Program on Marine Debris
Community Science for 4th/5th grades

DUML COMMUNITY SCIENCE

Duke NICHOLAS SCHOOL OF THE ENVIRONMENT
DUKE UNIVERSITY MARINE LAB

Our oceans, beaches and coastal waterways are full of many land-based items that do not naturally belong there. Plastics, metals, rubber, fabrics, abandoned boats, derelict fishing gear and more make their way into our waterways; and have created an enormous pollution problem called marine debris. According to NOAA, marine debris is defined "as any persistent solid material that is manufactured or processed and directly or indirectly, intentionally or unintentionally, disposed of or abandoned into the marine environment or the Great Lakes". Marine debris affects waterways and oceans throughout the world, and much of the problem stems from what is produced on land, used on land, and disposed of in a manner that makes its way into waterways. In Eastern North Carolina's 3,000 plus miles of coastline, the issue of marine debris is especially poignant because marine debris negatively affects the health of our marine environment. And activities that depend on healthy waterways generate over 2 billion dollars of GDP ocean economy for NC [1].

This Community Science Program on Marine Debris combines community science at Duke University's Marine Laboratory (DUML) with environmental literacy activities to connect elementary students to marine debris issues, research, and researchers in our community. The interdisciplinary activities in this booklet are designed to inspire our kids to explore and discover issues surrounding marine debris and utilize a mixture of newly created activities, existing research protocols, and education resources (from places like Washed Ashore, NOAA, and ScienceWorld) that have been modified based on local conditions here in NC. Together, these activities represent a year-long program that will engage elementary students with experiential learning based on local ecosystems. We hope DUML's Community Science Program on Marine Debris integrates into existing classroom activities, and provides teachers with hands-on exploration activities that complement existing curriculum.

As teachers, you know your class and students best. Please feel free to deliver the activities in a time frame that works best for your classroom flow. Topics and activities can be focused over a few weeks, spread out over a month, or peppered throughout the school year. Many of the activities have extension options that can allow you to expand your exploration in ways that work best for your students/classroom. Links to 4th grade common core standards in Math, Science, ELA, Art, Technology, Social Studies, and Civics & Government are located in the appendix (pg. 38).

The creation of this curriculum book was possible by the generous support of NSF.

NSF

[1] North Carolina's Ocean Economy: A First Assessment and Transitioning to a Blue Economy https://ncsea-grant.ncsu.edu/ncseagrant_docs/products/2010s/NC_Ocean_Economy_White_Paper.pdf

The activities in DUML's Community Science Program on Marine Debris are divided into the following component categories:

CLASSROOM EXPLORATIONS -- These science and technology activities are used to introduce topics and provide background information in your classroom on waste, plastics, and robotics (science, math and technology). These background topics set the stage for the field research and creative engagement components.

FIELD RESEARCH -- These science, math, and technology research activities are based on a beach clean-up to collect, quantify and measure marine debris in our waterways.

CREATIVE ENGAGEMENT -- These exploration activities work well with small groups, and allow students to further explore the topic of marine debris creatively with art, poetry, writing, research, civics, and technology. These activities are designed so that the products (art, poems, stories, and videos) can be shared with the general public and give students a sense of civic engagement within their community.

TEACHERS INVOLVE PARENTS IN SCHOOLWORK (TIPS) -- These are interactive homework assignments that allow students to share their work with family members.

DOCUMENTATION -- This is an on-going class activity where students use photos and videos of their activities to create a documentary of what they did and what they learned.

Contributing authors: Elizabeth DeMattia, Cristina Quattrone, and Annie Harshbarger.
Booklet Design: Courtney Edwards

Program on Marine Debris
Community Science for 4th/5th grades

DUML COMMUNITY SCIENCE

Duke NICHOLAS SCHOOL OF THE ENVIRONMENT
DUKE UNIVERSITY MARINE LAB

A ROAD MAP FOR DUML's COMMUNITY SCIENCE PROGRAM IN MARINE DEBRIS

CLASSROOM EXPLORATIONS (pg. 4)

Waste & Plastics
Waste Audit
How Long Till It's Gone?
What is Plastic?
A Plastic Ocean

Robotics
Physics of Marine Debris Movement
Marine Debris Entanglement
Majestic Plastic Bag
The Physics of Drone Flight

FIELD RESEARCH (pg. 13)

Beach Clean-up
Collect & Quantify Marine Debris
Data Analysis & Quantification

CREATIVE ENGAGEMENT (pg. 15)

Community Art
Marine Debris Mosaic
Marine Debris Poetry
Circle of Viewpoints
Journey of X Mural
PSAs

Civic Engagement & Communication
Public Presentation of Art & Civic Action

TEACHERS INVOLVE PARENTS in SCHOOLWORK (pg. 21)

TIPS #1: Interactive homework on marine debris

TIPS #2: Interactive homework on creative engagement

DOCUMENTATION (pg. 21)

Student-led documentation of the program with videos, photos and commentary

DOCUMENTATION (pg. 22)

Creation of student documentaries

DUML COMMUNITY SCIENCE

Duke NICHOLAS SCHOOL OF THE ENVIRONMENT
DUKE UNIVERSITY MARINE LAB

CLASSROOM EXPLORATIONS

The **CLASSROOM EXPLORATIONS** activities are designed to introduce topics and provide the background information so that your students are prepared for the marine debris field research component. There are two sections in Classroom Explorations: i) Waste and Plastics and ii) Robotics. Students will learn about marine debris, drones, scientific sampling, the physics of flight, and plastic pollution. The background activities can be spread out over weeks or consolidated for intense study.

Waste & Plastics: This classroom explorations section is designed to give your students background knowledge on the types of garbage that becomes marine debris. Activities have been designed to allow your students to analyze different streams of waste, understand what plastics are made of, and evaluate the life cycle of plastics.

Robotics: This classroom explorations section is designed to give students background knowledge on how robotic drones are used in scientific research, the physics behind drone flight, the physics of how garbage moves over land and into our waterways, and how aerial photographs from drones are used to assess area in scientific sampling.

WASTE & PLASTICS: Waste Audit (activity)

Waste and Plastics
► Waste Audit
How Long Till it'sGone
What is Plastic?
A Plastic Ocean

Introduction

This activity will introduce students to the waste/garbage issue by connecting it to their personal behavior and allowing students to extrapolate up from their personal behavior to that of their school, community, county and state.

Objectives

At the end of this activity students will be able to:

- Understand the scale of garbage generation on a personal level.
- Analyze personal garbage audits and scale up to create estimates for garbage generation in schools, communities, counties and state.
- Understand that marine debris starts as a garbage issue.

Activity Plan

1. Create a class definition of waste such that the definition incorporates waste (garbage we send to landfill), recycling (used materials that are reprocessed into other materials), and compost (organic matter broken down into fertilizer/soil).
2. Conduct an audit for one week of all waste generated by each individual in the class. Create three bins (waste, recycling, and compost) in your classroom, and give each student a tally sheet to write down the quantity of each item they put in

each bin. Note: classrooms can also create clear garbage bins on each desk (that are emptied daily) as a way for students to visually compare individual waste generation.

3. Analyze the results from your audit and evaluate how much waste each student and class generates (use the garbage audit worksheets included or create your own).
4. Calculate the average amount of garbage, recycling, and compost generated per student (per class, per school, per day and per year); and calculate diversion rates (equation is on garbage audit worksheets). Extrapolate to create averages for schools in the county and state.
5. Use the plastics collected during the waste audit and data from the math activities and create a mural explaining how much plastic your class uses.
6. Send home TIP #1 assignment (pg.27).

Materials

- A scale to measure garbage weight.
- Clear containers to keep garbage, recycling and compost. Students can keep tallies of individual pieces of trash and recycling, or just get weights before putting in the bins [hint: empty compost bin daily].
- A bucket of soapy water and vinegar spray to clean and disinfect plastic.
- A copy of garbage audit worksheets for students (pg. 24).
- TIPS Assignment Worksheet #1 (pg.27).

Extensions

- Build composting/vermicomposting stations at your school (many examples online).
- Compare classroom composting among different classes (have competitions for recycling and composting).
- Create Public Service Announcement graphs of the waste audit and present to younger classes in the school.
- Check out NOAA's Trash Talk videos for lots of background info: https://marinedebris.noaa.gov/discover-issue/trash-talk
- Check out Washed Ashore's *Resourcefulness in a Bottle* and *Divide and Conquer* art activities for ideas on how to use plastics and trash as art materials (www.washedashore.org).

WASTE & PLASTICS: How Long Till it's Gone (activity)

Waste and Plastics
Waste Audit
► How Long Till it's Gone
What is Plastic?
A Plastic Ocean

This activity was created by Washed Ashore (*www.washedashore.org*) and the full lesson plan can be found online. This activity has students playing a game to estimate the time it takes objects from daily life to break down.

Objectives
In this activity students will be able to:
- Provide examples of man-made materials that will last many decades.
- Define the terms Biodegrade, Corrode, and Photodegrade.
- Describe why different materials will take more or less time to degrade based on the environment they are in.

Activity Plan
This activity takes ~30-45 minutes.

Materials
- Washed Ashore Lesson Plan with background materials.
- Set of cards and NOAA "How Long Till It's Gone?" poster. The DUMLwebsite has a set of cards you can download and print, or you can create your own with notecards.

WASTE & PLASTICS: What is Plastic? (discussion)

Waste and Plastics
Waste Audit
How Long Till it'sGone
► What is Plastic?
A Plastic Ocean

This discussion was created by Washed Ashore (*www.washedashore.org*) and the full lesson plan can be found online. This discussion helps students understand man-made polymers -- why they were created, how they are used, and what they are recycled into. We suggest pairing this discussion with the *How Long Till It's Gone* activity.

Objectives
After this discussion, students will be able to:
- Describe basic polymer structure and characteristics.
- Describe the characteristics that make different types of plastic unique.

Activity Plan
This discussion takes ~10-20 minutes, and is easily tacked on to the *How Long Till It's Gone* activity.

Materials
- Washed Ashore Lesson Plan with background materials.
- Printed chart of household plastics.

WASTES & PLASTICS: *A Plastic Ocean* (film)

A Plastic Ocean is a documentary that follows the journey of explorers, scientists, engineers, and conservationists as they travel to remote parts of the world; documenting the environmental issues associated with plastic pollution and its impact on the environment, ecosystems and human health. You can buy or rent the 104 min film online at plasticoceans.org or Netflix.

Waste and Plastics
- Waste Audit
- How Long Till it'sGone
- What is Plastic?
- ► *A Plastic Ocean*

ROBOTICS: Physics of Marine Debris Movement (activity)

Robotics
- ► Physics of Marine Debris Movement
- Habitat Sampling Activity
- *Majestic Plastic Bag*
- Physics of Drone Flight

Introduction

Not all marine debris is left on the beach or thrown overboard by boaters. Some of it is dropped on land or escapes from trashcans on windy days and ends up on the beach or in the ocean. The forces of physics that drive the movement of airplanes and drones through the air are the same forces that move marine debris through the environment. In this activity, students explore the aerodynamic and hydrodynamic properties of types of trash that are common in the marine environment.

Objectives

- Apply concepts of aerodynamics to make inferences about the movement of different types of marine debris through the environment.
- Explain the characteristics that allow certain types of trash to move more easily through the air or water.
- Brainstorm ideas about how a piece of trash that wasn't left behind by a someone at the beach could end up on the beach. Note: This brainstorming exercise is a good preliminary exercise for the Journey of X activity in the Creative Engagement.

Activity Plan

1. Give each pair or group of students a different piece of trash from materials list.
2. Have each pair/group make a list of adjectives describing their item.
3. Have each pair/group identify features of their item that would make it move easily through air, on the ground, or in water. For example, a plastic bag is light and has a large surface area, so it will move easily through the air on a windy day. A glass bottle is smooth and round, so it would roll across a hard surface like pavement. A plastic bottle is hollow and floats on the water, so it could travel far across the ocean.
4. Optional: Use a fan and a bucket of water to test predictions about the objects.
5. Have each student tell the other members of their group a short story about how their piece of trash could end up on the beach, even if it wasn't left behind by a

someone at the beach.

Materials

- Various types of trash (ex: plastic bottles, glass bottles, empty soda cans, plastic bags, paper bags, pieces of string, straws, food wrappers, bottle caps, etc.)
- Pencil and Paper
- Optional: Fan, bucket of water

Extensions

- Have students explore ocean surface currents caused by wind on *https://www.windy.com* and make predictions about where marine debris will concentrate on an ocean-basin scale. While exploring these currents, students should think about what types of trash are most likely to be transported based on the findings from the Physics of Marine Debris activity. Students can check out maps to see areas where marine debris generally accumulates at the center of ocean gyres and learn more facts about plastics in the ocean: *http://www.thelivingsea.com/journal/wp-content/uploads/2012/08/five-ocean-gyres-trash1.jpg*
- What is Marine Debris? | A Cartoon Crash Course
  https://www.youtube.com/watch?v=fGQOkERpUhU

ROBOTICS: Marine Debris Entanglement (activity)

Robotics
Physics of Marine Debris Movement
► Debris Entanglement
Majestic Plastic Bag
Physics of Drone Flight

Introduction

Drones can provide high-resolution aerial imagery of areas and/or animals that scientists are interested in studying. In this activity, students will use North Atlantic Right Whale (*Eubalaeana glacialis*) imagery collected by drones to estimate the effects of derelict fishing gear on marine mammal body size. Marine mammal scientists at Duke University photographed the body of a right whale individual, and one year later pictures from drone imagery found the same individual entangled in derelict fishing gear. Using these drone photographs students will determine any change in body size over time for the Right Whale.

Objectives

- Analyze aerial pictures and determine the change in body size for an individual Right Whale.
- Understand the benefits and limitations of using aerial images for field studies.

Activity Plan

Using the provided Right Whale worksheet, students will:

1. Estimate the area of each of the two Right Whale photographs.
2. Estimate the change in body mass after entanglement.

Materials

- Marine Debris Entanglement Worksheet (pg 25).
- Pencil or pen.

Extensions

- Understanding drag and how it affects speed of movement: *Running is a Drag* (https://www.scienceworld.ca/resources/activities/running-drag). This activity is a running game that can simulate how entanglement can affect the swimming of marine mammals.

ROBOTICS: *Majestic Plastic Bag* (online film)

Robotics
Physics of Marine Debris Movement
Debris Entanglement
► *Majestic Plastic Bag*
Physics of Drone Flight

Majestic Plastic Bag is a 4 minute "mockumentary" that is narrated by Jeremy Irons and follows the journey of a plastic bag from a grocery store to the Pacific garbage patch. This film is an example of using comedy to tackle a difficult problem and can be used as an example for communication projects that students can undertake in the Creative Engagement section.

ROBOTICS: Physics of Drone Flight (activity)

Robotics
Physics of Marine Debris Movement
Debris Entanglement
Majestic Plastic Bag
► Physics of Drone Flight

Introduction

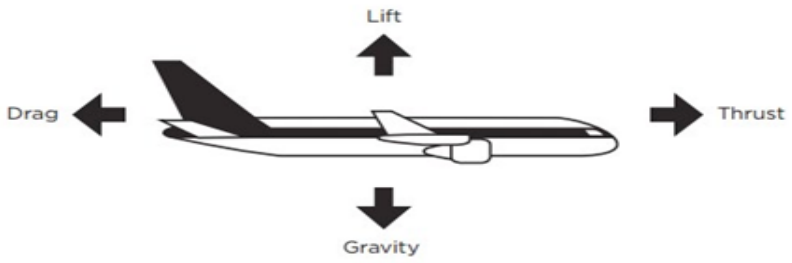
Drones have become an increasingly useful tool for scientific research and in many ways are like airplanes. The same four physical forces that affect airplanes in flight also affect drones. At DUML, both fixed-wing and multirotor drones are used in marine debris research monitoring.

Fixed-wing drones look like normal airplanes. They are very aerodynamic and can cover large areas. A fixed-wing drone might be used to fly over an island and detect animals with a thermal camera, or used to map a large area of habitat.

Multirotor drones look like helicopters with multiple propellers. Unlike fixed-wing drones, they can hover over a target and carry more weight. A multirotor drone might be used to take high-resolution pictures that can be used to accurately measure whales or other animals.

What makes a fixed-wing drone aerodynamic? There are four forces that act on any aircraft in flight, and a fixed-wing drone is optimized to take advantage of the forces that help it fly and reduce the effect of the forces that don't. These four forces are:

- Lift - an upward acting force, the opposite of gravity, which is generated by the movement of air over the wings.
- Gravity - a downward force, the opposite of lift, generated by the mass of the drone and the mass of the Earth.
- Thrust - a forward acting force, the opposite of drag, generated by the plane's engines and/or propellers.
- Drag - a backward acting force, the opposite of thrust, generated by the movement of air against the plane's direction of motion.



(Image courtesy of *https://www.scienceworld.ca/resources/activities/four-forces-flight)*

During this lesson, students will explore the four forces of flight from the perspective of a fixed-wing aircraft; however, they should keep in mind that these same four forces act on multirotor aircraft as well!

This activity is based on the Flight unit (*https://www.scienceworld.ca/resources/units/flight*) and Four Forces of Flight activity (*https://www.scienceworld.ca/resources/activities/four-forces-flight*) from Science World British Columbia, modified to fit the context of drone research.

Objectives

- Describe the four forces involved in flight.
- Understand the physics behind drone and airplane flight.

Activity Plan

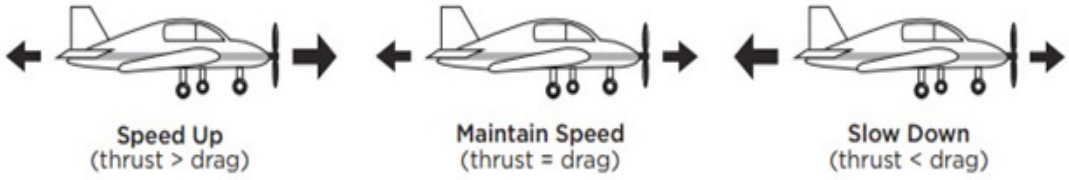
1. Hand out a piece of paper to each student to make a basic paper airplane, and then fly their airplane.
2. Have students draw arrows on their planes to label the forces that act on an airplane when it is in flight. Each arrow should identify the direction of the force and what's causing it.

3. Have students compare their arrows with a partner.
4. Introduce the terms: thrust, drag, lift and gravity.
5. Ask students to discuss with their partner the forces they identified, and whether those forces are thrust, drag, lift or gravity. For example, a student might identify friction, or air resistance, or the force of the propeller...

Materials

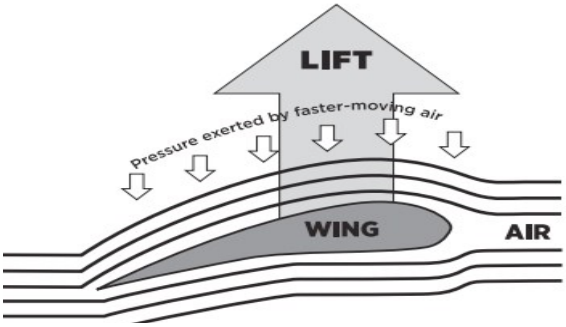
- A sheet of paper.
- Marker or pencil.
- Scissors (optional).

Extension Information



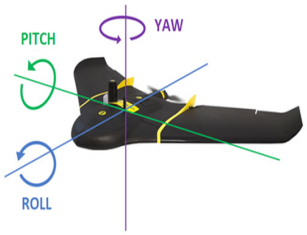
(Image courtesy of *https://www.scienceworld.ca/resources/units/flight)*

The shape of the airfoils that make up the drone's wings generates lift. The wing is generally wider in the front and narrower in the back with a slightly curved shape. Air that gets pushed over the wing moves faster than air that gets pushed under the wing, which creates low pressure above the wing and high pressure below it. This generates the lift that allows fixed-wing drones and airplanes to fly!



(Image courtesy of *https://www.scienceworld.ca/resources/units/flight*)

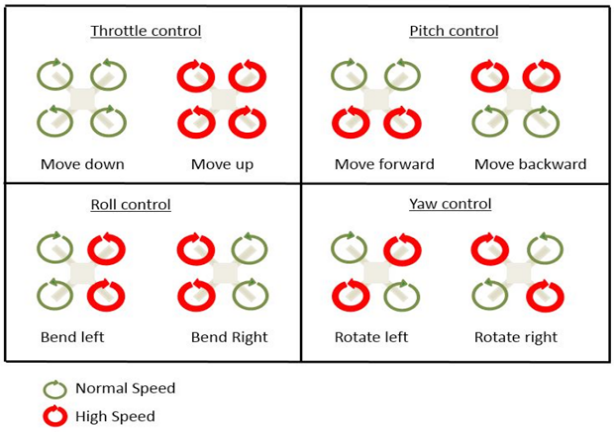
The airplane moves on three axes of flight: Yaw, pitch, and roll.



- Yaw points the nose of the aircraft left or right.
- Pitch tilts the nose of the aircraft up or down so that the front is higher than the back, or vice versa.
- Roll leans the aircraft left or right, so that one wingtip is higher than the other.

These 4 forces and 3 axes of flight also apply to multirotor drones!

A quadcopter has 4 propellers that spin to generate lift. Opposite propellers spin in the same direction, which balances the aircraft and allows it to hover. Changing the speed of rotation of the propellers can change the motion of the quadcopter. If all the propellers spin faster, the quadcopter will fly higher. If the two propellers in the back rotate faster, the quadcopter will pitch forward. If opposite propellers spin faster, the quadcopter will yaw in the direction they are rotating.



(Image above courtesy of *http://www.socialledge.com/sjsu/index.php?title=S14:_Quadcopter)*

FIELD RESEARCH INTRODUCTION

These Field Research activities will be centered around cleaning up marine debris, giving students hands-on experience collecting data in the field, analyzing results from the collected data, AND connecting students to our local environment. Specifically, students will collect and quantify marine debris data, analyze their data, and compare their research results to global estimates.

Beach Clean-up
► Collect & Quantify Marine Debris
Data Analysis & Quantification

BEACH CLEAN-UP: Collect and Quantify Marine Debris (field activity)

Introduction

This activity will introduce students to collecting data in the field, connect them with a local beach ecosystems, and help students understand the importance of stewardship for local habitats (~ 3 hours).

Objectives

At the end of this activity students will be able to:

- Understand how to collect field data.

Activity Plan

1. Review safety and data collection with students:
   a) How to safely collect marine debris: wear gloves, leave sealed cans/bottles alone, how to collect sharp object (including needles and broken glass).
   b) How to fill out the Ocean Conservancy's *International Coastal Cleanup data sheets*: Make sure that each piece of garbage gets recorded with tally marks and describe the general headings.
2. Teachers should divide their class into groups of three or four. Groups should clean their designated beach areas, and return to their school with their trash.
3. After each group returns to their class, students will weigh/record their trash, sort trash for "art trash", clean and disinfect "art trash", and enter their data on class ICC data sheets.

Materials

Students should come prepared to spend the day outside (i.e., students should wear shoes that can get wet, wear a sun hat, bring a reusable water bottle, wear sunscreen, and bring a jacket if the weather is cool). The following materials are needed:

- Downloaded ICC Marine Debris Data Sheets for each group of four (go to oceanconservancy.org).
- Clipboards (for each group of four) with pencils attached.

- First Aid Kit.
- 15 Buckets for garbage *(usually provided by beach clean up organization)*.
- 30 pairs of cotton gloves *(usually provided by beach clean up organization)*.
- Scale, clipboard and pencil for weigh station.
- Dish soap, vinegar, and scrub brushes for cleaning "art trash".

BEACH CLEAN-UP: Data Analysis (activity)

Beach Clean-up
Collect & Quantify Marine Debris
► Data Analysis & Quantification of Accumulated Rates

Introduction

This activity will introduce students to analyzing data from field collections, and give them an understanding of the importance in data quality (~ 1 hour).

Objectives

At the end of this activity students will be able to:

- Create a graph of their marine debris and compare and contrast it to ICC data from previous years.
- Understand sources of error in the data (such as, recording errors, classification errors, heading errors, etc.).
- Develop hypotheses for why certain types of garbage are more/less prevalent on NC beaches in comparison to the ICC global data.
- Understand and recognize the effects of marine debris on local wildlife.

Activity Plan

This activity can be completed back in the classroom at your school. Preparation (10 min): Prepare a table for the students to fill out (with headings for marine debris) on a white board (or projected from a computer spreadsheet). Student groups will record their group totals for weight and totals for pieces of trash and determine the class totals. Students will use the class data for the graphing exercise.

1. Have groups sit together with their data sheets, and have one person (from each group) report out totals for each heading. Discussion can occur during the reporting or at the end, but make sure to discuss: i) differences in tally numbers among the groups (and how sources of error can affect the data); ii) why certain types of marine debris are more prevalent; and iii) how different debris can potentially harm local wildlife.
2. Have each group record the finalized class totals (numbers of marine debris per type and total weight) for their graphs.
3. Each Group (or student) will create a hand drawn graph from their data that compares their data to ICC (graphs could illustrate: total number of garbage by topic, total number of pieces, total weight, amount of garbage per area, etc.). Have different groups create different graphs.
4. Data Presentation: Each group will present their graph to the class and ask for feedback in making their data display even clearer. This feedback will help students create clear and coherent products for communicating to the public.

Materials

- Graph paper, colored pencils, pens.
- Prepared table on white board (or on a projected worksheet) with the categories of marine debris at the top and sections to add all the tallies from each group.
- Downloaded ICC data (*https://oceanconservancy.org/trash-free-seas/international-coastal-cleanup/annual-data-release/*) to compare and contrast the class data with global results (this can be printed out from the ICC website or projected for the whole class).

CREATIVE ENGAGEMENT INTRODUCTION

These creative engagement activities are centered around using art and literature to present the marine debris issues to our community in a creative and informative manner. Students will creatively think about marine debris, design and build trash art, write poetry and stories, create a classroom mural, and develop public presentations for civic action.

COMMUNITY ART: Marine Debris Mosaic (activity)

Community Art
► Marine Debris Mosaic
Marine Debris Poetry
Circle of Viewpoints
Journey of X Mural
PSAs

Introduction

This activity allows students to create an art mosaic using pieces of marine debris from their Beach Clean Up. This activity is based on the *Culmination* activity created by Washed Ashore (*www.washedashore.org*). Remember, this activity uses colorful recyclable materials and garbage (cleaned) from the Beach Clean Up for students to use in their class art -- so remember to save your "art trash"!

Objectives

At the end of this activity students will be able to:

- Assemble unrelated pieces of marine debris into mosaic materials.
- Design and create a mosaic for use in community engagement.
- Create a piece of art that illustrates the issues of marine debris and inspires community members to think about an issue affecting their community.

Activity Plan

This activity takes ~120-60 minutes, see Washed Ashore lesson plan for detailed activity plan. Note: this is a good activity to collaborate with the art teacher/department at your school.

Materials

- Cleaned marine debris from Beach Clean Up.
- Miscellaneous art supplies (such as: hot glue guns, paint, scissors, wire, etc.).

COMMUNITY ART: Marine Debris Poetry (activity)

Community Art
Marine Debris Mosaic
► Marine Debris Poetry
Circle of Viewpoints
Journey of X Mural
PSAs

Introduction

This activity will allow students to add to their community art with poetry. Students will learn how to construct a Haiku, and then use the Haiku format to create poetry that helps communicate their feelings about the beach clean up and the marine debris art. This activity can be introduced before the field research, and also repeated during the art making. By creating numerous Haikus, students will practice the poetry form and get a chance to think deeply about their environment and marine debris.

Objectives

At the end of this activity students will be able to:

- Interpret their art and science through poetry.
- Understand the structure of Haiku poems.
- Assemble words that generate feelings of marine debris into a Haiku.
- Read their Haiku aloud to their peers.

Activity Plan

- Introduce Haikus (see worksheet pg. 30).
- Have kids go to a beach and listen to the sounds of the ocean and nature, then think of nature-based Haikus.

Materials

- Sticky pads for Haikus.
- Haiku lesson plan handout (in appendix).

COMMUNITY ART: Marine Debris Circle of Viewpoints and Journey of X Mural (Activity)

Community Art
Marine Debris Mosaic
Marine Debris Poetry
► Circle of Viewpoints
► Journey of X Mural
PSAs

Introduction

These activities allow students to develop a new understanding of marine debris and use art and literature to explore the journey of marine debris from useful object to unwanted marine debris. Students will look at a piece of marine debris from the perspective of different users and then work in small groups to create a Journey of X story and drawing for a class mural. By thinking about different perspectives, students will gain an understanding

about the complexity of marine debris and it will allow them to evaluate the issue with a greater sophistication.

Objectives

At the end of this activity students will be able to:

- Understand differing perspectives of marine debris.
- Write a creative story about the journey for their piece of marine debris.
- Illustrate their story with a drawing.
- Assemble the group stories and drawings into a class mural.
- Describe their mural to the public.

Activity Plan for Circle of Viewpoints (60-90 minutes)

- Introduce Circle of Viewpoints: In small groups have kids sit in a circle and then think about their marine debris from a different point of view (for example: sand, water, fish, an adult, manufacturer, person whose job it is to make the X, company, kids, local fishers, local business owners, etc. 0.
- After writing down their point of view, discuss all the different points of view, (hint: position each person close to others with the same viewpoints).
- After the small group activity, give students "The Journey of X" handout so that they can start writing fiction of how their piece of marine debris ended up in their beach clean up (see below).

Activity Plan for The Journey of X (60-120 minutes)

- Have students draft their stories and revise their stories with a partner.
- Have students create an illustration for their story mural.
- Have students create a final draft of story (on computer or with nice handwriting).
- Have students create background for mural (students who finish early can help design the set up for mural, and create placeholders to tell the mural story.
- Attach all illustrations and stories to mural.

Materials

- Circle of Viewpoints handout (one for each student) found on pg. 31.
- Interesting pieces of marine debris from your cleanup for the center of each circle.
- *Journey of X* worksheet (one for each student) found on pg. 32.
- Pens, markers, crayons, blank paper for illustrations, and big mural paper to combine the stories and illustrations from *Journey of X*.

COMMUNITY ART: Public Service Announcements (activity)

Community Art
Marine Debris Mosaic
Marine Debris Poetry
Circle of Viewpoints
Journey of X Mural
►PSAs

Introduction
A Public Service Announcement (PSA) is an a commercial or advertisement that is broadcast to help the public. This activity will allow students to share a public service announcement about marine debris for their community. How and when classes share their PSAs can be part of the classroom discussion.

Objectives
At the end of this activity students will be able to:
- Develop talking points that aid in explaining the issues of marine debris to others.
- Describe and discuss the role of marine debris to their community.
- Create a script about marine debris.
- Use technology to create and film/record PSAs.
- Evaluate non-fiction for relevant and interesting facts.

Activity Plan
How can you make a PSA? When you make a PSA, remember it is a type of advertisement/ commercial; and the best advertisements are ones that have a clear message and are fun to listen to and/or watch. They also are short in length 30-60 seconds! Here are four things to think about when you organize your PSA: know, feel, see, and do.
- What do we want the audience to KNOW?
- How do we want the audience to FEEL?
- What do we want the audience to SEE? (only if you are doing a video-- not relevant for just radio PSAs)
- And after listening/watching the PSA, what do we want the audience to DO?

Step one: Watch these PSA examples:
1. Kids Safety Internet PSA - (:34)
   - https://www.youtube.com/watch?v=PS-t78Z1exQ
   - Strategy: Take a pledge.
   - How could you use that strategy with marine debris?_____

2. Child Passenger Safety: Bibbidi 30 (2005) Ad Council Radio PSA (:30)
   - https://www.youtube.com/watch?v=WKgUdll2L74
   - Strategy: Repeat an action or phrase several times.
   - How could you use that strategy with marine debris?_____

3. Active For Life Public Service Announcement (PSA) (:33)
   - https://www.youtube.com/watch?v=2syJ1bAMOvc
   - Strategy: Use statistics and state a solution.
   - How could you use that strategy with marine debris?_____

4. Kids Ask the Candidates for President to Debate Science (:30)
   - https://www.youtube.com/watch?v=yvTr9z9e3MA
   - Strategy: Interview format.
   - How could you use that strategy with marine debris?_____

STEP Two: Use the PSA worksheet to analyze the PSA examples and create a script.

Materials
- Public Service Announcement Worksheet (pg 34).
- Computer loaded with the PSA example websites.

Teacher tips:

1. *Have students read marine debris non-fiction and take notes before the PSA lesson*. While students read the non fiction articles, have them keep track of evidence and statistics that shock and surprise them. Then, the students will be even more prepared. Check out the non-fiction articles at the DUML Community Science website (links to articles can be found under background resources).

2. *Some helpful ideas for the PSA example (in case some students are stuck)*
   - Kids Safety Internet PSA - (:34). Potential ideas for marine debris: Take the pledge for a cleaner beach…? Take the pledge to reduce plastic (could use the 9 tips to reduce plastic as a basis: https://lessplastic.co.uk/9-tips-living-less-plastic/).
   - Child Passenger Safety: Bibbidi 30 (2005) Ad Council Radio PSA (:30). Potential ideas for marine debris: repeat an action or an idea over and over (i.e., drive home the "say no to straws" or something similar.
   - Active For Life Public Service Announcement (PSA) (:33).Marine debris ideas: This could be easy to imitate with voices that just state stats and then state simple solution; and use kids as graphs to represent crazy amounts of plastic (like the circle graph in the beginning).
   - Kids Ask the Candidates for President to Debate Science (:30) Marine debris ideas: This could also be easy to imitate with kids asking pointed questions to the adults about their plastic consumption, recycling habits, etc.

Supplemental Ideas
This activity is perfect for technology extensions. After creating a PSA script, students can use audio, video, or stop-motion animation to make their PSA unique.

CIVIC ENGAGEMENT & COMMUNICATION: Public Presentation of Art & Civic Action

Introduction
This activity will allow students to share their art (marine debris mosaics, poetry, literature, etc.) with their community. How and when classes share their art can be part of the classroom discussion. The goal of presenting art to the public is to illustrate how our students are public stewards and to help illustrate how marine debris is affecting our community.

Objectives
At the end of this activity students will be able to:
- Develop talking points that aid in explaining the issues of marine debris to others.
- Describe and discuss the role of marine debris to their community.

Activity Plan
The type of public presentation will be discussed at the beginning of the program, but options include: presenting art at one of the local museums, presenting art at local businesses, having a public presentation at the local town commissioners meetings (or school board), presenting information in local parades, having booths at local festivals, traveling to Raleigh to talk with regional/state-level politicians, etc. Depending on the type/location of the presentation, supplemental presentation options may be possible.

Materials
- Marine Debris Mosaic Art.
- Marine Debris Haikus.
- Journey of X Class Mural.
- Public service announcement.
- Video documentary of the process (see Documentation pg 21).
- TIPS Assignment Worksheet #2.

TEACHERS INVOLVE PARENTS IN SCHOOL WORK (TIPS)

TIPS Assignments

Introduction
The Teachers Involve Parents in Schoolwork (TIPS) assignments are interactive homework assignments that allow students to share their work with family members.

Objectives
At the end of these activities students will:
- Explain the issues of marine debris to their family.
- Connect the work they are doing at school to their home.

Activity Plan
Go over the homework sheet in class, and have each student fill out the top section, with a due date. Remind students during class to return the TIPS Worksheets.

Materials
1. TIPS Assignment Worksheet #1 (pg 27).
2. TIPS Assignment Worksheet #2 (Pg 29).

DOCUMENTATION

Introduction
The Documentation activities are a way for students to document their learning process and create a video about what they learned. In addition, the videos are also a way for teachers to "see" the marine debris project and activities from their students perspective.

Objectives
At the end of this activity students will:
- Describe the activities that they completed.
- Discuss how the activities changed their perspectives on plastics, waste and marine debris.

Activity Plan
During each activity throughout the marine debris program, assign one student per group as " the reporter". The reporter's job is to take pictures and videos of the activity and their classmates, and then organize and store the photos on a class computer/drive.

At the end of the program (i.e. after your class has completed all the activities), have students interview each other (either voice or video) and ask questions about the project. Possible questions include:

- Why did you compose your marine debris art the way you did?
- How did you decide on what materials to use?
- What did you want your marine debris piece of art to show?
- What do you think you have learned about marine debris after doing this program?
- Have you personally done anything differently in your life since you've been part of this program? Did your behavior change?
- Have you talked to anybody after you went through this program to tell them about what you've learned? Who did you talk to and what did you say?
- Do you think that kids can make a difference?
- Is there anything else you want to say?

Have students work in small groups (or as a class) and create a two-five minute documentary (per group) about their experience with the marine debris program. Encourage them to weave together pictures and videos, use music, quotes, and anything from their creative engagement activities!

Materials

1. A camera or video recorder. Cell phones, ipads and GoPro cameras all work well.
2. A voice recorder. Cell phones and ipads work well (e.g., voice recorder).
3. Photo release forms for students in photos.
4. A movie/video app for students to create their own documentary (e.g., iMovie).

Supplemental Ideas

Make a list of words from the interviews and create a word cloud about the project.

Appendix

DUML COMMUNITY SCIENCE

Duke NICHOLAS SCHOOL OF THE ENVIRONMENT
DUKE UNIVERSITY MARINE LAB

Classroom Explorations
Waste & Plastics Worksheet

Student/Group Name:_____
Number of students in your group: _____

Category	Day 1 Weight	Day 2 Weight	Day 3 Weight	Day 4 Weight	Day 5 Weight	Total Weight
Recyclable containers (plastic, metal, glass...)						
Recyclable Paper (paper, cardboard, newsprint...)						
Other recyclables (cartridges, batteries...)						
Food wastes/compost						
Garbage						

Write out Calculation equations for:

1. Total Garbage per student at school [hint: calculate garbage per person and multiply by number of students and number of school days]

2. Calculate Amount Diverted from landfill via recycling and composting.
   [total waste - (recycling + composting)]
   Hint: diversion = total garbage - (recycling + composting)

Classroom Exploration: Robotics
Marine Debris Entanglement Worksheet

Student/Group Name: _____ Date _____

NORTH ATLANTIC RIGHT WHALE - CALCULATING BODY SIZE

In this activity, you will use two images of the same North Atlantic Right Whale (*Eubalaeana glacialis*) taken in February 2010 and December 2010, before and after the whale became entangled in a snow crab pot and 132 m of rope. With these images, you will be able to determine changes in the whale's body size before and after entanglement. Each square on the grid is 1 whale body unit long and 1 whale body unit wide.

You will estimate area by counting the number of whole and half boxes covered by the whale body.

- *AREA OF WHALE BODY = area of whole boxes + area of half boxes*
- Calculations needed for area of whale body
  - # of whole boxes _____ x 1 = _____ (area of whole boxes)
  - # of 1/2 boxes _____ x 0.5 = _____ (area of half boxes)

Estimate the area of the whale in February 2010 in whale body units^2, using the grid provided.

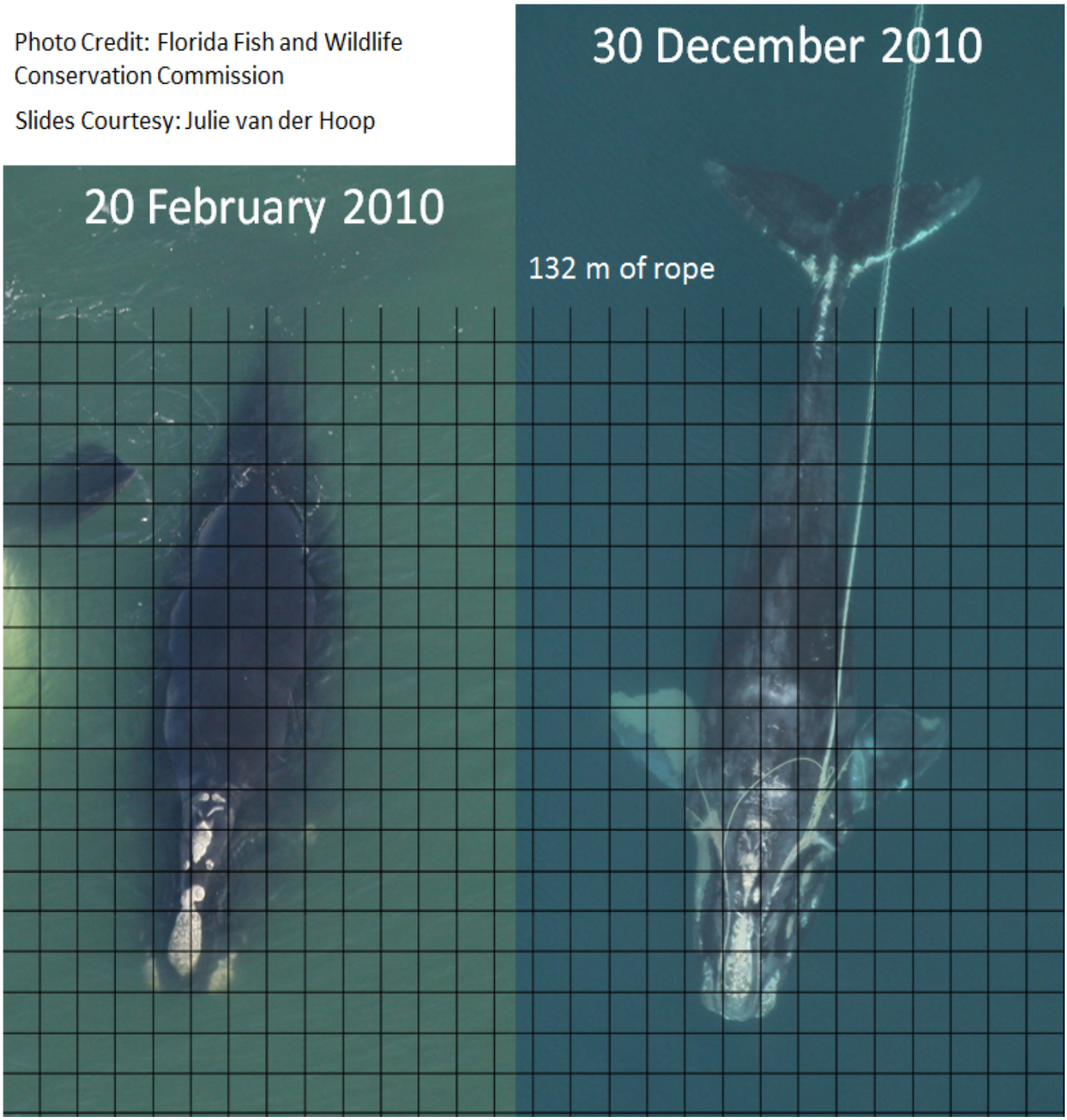
Estimate the area of the whale in December 2010 in whale body units^2, using the grid provided.

What is the difference of whale body size in December and February?

Why do you think there were changes in the area of the whale body?

Photo Credit: Florida Fish and Wildlife Conservation Commission

Slides Courtesy: Julie van der Hoop



TEACHERS INVOLVE PARENTS IN SCHOOL WORK
TIPS #1: The Marine Debris Project

Dear Parent/Family Partner,

We are currently studying human impact on the environment, with a specific focus on plastics. In this assignment, I will teach you a little bit about what I have learned about these topics in ELA and Science, apply some math skills, and then we will examine our "human footprint" at home. I hope you enjoy this activity with me! The assignment is due _____.

Sincerely,

_____
Student's signature

Part A: HOW LONG 'TIL IT'S GONE?
Family Partner: _____
Student: Ask your family partner to rank how quickly these items might deteriorate in the environment on a scale of 1-5 (1 breaks into small pieces the fastest, 5 breaks into small pieces the slowest)

Paper towel 	**Plastic bag** 	**Plastic beverage bottles** 
Disposable diapers 	**Tin can** 	**Apple core** 

Part B: TRACKING OUR TRASH
Directions: This week, collect any trash you generate when cooking meals or preparing foods at home. We will use this trash to compare data and create graphs in class!

Type of Trash	*Amount (record with tally marks)*
Plastics (wrappers, utensils, disposable containers)	
Cardboard	
Paper products (napkins, paper towels, plates, etc.)	
Food scraps (peels, apple cores, seeds, etc.)	

Solve with your family partner:
If 3,600 pieces of plastic trash wash up on Henderson Island in a day, how much will show up in the month of February? Show your work using an area model or partial products.

Explain 3 of the most shocking or interesting facts you have learned about Marine Debris.
We discussed:

Dear Parent/Family Partner,
Please share your reactions to your child's work on this activity. Write YES or NO next to each statement.
_____ 1. My child understood the homework and was able to discuss it.
_____ 2. My child and I enjoyed the activity.
_____ 3. This assignment helped me know what my child is learning in class.
Other comments:

Parent Signature: _____

TEACHERS INVOLVE PARENTS IN SCHOOL WORK
TIPS #2: Creativity and Marine Debris

Dear Parent/Family Partner,

We are currently using our creativity to explore the issue of marine debris. In this assignment, I will describe to you what I created, and then ask you questions about my work. I hope you enjoy this activity with me!
The assignment is due _____.

Sincerely,

_____
Student's Signature

Describe your work
Family Partner: _____
Student: I will be describing this creative work: _____
Describe (or show) your creative work to a family partner. Why did you create this work? What is the message of the work? What choices did you make in creating this work?

Interview your family member: *After describing your work, create two questions and interview your family partner to understand how your work made them feel.*

Question 1:_____
Parent answer:

Question 2:_____
Parent answer:

Dear Parent/Family Partner,
Please share your reactions to your child's work on this activity. Write YES or NO to each statement.
_____ 1. My child understood the homework and was able to discuss it.
_____ 2. My child and I enjoyed the activity.
_____ 3. This assignment helped me know what my child is learning in class.
Other comments:

Parent Signature: _____

DUML COMMUNITY SCIENCE

Duke NICHOLAS SCHOOL OF THE ENVIRONMENT
DUKE UNIVERSITY MARINE LAB

CREATIVE ENGAGEMENT: COMMUNITY ART
Marine Debris Poetry

Haiku: a Japanese poem of seventeen syllables, in three lines, one line of five syllables, one line of seven syllables, and one line of five syllables; traditionally evoking images of the natural world.

Brainstorm

In the space below, describe parts of your beach clean up today. What did you hear? What did you see? What did you feel? How did picking up debris make you feel? What types of images were you thinking about while collecting marine debris? Before you picked it up? While picking it up? After picking it up? How did collecting data make you feel?

Line one (5 syllables): _____

Line two (7 syllables): _____

Line three (5 syllables): _____

Peer feedback

After you read your haiku to your partner, what did they see? What did they hear in your poem? How did your poem make them feel?

CREATIVE ENGAGEMENT: COMMUNITY ART
Circle of Viewpoints

Brainstorm: In the space below, list as many perspectives as you can think of that have come into contact with this piece of marine debris (human, animal, inanimate are all fine):

My viewpoint: _____

I think….
A question I have from my viewpoint...

DUML COMMUNITY SCIENCE

Duke NICHOLAS SCHOOL OF THE ENVIRONMENT
DUKE UNIVERSITY MARINE LAB

CREATIVE ENGAGEMENT: COMMUNITY ART
Journey of X

Brainstorm

In the space below, jot down ideas for the lifespan of a piece of marine debris you collected. Where did it begin it's "life"? How old is it? How did it get here? What did it see on it's journey? What types of people or animals or things did it interact with during it's lifetime (interaction can be positive and negative)? Does your object have feelings? If so, what would they be? Who is telling the object's story (first-hand or narrator)? Be creative!

Object: _____
Voice:_____
Age: _____

Adventures during beginning of life:
Adventures during middle of life:
Interactions during "lifetime"

Feelings
How did it end up where it is now?
Other interesting details

DUML COMMUNITY SCIENCE

Duke NICHOLAS SCHOOL OF THE ENVIRONMENT
DUKE UNIVERSITY MARINE LAB

CREATIVE ENGAGEMENT: COMMUNITY ART
PSA Worksheet

PSA STEP Two: Analyze the PSA examples and then answer/discuss these questions on your own. After finishing this sheet, discuss with your partner.

PSA Title to Analyze_____

What did the PSA want the audience to KNOW?
What did the PSA want the audience to FEEL?
What did the PSA want the audience to SEE?

What did the PSA want the audience to DO?
What strategy did the PSA use?

DUML
COMMUNITY SCIENCE

Duke
NICHOLAS SCHOOL OF THE ENVIRONMENT
DUKE UNIVERSITY MARINE LAB

STEP THREE: Make a PSA outline on Marine Debris:
In the space below, list all the marine debris facts that you can think of that are important to your PSA (hint: think about facts from your non-fiction articles/research):

Based on the marine debris facts, what do you want people to KNOW, FEEL, SEE and DO after the PSA?
I want people to KNOW:
I want people to FEEL:
I want people to SEE:

I want people to DO:
Of the PSAs you reviewed, which model best suits your ideas and why?
Using the information above, outline how you might make a PSA

Activity Group	Activity Title	Education Standards
Classroom Explorations: Wastes & Plastics	Waste Audit (activity)	Social Studies: 4.G.1.2 Explain the impact that human activity has on the availability of natural resources in North Carolina. Science: 4.P.2 Understand the composition and properties of matter before and after they undergo a change or interaction. Science: 4.L.1.1 Give examples of changes in an organism's environment that are beneficial to it and some that are harmful. Science: 4.L.1.3 Explain how humans can adapt their behavior to live in changing habitats (e.g., recycling wastes, establishing rain gardens, planting trees and shrubs to prevent flooding and erosion). Science: 4.L.2 Understand food and the benefits of vitamins, minerals and exercise.
	How Long Till It's Gone (activity)	
	What is Plastic (Activity)	
	A Plastic Ocean (film)	
Classroom Explorations: Robotics	Physics of Marine Debris Movement (activity)	Social Studies: 4.G.1.2 Explain the impact that human activity has on the availability of natural resources in North Carolina. Math: 4.OA.2 Multiply or divide to solve word problems involving multiplicative comparison. Math: 4.OA.3 Solve multi-step word problems posed with whole numbers and having whole-number answers using the four operations, including problems in which remainders must be interpreted. Represent these problems using equations with a letter standing for the unknown quantity. Assess the reasonableness of answers using mental computation and estimation strategies including rounding. Math: 4.NBT.4 Fluently add and subtract multi-digit whole numbers using the standard algorithm. Math: 4.NBT.5 Multiply a whole number of up to four digits by a one-digit whole number, and multiply two two-digit numbers. Math: 4.NF.4 Apply and extend previous understandings of multiplication to multiply a fraction by a whole number. Solve word problems involving multiplication of a fraction by a whole number. Math: 4.NF.6 Use decimal notation for fractions with denominators 10 or 100. Math: 4.MD.1 Know relative sizes of measurement units within one system of units.
	Marine Debris Entanglement (activity)	

Activity Group	Activity Title	Education Standards
Classroom Explorations: Robotics	*Majestic Plastic Bag* (film)	*(cont.)* Math: 4.MD.2 Use the four operations to solve word problems involving distances, intervals of time, liquid volumes, masses of objects, and money, including problems involving simple fractions or decimals, and problems that require expressing measurements given in a larger unit in terms of a smaller unit. Represent measurement quantities using diagrams such as number line diagrams that feature a measurement scale. Math: 4.MD.3 Apply the area and perimeter formulas for rectangles in real world and mathematical problems. Technology: 4.TT.1 Use technology tools and skills to reinforce classroom concepts and activities. Technology: 4.RP.1 Apply a research process as part of collaborative research.
Field Research	Collect & Quantify Marine Debris	Science: 4.L.1.1 Give examples of changes in an organism's environment that are beneficial to it and some that are harmful. Science: 4.L.1.3 Explain how humans can adapt their behavior to live in changing habitats (e.g., recycling wastes, establishing rain gardens, planting trees and shrubs to prevent flooding and erosion).
	Data Analysis & Quantification	Social Studies: 4.G.1.2 Explain the impact that human activity has on the availability of natural resources in North Carolina. Math: 4.OA.2 Multiply or divide to solve word problems involving multiplicative comparison. Math: 4.OA.3 Solve multi-step word problems posed with whole numbers and having whole-number answers using the four operations, including problems in which remainders must be interpreted. Represent these problems using equations with a letter standing for the unknown quantity. Assess the reasonableness of answers using mental computation and estimation strategies including rounding. Math: 4.NBT.4 Fluently add and subtract multi-digit whole numbers using the standard algorithm. Math: 4.NBT.5 Multiply a whole number of up to four digits by a one-digit whole number, and multiply two two-digit numbers. Math: 4.NF.4 Apply and extend previous understandings of multiplication to multiply a fraction by a whole number. Solve word problems involving multiplication of a fraction by a whole number.

Activity Group	Activity Title	Education Standard
Field Research	Data Analysis & Quantification	*(cont.)* Math: 4.NF.6 Use decimal notation for fractions with denominators 10 or 100. Math: 4.MD.1 Know relative sizes of measurement units within one system of units Math: 4.MD.2 Use the four operations to solve word problems involving distances, intervals of time, liquid volumes, masses of objects, and money, including problems involving simple fractions or decimals, and problems that require expressing measurements given in a larger unit in terms of a smaller unit. Represent measurement quantities using diagrams such as number line diagrams that feature a measurement scale. Math: 4.MD.3 Apply the area and perimeter formulas for rectangles in real world and mathematical problems. Technology: 4.TT.1 Use technology tools and skills to reinforce classroom concepts and activities. Technology: 4.RP.1 Apply a research process as part of collaborative research.
Creative Engagement: Community Art	Marine Debris Art (activity)	Art: 4.V.1.2: Apply personal choices while creating art. Art: 4.V.1.3: Infer meaning from art. Art: 4.V.1.4: Understand how the Elements of Art are used to develop a composition. Art: 4.V.1.5: Understand how the Principles of Design work in relation to each other. Art: 4.V.2.1: Identify different successful solutions to artistic problems. Art: 4.V.2.2: Use ideas and imagery from North Carolina as sources for creating art. Art: 4.V.2.3: Create abstract art that expresses ideas. Art: 4.V.3.1: Apply a variety of methods of manipulating a single tool, safely and appropriately Art: 4.V.3.2: Compare characteristics of a variety of media. Art: 4.V.3.3: Create art using the processes of drawing, painting, weaving, printing, stitchery, collage, mixed media, sculpture, ceramics, and current technology.

Activity Group	Activity Title	Education Standard
Creative Engagement: Community Art	Marine Debris Art (activity)	*(cont.)* 4.CX.2.2: Apply skills and concepts learned in other disciplines, such as math, science, language arts, social studies, and other arts, in the visual arts. 4.CX.2.3: Understand individual roles, while applying collaborative skills in creating art.
	Marine Debris Poetry (activity)	ELA: 4.R. 7 Integrate and evaluate content presented in diverse media and formats, including visually and quantitatively, as well as in words. ELA: 4.R. 8 Delineate and evaluate the argument and specific claims in a text, including the validity of the reasoning as well as the relevance and sufficiency of the evidence. ELA: 4.R.10 Read and comprehend complex literary and informational texts independently and proficiently. ELA: 4.W 1-10 (hits all the writing and editing standards) Social Studies: 4.G.1.2 Explain the impact that human activity has on the availability of natural resources in North Carolina. Social Studies 4.G.1.3 Exemplify the interactions of various peoples, places and cultures in terms of adaptation and modification of the environment.
	Circle of Viewpoints (activity)	
	Journey of X Mural (activity)	
	PSA (activity)	Technology: 4.TT.1 Use technology tools and skills to reinforce classroom concepts and activities
Creative Engagement: Civic Engagement & Communication	Public Presentation of Art & Civic Engagement	Civics & Government: 4.C&G.1.2 Compare the roles and responsibilities of state elected leaders. Technology: 4.TT.1 Use technology tools and skills to reinforce classroom concepts and activities. Technology: 4.RP.1 Apply a research process as part of collaborative research. ELA: 4.SL.1-6 Covers all the speaking and listening standards.
Documentation	Documentary video	Technology: 4.TT.1 Use technology tools and skills to reinforce classroom concepts and activities. ELA: 4.SL.1-6 Covers all the speaking and listening standards..