly is trash made up of? And if we are throwing trash away, where is “away?”

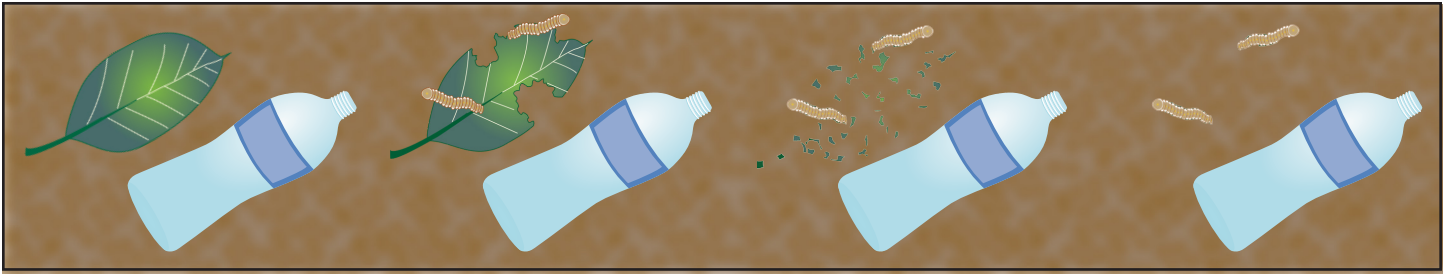
What types of materials make up trash?

3. Trash is all of the items that we discard. These items of trash are made of materials that originally came from nature, such as wood, minerals, coal, crude oil, and other fossil fuels. Although you may be able to observe an object and conclude that it came from nature (such as a wooden chair), there are many items that are made from materials that are difficult to identify through observation alone. A plastic bag, for example, is made from natural resources, but it isn't easy to know from which ones just by looking.
4. Some items can look very different from the materials they come from because they are either made of many different types of materials or the natural resources that made them were changed. Materials that are changed actually have a different chemical composition and are called “synthetic” materials. This is in contrast to “natural” materials, which have the same chemical composition and look similar to the natural materials they are made of (like a wooden chair). Both natural and synthetic materials are made into the items that we use in everyday life and eventually discard as trash.

Where does our trash go when we throw it “away”?

5. Trash that is properly contained in bags or trash cans is collected by local waste management companies in garbage trucks and taken to landfills. Landfills are large areas of land specifically set aside to store trash. Landfill operators usually try to confine the trash that is deposited in a landfill to as small an area as possible and modern landfills bury or cover waste with layers of soil.
6. Items that have been put in the recycling bin are typically collected by recycling waste management companies that sort the items, separate them into different types of materials, and send them to manufacturers who make new products from the materials. If items have been contaminated with food or other materials, they may not be able to be recycled and are sent to a landfill.
7. Sometimes, trash is not discarded into containers where it can be taken to a landfill or to a recycling facility. Instead, it enters the natural environment where it becomes pollution. This can happen when people do not put their trash in cans or bins, or when dumpsters or trash cans are overfilled. It can also happen when garbage bags are ripped, or trash is not properly contained. In all of these cases, trash can be carried by wind or water across land and into waterways.





What happens to natural waste materials over time?

8. Whether trash is made from materials that were once living will determine what happens to it over time. Organic materials come from either the waste products of living things or their remains. Organic materials are biodegradable. This means that specialized organisms called decomposers (like bacteria, fungi, and earthworms) can feed on the material and break it into simple elements and nutrients. This process of decomposers breaking organic materials down into usable nutrients is called biodegradation.
9. Biodegradation is an important process in nature because it allows the elements and nutrients contained in one organism to be cycled back into the ecosystem for other organisms to utilize. One example found in nature is the cycle of trees losing their leaves in the autumn. Leaves are organic and therefore they biodegrade quickly and easily. When leaves fall off trees, decomposers break down the structure of the leaves as they digest them. Decomposers help to prevent materials from building up, or accumulating in the environment. Without decomposers to digest and break down the leaves that fall from trees, for example, there would eventually be piles of leaves taller than the trees themselves!
10. Some materials, like clay, stone, and minerals like aluminum and sodium, are found naturally in the environment, but they are not organic, meaning they have never been a part of materials that were once living. They are not broken down to be used as nutrients by decomposers.

What happens to synthetic materials over time?

11. Many of the items that we use in everyday life are not natural and are not organic. These items are made from synthetic, human-made materials such as fibers, medicines, and plastics. While some of the ingredients used to make these materials may have been natural or organic at one time, the process to turn them into the synthetic materials during manufacturing changes their structure, which can result in the materials being much more difficult to break down through biodegradation.
12. Plastic, for example, is a synthetic material that is made from natural materials like crude oil and natural gas. The manufacturing process changes the chemistry of these original liquid and gas materials to a solid that is very difficult for decomposers to break down in order to extract nutrients. This means that items made out of plastic (like plastic bags) may be broken up into smaller pieces over time, but not easily broken down through biodegradation. Scientists estimate that it will take considerable amounts of time (even hundreds of years) for plastics to be broken down into tiny pieces. Thus, pieces of synthetic materials like plastic remain and accumulate in ecosystems, where they can pollute the air, water and soil and cause harm to living things for years and years.

What can you do to help?

13. Humans are using more and more plastic items every day and enormous amounts of plastic trash are entering ecosystems. Think about the choices that you make when it comes to using items and discarding them as trash. Are there things you can do to help reduce the amount of trash and its harmful impacts in our natural environments?

PLASTICS BREAK UP INTO MICROPLASTICS.

HOW LONG DOES IT TAKE?



PLASTIC BEVERAGE HOLDER
400 YEARS



PLASTIC WATER BOTTLE
450 YEARS



PLASTIC UTENSIL
200 YEARS



PLASTIC STRAW
200 YEARS



PLASTIC BAG
20 YEARS



FOAM PLASTIC CUP
50 YEARS

MICROPLASTICS

Microplastics are small plastic pieces less than five millimeters long which can be harmful to our aquatic life.

Decomposition rates will vary depending on product material and environmental conditions

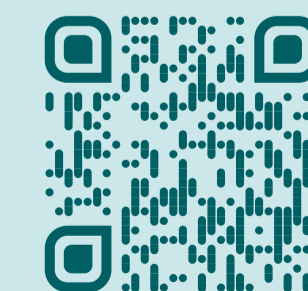
WHAT CAN YOU DO?

-  Skip the straws, plastic bags, and plastic take-out items!
-  Reduce, Reuse, and Recycle...or just Refuse to Use!
-  Participate in beach and community greenspace cleanups!



PLASTICWATCH

Visit our website to learn more
www.umces.edu/plasticwatch



The PlasticWatch project is funded using federal funds under award number NA16NOS4190170 from NOAA, U.S. Department of Commerce. The statements, findings, conclusions, and recommendations are those of the author and do not necessarily reflect the views of NOAA or the U.S. Department of Commerce."

STUDENT WORKBOOK



WAVE OF PLASTIC

Meaningful Watershed Educational
Experience

LESSON THREE: FROM HAND, TO LAND, TO SEA

Sources & Destinations of Plastic Pollution

- How do we describe, quantify, and communicate about issues related to plastic waste?
- What are the causes and effects of pollution?
- What are the sources of plastic pollution?
- How and why does plastic pollution enter our waterways?
- How can we communicate our ideas, inform perspectives, and inspire action?

Student Name: _____

Unit Driving Question:

How do human choices regarding the consumption and disposal of plastics impact ecosystems and our communities and what actions can we take to minimize those impacts?

Wave of Plastic: Meaningful Watershed Educational Experience
Student Workbook: Lesson Three – From Hand, to Land, to Sea

Part 1- Introduction: Building Understanding

Objectives:

- We will obtain, evaluate, and communicate information about the types of pollution and the negative impacts it can have on the environment and living things.

DIRECTIONS

As you review the resources provided by your teacher, use the charts below to help collect, synthesize, organize and share information about the properties, sources, and effects of pollution.

Using your own words, pictures, and/or symbols, define the word, *pollutant*.

Source(s) I used to answer the question	Definition
	<hr/> <hr/> <hr/> <hr/>

Using your own words, pictures, and/or symbols, define the word, *pollution*.

Source(s) I used to answer the question:	Definition
	<hr/> <hr/> <hr/> <hr/>

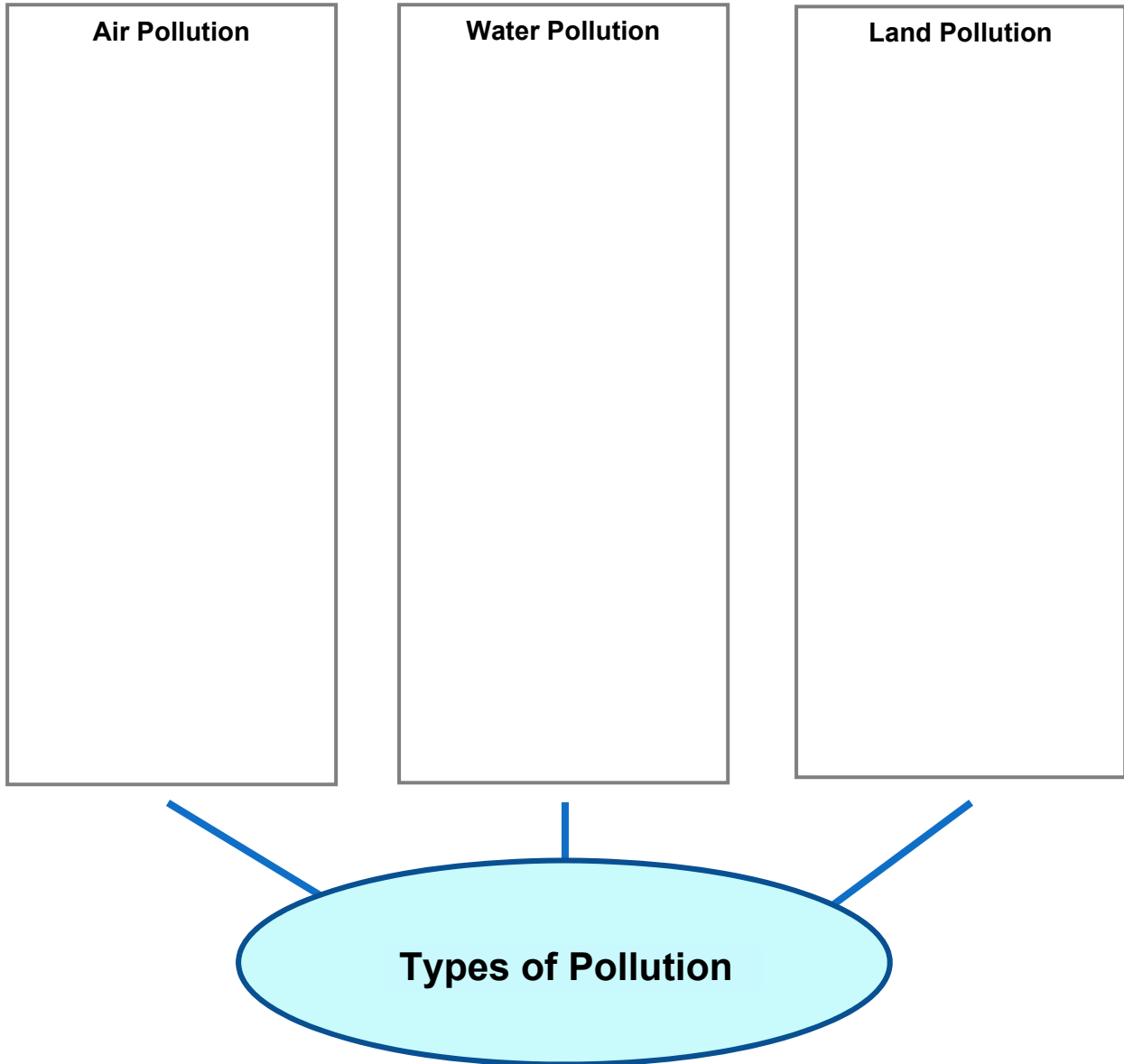
Jigsaw Activity: What Are Some of the Different Types of Pollution?

Chart Number 1 – Taking a Look at One Type of Pollution

Use words and pictures in the boxes below:

<p>Definition</p>	<p>Examples</p>
<p>Pollution type:</p>	
<p>Sources of this type of pollution</p>	<p>The most important fact about this type of pollution</p>

Jigsaw Activity: What Are Some of the Different Types of Pollution?
Chart Number 2 – Three Types of Pollution



How might these three types of pollution be connected?

Part 2- Investigation: Integrating Information & Ideas

Objectives:

- We will explore the different properties of plastics by sorting plastic waste items.
- We will read informational text about how plastic pollution moves across land and into water.
- We will investigate how water (runoff) moves across our school grounds.
- We will conduct a survey of the plastic pollution found on our schoolgrounds and in our neighborhoods.

DIRECTIONS

The picture below features plastic bottles floating in a body of water. In the comic strip boxes below, illustrate your prediction (step-by-step) for where the bottles came from and how they ended up in that body of water.



Wave of Plastic: Meaningful Watershed Educational Experience
Student Workbook: Lesson Three – From Hand, to Land, to Sea

DIRECTIONS

Read the article, “From Land, to Hand, To Sea” that your teacher provides. Then, use your own words, pictures, and/or symbols answer the questions below.

1. What is runoff?

2. Describe how runoff can move plastic from where it is discarded on land to a body of water.

3. Explain how the properties of plastic allow it to be easily transported from land to waterways.

Wave of Plastic: Meaningful Watershed Educational Experience
Student Workbook: Lesson Three – From Hand, to Land, to Sea

4. What effects might *increasing* human populations and per-capita consumption of plastic have on the potential for plastic waste to enter the environment?

5. Review the comic strip that you created above. Update your explanation for where the bottles came from and how they ended up in that body of water based on information from the article you read and class discussion.



Outdoor Field Experience A

How does water (runoff) move across our school grounds?

DIRECTIONS

1. Sketch your school site in the space below. (Be sure to include the closest waterway in your sketch) .
2. With your teacher, go outside. Bring a bucket, cup, or bottle of water with you.
3. Once you are outside, locate the storm drains on the property and add them to your map. Make any other adjustments that might be necessary. Be sure to note areas that are grassy, paved, etc. on your map.
4. Observe the shape of the land on your school site. With your group discuss how you think water will flow on the land.
5. Pour water onto the ground to test your predictions about the direction that runoff flows.
6. What evidence can you observe for how runoff flows on your school grounds? Add these details to your map.

School Site:

Closest Waterway:

DIRECTIONS

1. Take a walk around your schoolgrounds and note each item of plastic trash you see (use the “Types of Plastic Trash” handout to help you).
**Note: you do not have to pick up the trash that you see! If you’d like to pick up trash, please wear gloves!*
2. Keep track of how many of the items of plastic trash pollution that you see during your walk in the chart below.
3. Use the chart to note whether the items may easily be moved by wind or runoff into a storm drain (and thus a waterway).

TYPES OF PLASTIC TRASH



Food Wrappers



Beverage Bottles



Jugs and containers



Bottle/Container Caps



Cigar Tips



Plastic Food Bags



Other Plastic Bags



Disposable Lighter



6-Pack Rings



Coffee-Cup Lids



Plastic Cups



Plastic Utensils



Plastic Straws



Balloons



Coffee Stirrers



Plastic Fragments



Personal Care Products



Other (Sketch Your Own)

Outdoor Field Experience B
Plastic Pollution Survey: Our School Grounds

Survey Site: _____ Date: _____

The weather today: _____

The weather in the last few days: _____

Item	Total Tally (e.g. III)	Could it easily enter a storm drain? (by wind, rain, runoff?)		
		Yes	No	Unsure
Food wrappers				
Beverage bottles				
Other jugs or containers				
Bottle or container caps				
Electronic cigarette materials				
Plastic food bags				
Disposable lighters				
6-pack rings				
Plastic bags				
Coffee cup lids				
Plastic cups				
Plastic utensils				
Straws				
Coffee stirrers				
Personal care products				
Plastic fragments				
Other:				
Totals				

School Grounds Plastic Pollution Survey Results

My Team's Totals	Total number of plastic pollution items:
	Number of items near a storm drain:
	Most common item:
Class Totals	Total number of plastic pollution items:
	Number of items near a storm drain:
	Most common item:

6. Where do you think that the plastic pollution you observed during your survey will 'end up?'
How will it get there?

7. Why is it important to consider recent weather events when conducting your survey? How could weather affect the plastic you observe and where it might 'end up?'

Outdoor Field Experience C

Plastic Pollution Survey: My Neighborhood/Community

Survey Site: _____ Date: _____

The weather today: _____

The weather in the last few days: _____

Item	Total Tally (e.g. III)	Could it easily enter a storm drain? (by wind, rain, runoff?)		
		Yes	No	Unsure
Food wrappers				
Beverage bottles				
Other jugs or containers				
Bottle or container caps				
Electronic cigarette materials				
Plastic food bags				
Disposable lighters				
6-pack rings				
Plastic bags				
Coffee cup lids				
Plastic cups				
Plastic utensils				
Straws				
Coffee stirrers				
Personal care products				
Plastic fragments				
Other:				
Totals				

Wave of Plastic: Meaningful Watershed Educational Experience
Student Workbook: Lesson Three – From Hand, to Land, to Sea

Part 3 – Application: Applying What We Learned Through Informed Action

Objectives:

- We will explore how conceptual models are used in science.
- We will review examples of conceptual models in the form of infographics that explain concepts related to plastic pollution.
- We will work individually or in teams to develop a model in the form of an infographic that represents the possible sources, movement, and destinations of plastic pollution in our communities.

DIRECTIONS

Review the materials that your teacher provides. Then, answer the questions below.

1. What is a conceptual model? _____

2. How are conceptual models used in science? Provide an example to support your response.

3. What is an infographic? _____

4. What elements make an infographic effective? Explain your answer.

Wave of Plastic: Meaningful Watershed Educational Experience
Student Workbook: Lesson Three – From Hand, to Land, to Sea

DIRECTIONS

Work individually or in teams to develop a model in the form of an infographic that demonstrates the possible sources, movement, and destinations of plastic pollution in our communities.

1. Who is your audience and why?

2. What key ideas will you communicate with your infographic?

- ---
- ---
- ---
- ---
- ---

3. What is your intended impact? In other words, what do you hope will happen as a result of sharing your infographic with your audience?

Wave of Plastic: Meaningful Watershed Educational Experience
Student Workbook: Lesson Three – From Hand, to Land, to Sea

4. In the space below, sketch your plan for your infographic.
Be sure to note the elements of effective infographics you will use.

Wave of Plastic: Meaningful Watershed Educational Experience
Student Workbook: Lesson Three – From Hand, to Land, to Sea

Part 4- Assessment: Demonstrating Our Understanding

Objectives:

- Students describe how plastic pollution can enter an environment and how it might travel to other environments.

DIRECTIONS

Use the Claim, Evidence, Reasoning model to respond to the question below.

Claim/Evidence/Reasoning Writing Rubric				
	0	1	2	3
Claim – statement or conclusion that answers the original question/problem.	Does not make a claim.	Makes an inaccurate claim.	Makes an accurate but incomplete claim.	Makes an accurate and complete claim.
Evidence – scientific data that supports the claim. The data needs to be appropriate and sufficient to support the claim.	Does not provide evidence.	Only provides inappropriate evidence (Evidence that does not support the claim.).	Provides appropriate, but insufficient evidence to support claim. May include some inappropriate evidence.	Provides appropriate and sufficient evidence to support claim.
Reasoning – justification that links the claim and evidence and includes appropriate and sufficient scientific principles to defend the claim and evidence.	Does not provide reasoning	Only provides reasoning that does not link evidence to claim.	Repeats evidence and links it to some scientific principles, but not completely.	Provides accurate and complete reasoning that links evidence to claim. Includes appropriate and sufficient scientific principles.

- ★ Construct an argument supported by evidence to describe how plastic pollution can enter an environment and how it might travel to other environments.

What is Pollution?

Types and environmental impacts

What is Pollution

1. Pollution is the introduction of substances or energy (such as light or heat) into the natural environment in amounts or concentrations that can be harmful for humans, animals, and plants.
2. Pollution can reduce the health of ecosystems by harming or even causing death to the living things that call those ecosystems home. The negative effects of pollution can range in severity depending on what the pollutant is, the characteristics of the pollutant, and where the pollutant is located.
3. Pollution is most often composed of synthetic, or human-made substances (like plastic, for example), although even natural substances like sediment, nutrients, and carbon dioxide can become pollutants when they exceed a particular level. If natural substances exceed healthy levels, however, it is very likely the result of human activities.
4. The way in which pollution is categorized, studied, and managed depends on what Earth system is affected. Parts of Earth's systems that can be affected by pollution include land, waterways (such as ground-water, rivers, lakes, bays, and oceans), air, and climate.

What are some different types of pollution?

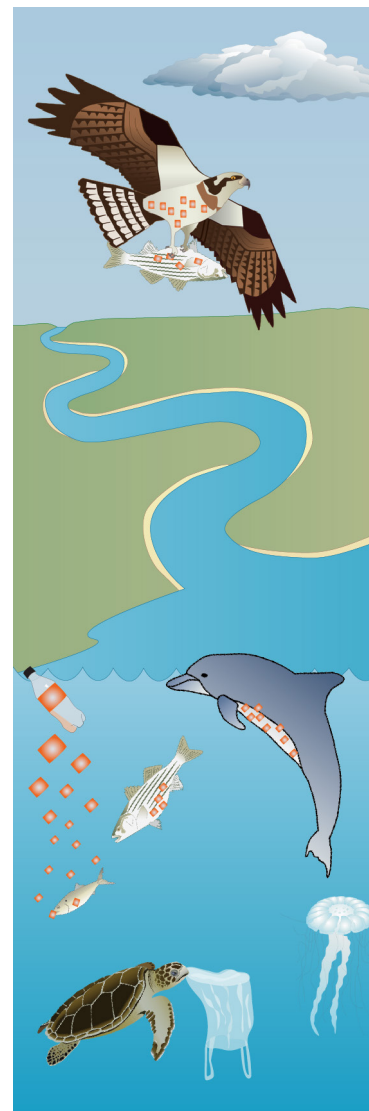
5. Water, air, and land pollution are three major categories of pollution. Sometimes pollution is easy to detect and is obvious to see, like an oil spill from a ship in the ocean. However, pollution can also be hard to see, like in the case of many types of air pollution. Specific pollutants can also contaminate more than one system at a time. For example, spilled chemicals may contaminate soil at the spill site (land pollution), and rain water may carry the chemicals and some of the contaminated soil into waterways (water pollution).
6. Land pollution can be anything from litter on the streets to spilled chemicals, such as gasoline in a gas station parking lot. A large portion of land pollution comes from industrial waste, which is generated from manufacturers or factories. It can also come from commercial waste produced by businesses, such as plastic food wrappers.
7. Another common source of land pollution is solid waste, such as household garbage. The garbage, or trash, that we generate includes things like food packaging, food waste, personal care products, and other unwanted items.
8. Land pollution can become water or air pollution. In fact, most of the pollution in the ocean comes from sources on land! One major way that this happens is through runoff, when rain or wind washes pollutants off the land and into storm drains or waterways. As the runoff travels, it picks up any pollutants in its path like trash and chemicals. Once in storm drains, the polluted runoff can then enter streams, rivers, and eventually bays and the ocean.



- Air Pollution is a mixture of gases and solid particles in the air. Air pollution comes from the exhaust that cars and trucks produce when they burn gasoline for fuel, chemicals from factories, dust, mold, smog, and other sources. Air pollution can reach harmful concentrations both outside and indoors.
- Water pollution can occur when pollutants are introduced into groundwater, rivers, lakes, ponds, and oceans. Sources of water pollution include synthetic materials like plastics, chemicals, pesticides, and fertilizers, and natural materials like nutrients and sediments. These pollutants often accumulate or build up as they flow downstream. They often eventually end up in bays and oceans, since all of these waterways are connected.

What are the effects of pollution on the environment and living things?

- Pollution harms the environment by making it less suitable for living things. Sometimes a pollutant is toxic or dangerous and can directly cause living things to die. However, lower amounts of a pollutant or different types of pollutants may make a living thing sick, cause injury, or reduce its ability to find good habitat or food.
- Pollutants can be especially dangerous when they accumulate, or build up, in an ecosystem and reach high, toxic concentrations. Plants and animals can absorb or ingest toxins from pollution, which can be damaging to their own health. As organisms eat each other, toxins from the pollution can then be passed from organism to organism up the food chain, increasing in concentration each time until they are at such high levels that they can cause death or serious health problems to the organism. Air pollution can be very dangerous to the animals and humans who breathe it in. It can cause short-term issues such as sneezing or coughing as well as long-term problems such as disease and even death.



What is plastic pollution?

- Much of the solid waste that becomes land and water pollution is made of plastic. There are many properties of plastic pollution that make it dangerous to natural environments. Items made of plastic (like plastic bags and bottles) are lightweight and float, which makes it easy for them to travel by wind and water into the environment. Because plastic is very durable and it can withstand damage, plastics can remain in ecosystems for years and years. As pollution, plastic can injure animals if they become entangled in it (for example, if an animal gets tangled in an abandoned plastic nylon fishing net) or if animals ingest plastic because they mistake it for food.

What can you do to help?

- Pollution can cause a variety of negative changes to the environment and the living things that call it home (including us). Can you think of ways you could prevent different types of pollution in your environment and beyond?



From Hand to Land to Sea:

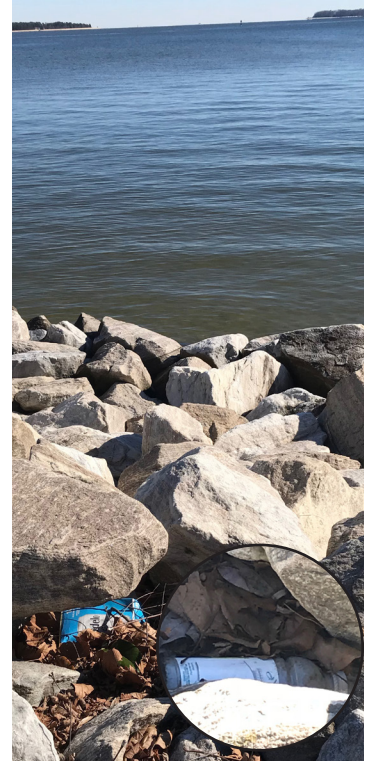
Sources and Destinations of Plastic Pollution

What are the Sources of Pollution?

1. The majority of pollution comes from human activities. Pollution is defined as any substance or energy that is foreign to a particular environment or is present in high enough quantities to cause harm to humans, animals, and plants.
2. Pollution can enter the environment in direct ways. For example, some factories discharge polluted wastewater through pipes directly into nearby lakes or rivers. Pollution can also get into the environment through indirect ways. Runoff can happen when rain or melting snow moves across the surface of the land without being absorbed. As runoff water travels it picks up pollutants like trash and chemicals and carries them into streams or rivers, or into storm drains which lead directly into the nearest water body, ultimately flowing into the ocean. This means that trash, such as drink bottles, can travel from our neighborhoods to the Chesapeake Bay and eventually the ocean! This also means that the source of the pollution can be very far from the environment where it ends up.

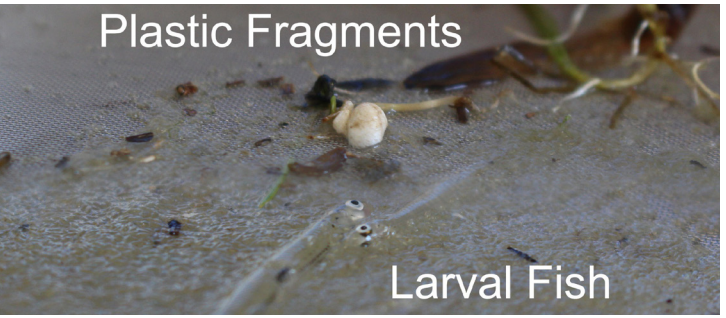
What about plastic pollution?

3. Most of the plastic pollution in the ocean comes from the land and is carried there by runoff. Our per-capita use of plastics - in other words, the amount of plastic that each person in the growing population uses - keeps increasing, which means the chance of it becoming pollution are also increasing. Plastic items can become pollution when they are either intentionally put into the natural environment or when they accidentally get there, such as if the wind blows a trashcan over.
4. There are multiple properties of plastic that make it easy for plastic waste items to be carried by wind and runoff into natural environments. Plastic is lightweight and buoyant (meaning it can float), and because of this, plastic items can be easily carried by wind and water, traveling from your hand, to the land, to streams and rivers, and finally into bays and the ocean.
5. Some plastics easily **break up** into smaller pieces over time, but those pieces do not easily **break down** in the ways that natural materials do. The majority of plastic pollution in the ocean is made up of microplastics. Microplastics are small bits of plastics that are less than 5 millimeters long (about the length of a red ant). Microplastics are plastics that were once larger items (such as plastic forks, children's toys, or microfibers from clothes) that broke apart into smaller pieces or that were originally very small, such as plastic microbeads and glitter. Microplastics are easily carried by the wind and rain because they are lightweight and buoyant, but their tiny size makes their transport through landscapes and waterways even faster. Microplastics are so small in fact that they can be difficult to see and can be very challenging to filter from water, sediments and soil.





Scientists sample the Patuxent River for microplastics



Microplastics were found in all Patuxent River samples

What does pollution do to aquatic systems?

6. Pollution can cause a wide range of problems to living things by negatively affecting the function and stability of the ecosystem. For example, an ecosystem that is affected by pollution may not be able to provide the services it normally does, like clean water, fresh air, or access to food. This can then harm the living things in the ecosystem that depend on those services by causing illness, injury, or even death.
7. Plastic pollution that gets into the environment breaks up into smaller pieces or microplastics over time. When plastic is in the environment, it can also release harmful chemicals that contaminate the air, water, and soil. If living things mistake microplastics for food and ingest them, these harmful chemicals can also be released into their bodies and cause illness or death.
8. Once plastic enters the food chain, it can accumulate in the bodies of organisms either when a living thing directly ingests plastic or when one organism eats another organism that has plastic in its body. Fish, oysters, dolphins, birds, whales and sea turtles have all been found with stomachs full of plastic! These large amounts of plastic prevent these animals from being able to digest real food and will often cause them to eventually die of starvation. Plastic can also accumulate in the environment, reducing the amount of suitable habitat for plants and other organisms by blocking space and sunlight.
9. Large pieces of plastic pollution, like plastic fishing line or soda can rings, can also entangle or wrap around the bodies, fins or limbs of organisms, preventing them from being able to hunt for food or even move. This eventually can lead to suffocation, starvation, or even death for entangled individuals.

What can we do to help?

10. There are many different actions that cities, organizations, and individuals (you!) can take to prevent pollution, especially plastic pollution. The best way to prevent pollution is by reducing the amount we use and waste we produce. For example, you can select foods with little or no plastic packaging or choose to use reusable items instead of single-use ones. You can spread this action to your community by acting as an example and telling them what you have learned about pollution and where it comes from.
11. As citizens and voters, we can also propose and support efforts to make laws that require businesses, factories, and communities to reduce the pollution they produce.
12. Having local cleanups to pick up trash can stop pollution from getting into important habitats and help raise awareness about the problem. People also tend to be less likely to litter in a cleaner environment.
13. Finally, proper disposal of waste items is very important to prevent them from getting picked up by wind and rain and carried to the ocean. Make sure that waste items are contained in trash bags or cans with lids and that they are not overfilled. For plastic waste, check the bottom of the plastic item for the recycling code number and find out if your city will let you recycle it (make sure it's clean first!).
14. **What actions do you plan on taking to prevent pollution in your community?**

HOW DO PLASTICS GET INTO THE CHESAPEAKE BAY?

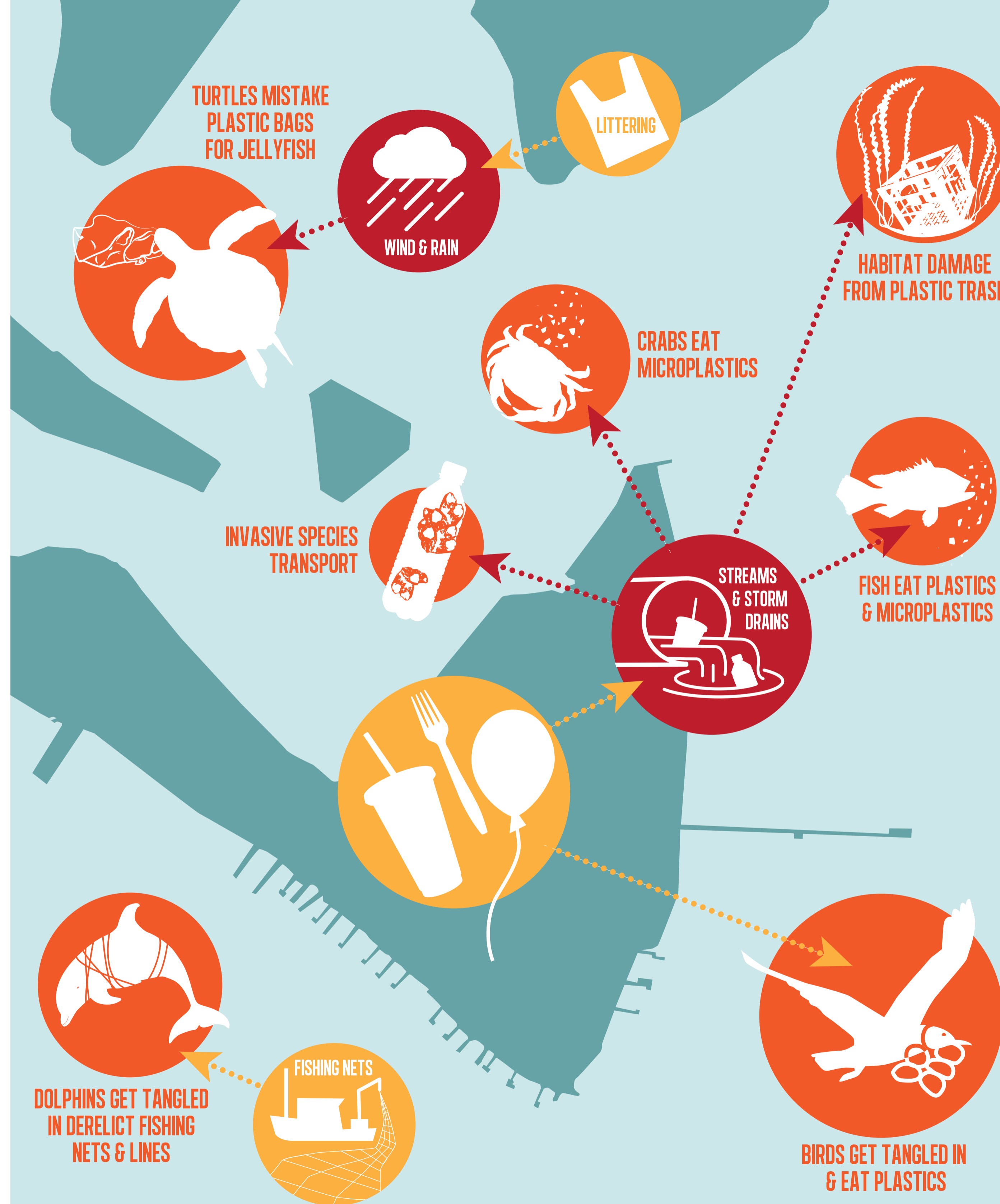
An estimated 8 million tons of plastic enters the water from land globally every year! This includes many single-use items, like plastic straws, bags, bottles and take-out containers.

Plastic doesn't just enter waterways through boat-based activities. Most plastic marine pollution comes from activities on land. Strong rain or winds can blow over trash cans and wash litter from roads directly into local waterways or into storm drains that flow into rivers.

Here, small streams and rivers flow into the Patuxent River, which leads to the Chesapeake Bay, and the Atlantic Ocean.

WHY SHOULD WE CARE?

Plastics can harm and kill wildlife, pollute our beaches and waterways, and cost millions of taxpayer dollars to cleanup every year. Chemicals are also within and on plastics and as these chemicals interact with our environment, they may accumulate in the things we eat.



WHAT CAN YOU DO?

-  Skip the straws, plastic bags, and plastic take-out items!
-  Reduce, Reuse, and Recycle...or just Refuse to Use!
-  Participate in beach and community greenspace cleanups!



PLASTICWATCH

Visit our website to learn more
www.umces.edu/plasticwatch



The PlasticWatch project is funded using federal funds under award number NA16NOS4190170 from NOAA, U.S. Department of Commerce. The statements, findings, conclusions, and recommendations are those of the author and do not necessarily reflect the views of NOAA or the U.S. Department of Commerce.

STUDENT WORKBOOK



WAVE OF PLASTIC

Meaningful Watershed Educational Experience

LESSON FOUR IMPACTS ON AQUATIC ECOSYSTEMS

- How do we describe, quantify, and communicate about issues related to plastic waste?
- What causes disruptions to the stability of ecosystems?
- How can we use models to make predictions about the impacts of plastic pollution on ecosystems?
- How can personal choices and behaviors reduce the impacts of plastic pollution on ecosystems?

Student Name:

Unit Driving Question:

How do human choices regarding the consumption and disposal of plastics impact ecosystems and our communities and what actions can we take to minimize those impacts?

Wave of Plastic: Meaningful Watershed Educational Experience
Student Workbook: Lesson Four – Impacts on Aquatic Ecosystems

Part 1- Introduction: Building Understanding

Objectives:

- We will obtain, evaluate, and communicate information about ecosystems as biological communities of interacting organisms and their physical environments.

DIRECTIONS

As you review the resources provided by your teacher, use the charts below to help collect, synthesize, organize and share information about ecosystems.

1. What is biodiversity?

Resources that I used	Notes

2. What does it mean for an ecosystem to be healthy and stable?

Resources that I used	Notes

Wave of Plastic: Meaningful Watershed Educational Experience
Student Workbook: Lesson Four – Impacts on Aquatic Ecosystems

3. Why do scientists use an ecosystem's biodiversity as a measure of the health and stability of that ecosystem?

Resources that I used	Notes

4. In the box below, illustrate and label an example of a healthy and stable ecosystem.

5. What sorts of things can cause disruptions to the stability of ecosystems?

Resources that I used	Notes

Part 2- Investigation: Integrating Information & Ideas

Objectives:

- We will model and describe how plastic pollution in ecosystems affects organisms.

Activity: “You Are What You Eat”

DIRECTIONS

Follow your teacher’s directions to participate in the activity, “You Are What You Eat.” Then, answer the questions below.

Student Data Collection Sheet					
My condition: _____		My name: _____			
	Color 1:	Color 2:	Color 3:	Color 4:	Total:
Round 1					
Round 2					
Round 3					
Total Consumed (A)					
				Total Plastic (B)	
				Total Food (C)	


1. Compare your data to that of your group. What kind of effects from plastic pollution did your group members experience?

2. Which team member obtained the least amount of food? Why?

Wave of Plastic: Meaningful Watershed Educational Experience
Student Workbook: Lesson Four – Impacts on Aquatic Ecosystems

3. How could the properties of plastic prevent an organism from getting the nutritional value it needs?

4. In the space below, illustrate an example of plastic pollution that is negatively impacting the organisms in an aquatic ecosystem. Be sure to label your illustration.



Part 3 – Application: Applying What We Learned Through Informed Action

Objectives:

- We will discuss how small changes in one part of a system might cause large changes in another part.
- We will apply what we've learned about per-capita consumption, plastic pollution, and the effects on ecosystems to develop a personal pledge for behavior change.

“I Make A Difference” Reducing Plastic Pollution Personal Pledge

DIRECTIONS

Develop a personal pledge that you plan to follow in order to help reduce harmful effects that plastic pollution has on ecosystems.

Things to keep in mind:

- Students can do many things to help make the world a better place. Applying what you've learned about an issue into positive and informed action is a perfect example!
- Personal pledges are commitments that a person makes to help them achieve a personal goal.
- Personal pledges might be focused on completing a certain action, such as taking reusable bags to the store, or it might focus on *not* doing a certain action, such as refusing to use plastic straws.
- Revisit your Personal Waste Inventory (from Lesson 1) and use other resources from the *Wave of Plastic* lessons to help you brainstorm ideas and get inspired!

Wave of Plastic: Meaningful Watershed Educational Experience
Student Workbook: Lesson Four – Impacts on Aquatic Ecosystems

List ideas for your personal pledge:

- 1.
- 2.
- 3.

Which of your ideas would be something you could pledge to do/not do starting today?

Which of your ideas would require some setup before you could start your pledge?

Which action will you pledge to take?

When are you planning to take this action?

Is it a one-time event or a habit to change?

What do you hope will be the impact of your pledge?

What could be the potential impact if everyone at your school engaged in this action?

What could be the impact if everyone in your state engaged in this action?

What could be the impact if everyone in the country engaged in this action?

If this action is not taken, what would/could happen?

I, _____,

**pledge to protect ecosystems
from the harmful effects
of plastic pollution by**

My actions **matter** because

Trace your hand in the space below. If you'd like, you can decorate it to fit your pledge!

Wave of Plastic: Meaningful Watershed Educational Experience
 Student Workbook: Lesson Four – Impacts on Aquatic Ecosystems

Part 4- Assessment: Demonstrating Our Understanding

Objectives:


- Students describe how plastic pollution can cause changes to physical and biological components of an ecosystem.

DIRECTIONS

Use the Claim, Evidence, Reasoning model to respond to the question below.

Claim/Evidence/Reasoning Writing Rubric				
	0	1	2	3
Claim – statement or conclusion that answers the original question/problem.	Does not make a claim.	Makes an inaccurate claim.	Makes an accurate but incomplete claim.	Makes an accurate and complete claim.
Evidence – scientific data that supports the claim. The data needs to be appropriate and sufficient to support the claim.	Does not provide evidence.	Only provides inappropriate evidence (Evidence that does not support the claim.).	Provides appropriate, but insufficient evidence to support claim. May include some inappropriate evidence.	Provides appropriate and sufficient evidence to support claim.
Reasoning – justification that links the claim and evidence and includes appropriate and sufficient scientific principles to defend the claim and evidence.	Does not provide reasoning	Only provides reasoning that does not link evidence to claim.	Repeats evidence and links it to some scientific principles, but not completely.	Provides accurate and complete reasoning that links evidence to claim. Includes appropriate and sufficient scientific principles.

- ★ Construct an argument supported by evidence to describe how plastic pollution can cause changes to physical and biological components of an ecosystem.



Wave of Plastic: Meaningful Watershed Educational Experience

STUDENT WORKBOOK

Stewardship & Action Journal



WAVE OF PLASTIC

Meaningful Watershed Educational Experience

LESSON FIVE WE CAN MAKE A DIFFERENCE

- How do we describe, quantify, and communicate about issues related to plastic waste?
- What is environmental stewardship?
- How are students and other citizens engaging in informed action to address issues of plastic pollution?
- What can we do?

Student Name:

Unit Driving Question:

How do human choices regarding the consumption and disposal of plastics impact ecosystems and our communities and what actions can we take to minimize those impacts?

Part 1- Introduction: Building Understanding

Objectives:

- We will ask questions and make observations about how our choices and activities regarding the consumption and disposal of materials contribute to issues of plastic pollution.
- We will explore ways that we can take informed action to address issues related to plastic pollution.
- We will integrate and interpret information presented in different media or formats to develop a coherent understanding of a topic or issue.

Use the space below to take notes and list ideas as you:

- Review and reflect on issues related to plastic pollution and how they affect the Chesapeake.**
- Review and reflect on the actions taken in previous Wave of Plastic Lessons.**
- Explore stewardship definitions and the different types of action projects.**

Part 2- Investigation: Integrating Information & Ideas
Part 3 – Application: Applying What We Learned Through Informed Action

Objectives:

- We will use our *Student Action Journals* to plan, implement, and evaluate solutions for addressing issues related to plastic waste in our communities.

Taking Action to Address Issues Related to Plastic Pollution

Using this journal as a tool, we will:

- ❑ **Ask questions.** We will ask questions about the problems related to plastic pollution that are affecting our community and identify a problem that we can take action to help resolve.
- ❑ **Collect information & draw conclusions.** We will collect information and draw conclusions to help us better understand the issue.
- ❑ **Develop a claim and identify solutions.** We will develop a claim based on the conclusions we have drawn. Our claim should reflect an opportunity for seeking solutions through informed action to address the problem in a way that seeks a solution.
- ❑ **Design a plan and take informed action.** We will design a plan for implementing our solution through informed action in our classroom, school, and/or communities. Our plan will include criteria for determining whether our actions successfully addressed the problem. We will implement our plan.
- ❑ **Evaluate and reflect.** We will reflect on the action and determine the extent to which it successfully addressed the problem we identified. We will identify opportunities for sustaining or extending the action.

Ask questions

We will ask questions about the problems related to plastic pollution that are affecting our community and determine a problem for which we can take action to help resolve it.

How do human choices regarding the consumption and disposal of plastics impact ecosystems and our communities and what actions can we take to minimize those impacts?

1. What issues related to plastic waste have you observed in your community? Brainstorm ideas with a partner or as a class. Write the list below.
 - *Example: Students at our school throw plastic trash on the ground outside*
 - *Example: Our school throws away a lot of plastic spoons and forks at lunchtime*
 - *Example: Students at our school do not know what items are recyclable*

- ◆ _____
- ◆ _____
- ◆ _____
- ◆ _____
- ◆ _____

2. Select one of these issues that YOU WILL address through informed action.
Circle your choice above.

Why did you choose that issue to address through informed action?

Wave of Plastic: Meaningful Watershed Educational Experience
Student Workbook: Lesson Five – We Can Make a Difference

Now that you have chosen an issue for your **Student Action Plan**, use the following questions to begin to better understand and solve the problem.

1. What information do you already know about your issue?

a. _____

b. _____

c. _____

2. In the chart below, identify who might be affected by the issue and by a project to help resolve the issue.

Who is affected by this issue?	Who will be affected by a project to help resolve the issue?

3. In the chart below, describe your perspectives on the issue. Then, describe perspectives that might differ or oppose your own. Finally, brainstorm some potential points of agreement.

Your Perspective on the Issue	Opposing Perspectives on the Issue
Potential Points of Agreement	

Wave of Plastic: Meaningful Watershed Educational Experience

Student Workbook: Lesson Five – We Can Make a Difference

Collect information & draw conclusions

We will collect information and draw conclusions to help us better understand the issue.

1. In the chart below, list the supporting questions you will need to answer and the information you will need gather to better understand your issue.

(For example: How many plastic straws were thrown away today during lunch? How many pieces of plastic could be recycled from our school lunches? How many people in our school know what can be recycled in our county?)

Supporting Questions
1.
2.
3.
4.
5.
6.

Wave of Plastic: Meaningful Watershed Educational Experience
Student Workbook: Lesson Five – We Can Make a Difference

1. What are some resources you could use to gather information to answer the supporting questions? Identify your resources in the chart below. Add any notes that you find helpful.

Websites:	Notes:
People/Organizations:	Notes:
Books/Articles:	Notes:
Other:	Notes:
Other:	Notes:

Wave of Plastic: Meaningful Watershed Educational Experience
Student Workbook: Lesson Five – We Can Make a Difference

2. Refer to your supporting questions and the resources you identified. In the space below, use your resources to answer your supporting questions. Record information that helps answer your supporting questions.

Research/Notes
1.
2.
3.
4.
5.
6.

Wave of Plastic: Meaningful Watershed Educational Experience
Student Workbook: Lesson Five – We Can Make a Difference

3. What does your research suggest about patterns or trends in your community?

4. How do these patterns or trends help you decide what action you should take?

Develop a Claim and Identify Solutions

We will develop a claim based on the conclusions we have drawn. Our claim should reflect an opportunity to take informed action to address the problem in a way that seeks a solution.

1. Using the chart below, develop a claim that responds to, or describes the problem you've been exploring. The claim should inspire or prompt informed action.

Use what you've learned in your investigations as evidence to support your claim.

Finally, provide the reasoning to justify and explain your claim and evidence.

Claim: A statement or conclusion that responds to the question/problem. *What is the problem?*

Evidence: The data that supports the claim. *The data should be appropriate and sufficient to support the claim.*

Reasoning: The justification that links the claim and evidence. *Why is it a problem?*

Wave of Plastic: Meaningful Watershed Educational Experience
Student Workbook: Lesson Five – We Can Make a Difference

2. Use the charts below. Brainstorm at least two solutions to the problem that you could implement. Explain how and why each solution would successfully address the problem. Describe the advantages and challenges of each solution. Finally, choose one solution to implement.

<i>Solution A: One possible solution that responds to the problem reflected in the claim.</i>
Evidence & Reasoning for Solution A: <i>How would Solution A respond to the problem?</i>
Potential Benefits of Solution A:
Potential Challenges to Solution A:

<i>Solution B: One possible solution that responds to the problem reflected in the claim.</i>
Evidence & Reasoning for Solution B: <i>How would Solution B respond to the problem?</i>
Potential Benefits of Solution B:
Potential Challenges to Solution B:

Wave of Plastic: Meaningful Watershed Educational Experience
Student Workbook: Lesson Five – We Can Make a Difference

3. Use the charts below to begin planning how you will implement your action project.

Our Solution: <i>Restate the solution you have chosen to implement through informed action</i>	
Evidence & Reasoning for Our Solution: <i>Describe why your solution is a good option for addressing the problem.</i>	
Criteria for Success: <i>How will you know whether your solution successfully addresses the problem?</i>	
<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	
Materials Needed: What materials will you need to complete your plan? How will you obtain those materials?	
Material	Source
<input type="checkbox"/>	
<input type="checkbox"/>	
<input type="checkbox"/>	
<input type="checkbox"/>	
<input type="checkbox"/>	
<input type="checkbox"/>	
<input type="checkbox"/>	

Wave of Plastic: Meaningful Watershed Educational Experience
Student Workbook: Lesson Five – We Can Make a Difference

4. **Action Plan:** In the space below, list the steps that you will take to implement your plan. As you carry out your plan, be sure to take notes on your progress, challenges you faced, and successes you had.

Step	Notes on Progress	Notes on Challenges <i>What challenges did you face and how did you resolve them?</i>	Successes <i>What was successful? Why do you think it was successful?</i>
<input type="checkbox"/>			
<input type="checkbox"/>			
<input type="checkbox"/>			
<input type="checkbox"/>			

Wave of Plastic: Meaningful Watershed Educational Experience
Student Workbook: Lesson Five – We Can Make a Difference

Evaluate and reflect

We will reflect on the action we took and determine the extent to which it successfully addressed the problem.
 We will identify opportunities for sustaining or extending the action.

1. After you have completed your action plan, use the chart below to restate the solution that you carried out through informed action and the criteria for determining whether your action was successful.

Our Solution: <i>Restate the solution you have chosen to implement through informed action</i>
Criteria for Success: <i>How will you know whether your solution successfully addresses the problem?</i>
<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>

2. In the chart below, describe whether and how your plan met each criterion you identified as being an indicator of success. What recommendations do you have for ensuring better success for each criterion?

Criteria	How successful was the plan according to these criteria?	Recommendations <i>What challenges did you face and how did you resolve them?</i>
<input type="checkbox"/>		
<input type="checkbox"/>		
<input type="checkbox"/>		

Wave of Plastic: Meaningful Watershed Educational Experience
Student Workbook: Lesson Five – We Can Make a Difference

3. Reflect on the experience of planning and implementing your action project. Respond to the following questions:

- What was something you and/or your group found particularly rewarding about the experience?

- What was something you and/or your group found particularly challenging about the experience?

- How would you describe the impact of your project on your community (in the short-term and the long-term)?

- How would you describe the impact of your project on ecosystems (in the short-term and the long-term)?

- Describe what steps are needed to ensure that your project is sustainable (in other words, that it will continue to be effective in the future).

Wave of Plastic: Meaningful Watershed Educational Experience
Student Workbook: Lesson Five – We Can Make a Difference

List of Artifacts

**In the space below, list any relevant artifacts that support your project.
(For example, data charts, graphs, photographs, prototypes, sketches etc.)**

Part 4- Assessment: Demonstrating Our Understanding

Objectives:

- Part 1: Students complete a *Student Action Project Summary* to demonstrate their understandings developed through Lesson 5.
- Part 2: Students will use the *Claim, Evidence, Reasoning model* to demonstrate understandings developed throughout the entire *Wave of Plastic* unit.

Part 1: Student Action Project Summary

DIRECTIONS

Use the chart below to summarize and reflect on your action plan.

Driving Question:

How do human choices regarding the consumption and disposal of plastics impact ecosystems and society (in our communities) and what actions can we take to minimize those impacts?

The problem that we addressed:

Our solution:

Wave of Plastic: Meaningful Watershed Educational Experience
Student Workbook: Lesson Five – We Can Make a Difference

The scientific principles that informed our solution:

The impact of our solution:

Advice for others working to address this problem:

Part 2: Claim, Evidence, Reasoning Response

DIRECTIONS

Use the Claim, Evidence, Reasoning model to respond to the question below.

Claim/Evidence/Reasoning Writing Rubric				
	0	1	2	3
Claim – statement or conclusion that answers the original question/problem.	Does not make a claim.	Makes an inaccurate claim.	Makes an accurate but incomplete claim.	Makes an accurate and complete claim.
Evidence – scientific data that supports the claim. The data needs to be appropriate and sufficient to support the claim.	Does not provide evidence.	Only provides inappropriate evidence (Evidence that does not support the claim.).	Provides appropriate, but insufficient evidence to support claim. May include some inappropriate evidence.	Provides appropriate and sufficient evidence to support claim.
Reasoning – justification that links the claim and evidence and includes appropriate and sufficient scientific principles to defend the claim and evidence.	Does not provide reasoning	Only provides reasoning that does not link evidence to claim.	Repeats evidence and links it to some scientific principles, but not completely.	Provides accurate and complete reasoning that links evidence to claim. Includes appropriate and sufficient scientific principles.

Use what you've learned about issues related to plastic waste throughout all *Wave of Plastic* lessons.

- ★ Construct an argument supported by evidence for how increases in human population and per-capita consumption of natural resources impact Earth's systems.

REDUCING PLASTIC POLLUTION IN THE CHESAPEAKE BAY

7 THINGS YOU CAN DO



**BRING YOUR OWN
SHOPPING BAG**



**USE A REUSABLE
WATER BOTTLE OR MUG**



**SAY NO TO STRAWS &
PLASTIC UTENSILS**



**PACK YOUR LUNCH IN
REUSABLE CONTAINERS**



**PARTICIPATE IN BEACH &
COMMUNITY CLEANUPS!**



**REDUCE, REUSE, AND RECYCLE...
OR JUST REFUSE TO USE!**



**SHARE THESE TIPS WITH YOUR FRIENDS.
TOGETHER WE ALL MAKE A DIFFERENCE!**

**PROOF
ONLY**



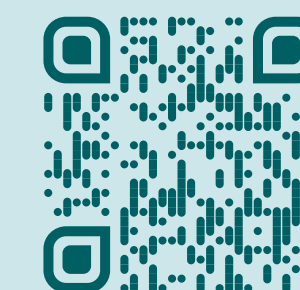
PLASTICWATCH

**Billions of pounds of
plastic pollution enter
the ocean every year.**

Where does it come from? Much of it comes from single-use disposable items, such as plastic straws, cups, bags and bottles. These plastics may be eaten by animals or they can become entangled causing them harm and even death.

Scientists at the University of Maryland Center for Environmental Science, Chesapeake Biological Laboratory, are working with businesses on a project called "PlasticWatch" to reduce the use of single-use plastics in our community.

Visit our website to learn more
www.umces.edu/plasticwatch



The PlasticWatch project is funded using federal funds under award number NA16NOS4190170 from NOAA, U.S. Department of Commerce. The statements, findings, conclusions, and recommendations are those of the author and do not necessarily reflect the views of NOAA or the U.S. Department of Commerce.