Program on Marine Debris
Community Science for 4th grade

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 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 existing education resources (from places like Washed Ashore, NOAA, and ScienceWorld) that have been modified based on local conditions here in Eastern 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. 40).

[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:

INTRODUCTION -- These activities will be delivered by the DUML Community Science team and are used to introduce the topic of marine debris, and also introduce local scientists and mentors to your class.

CLASSROOM EXPLORATIONS -- These art, science, and technology activities are used to introduce topics and provide background information in your classroom on mosaics (art), waste and plastics (science), and robotics (science 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 field trip with DUML to the Rachel Carson Reserve to collect, quantify and measure marine debris in the Rachel Carson Reserve.

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 mosaics, poems, stories, and videos) can be shared with the general public and give students a sense of civic engagement within their community.

CONCLUSION -- The conclusion activities will be delivered by the DUML Community Science team and are used to tie the program together and assess the impact of the program.

A ROADMAP FOR DUML's COMMUNITY SCIENCE PROGRAM IN MARINE DEBRIS

INTRODUCTION (pg. 4)

Systems Thinking Activity

↓

CLASSROOM EXPLORATIONS (pg. 6)

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

Art & Mosaics
Resourcefulness in a Bottle
Divide and Conquer
Wasteland

Robotics
Physics of Marine Debris Sampling
Habitat Sampling Activity
Majestic Plastic Bag
Physics of Drone Flight

↓

FIELD RESEARCH (pg. 19)

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

↓

CREATIVE ENGAGEMENT (pg. 22)

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

Civic Engagement & Communication
Public Presentation of Art & Civic Action

↓

CONCLUSION (pg. 26)

Systems Thinking Activity

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INTRODUCTION: Systems Thinking Activity

This Introduction activity will be delivered by the DUML Community Science team and is designed to: i) introduce the topic of marine debris and introduce local scientists/ mentors to your class; and ii) introduce different components of marine debris to your students in small groups with brainstorming opportunities. Students will get a chance to revisit this activity (as a conclusion activity) after spending a year investigating the topic of marine debris. Please note, the conversations in this activity will be used to evaluate the success of the program; and group conversations during the introduction activity will be compared and contrasted to the group conversation during the conclusion activity.

Objectives

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

- Understand that marine debris is made up of different components.
- Apply their component knowledge to create potential connections among the different marine debris components.
- Understand that marine debris is a human problem.

Activity Plan (facilitated by DUML ~ 25 minutes)

1. Small group discussion with pictures: Divide class into groups of 3-4 students (teacher can make groups ahead of time if needed), and give each group one picture. Ask each group to: "describe what you see in the photo", "what does the picture make you feel/think?". Have groups report back to whole group on their answers.
2. Small group discussion with pictures and quotes: Give each group the corresponding piece of writing for their picture. Ask students "How does this writing change how you think about the photo?"
3. Introduce systems thinking/connections to the whole group:
    - Define a system: A whole that cannot be divided into independent parts. Note: Components of the system can be considered alone, but they are not independent.
    - Understand the structure of a system: Components & their relationships. Identify components of the marine debris system suggested by the images (each group posts their picture on wall/white board). Have students suggest relationships between these components. Physically connect the images with chalk lines/markers. Ask students: "What does looking at all of the photos and their relationships encourage you to think about?", "What is missing from this system?".

Materials

- Laminated pictures of marine debris components (~10)
- Sticky pad note paper
- Laminated quotes for each picture
- Masking tape
- Chalk/white board markers
- Video recording device (to compare introduction activity to the activity at the end of the year-long program)

Extensions

This activity will be repeated at the end of the year, and analyzed to see whether students understand and recognize connections, can apply lessons learned over the year and expand their descriptions, and can analyze the marine debris systems and evaluate what is missing from the system.

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CLASSROOM EXPLORATIONS

The **CLASSROOM EXPLORATIONS** art, science, and technology 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 three sections in Classroom Explorations: i) Waste and Plastics; ii) Art & Mosaics; and iii) Robotics. Students will learn about marine debris, drones, scientific sampling, the physics of flight, and art mosaics. 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 lifecycle of plastics.

Art & Mosaics: This classroom explorations section is designed to give your students background knowledge on mosaics as an art form, and help break down the steps needed for making a mosaic mask from marine debris. Activities have been designed to allow your students to understand the basics of mosaic composition and color patterns. Students will start the construction of their giant masks and create the background, hair, and mouth in these activities.

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)

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. As a whole class create a definition of waste such that the class definition incorporates waste (the garbage we send to landfill), recycling (the used materials that are reprocessed into other materials), and compost (organic matter that is 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 up to create averages for schools in the county and state.

Materials

- A scale to measure garbage weight.
- Clear containers to keep garbage, recycling and composting (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 copy of garbage audit worksheets for students [worksheets found on pg. 29].

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

WASTE & PLASTICS: How Long Till it's Gone Activity (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 is reprinted with their permission in the Washed Ashore Lesson Plan Appendix. 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. DUML has a set of laminated cards you can borrow, or you can create your own with notecards.

WASTE & PLASTICS: What is Plastic? (discussion)

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

This discussion was created by Washed Ashore (*www.washedashore.org*) and the full lesson plan is reprinted with their permission in the Washed Ashore Lesson Plan Appendix. 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. DUML library has both the 102 minute feature length and the 22 minute condensed documentary for your classroom use (please make sure to reserve the film at least 2 weeks in advance).

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

ART & MOSAICS: Resourcefulness in a Bottle (activity)

Art & Mosaics
► Resourcefulness in a Bottle
Divide and Conquer
Wasteland

Introduction

This activity was created by Washed Ashore (*www.washedashore.org*) and the full lesson plan is reprinted with their permission in the "Washed Ashore Lesson Plan" appendix. The lesson plan has a great downloadable slide show of mosaic art, with mosaic portraits and masks that are great examples of the art form. For the DUML program, we suggest modifying this activity so that groups of students will just create a marine debris mask (not the eco-mask). *Resourcefulness in a Bottle* has students completing step one: creating the eyes and hair for their marine debris masks. Step two (*Divide and Conquer*) focuses on the background for the mask; and step three (Marine Debris Mosaic Masks) completes the masks using plastics from the Beach Clean up. We suggest conducting *Resourcefulness in a Bottle* and *Divide and Conquer* before the beach clean up. Also, remember to keep colorful recyclable materials and garbage (cleaned!) from your waste audit for students to use in their masks; these pieces of garbage can be added to marine debris for the final product (Marine Debris Mosaic Masks).

Objectives

In this activity students will be able to:

- Demonstrate an understanding of how lines can be used to communicate.
- Demonstrate how everyday objects and debris can become art supplies.
- Change the form of objects to fulfill a new function.

Activity Plan

This activity takes ~65 minutes, see Washed Ashore lesson plan for detailed activity plan.

Materials

- *Resourcefulness in a Bottle* Lesson Plan and Washed Ashore powerpoint (and projector).
- To prepare for this lesson, complete the giant masks templates by cutting out large cardboard ovals roughly four feet by six feet. Size and number can be adjusted based on class size and how you want to group your students. The suggested size works well for a group of roughly 10-20 students. These cardboard templates can be cut from one large box or several small boxes taped together. Details on the template can be found in the lesson plan.
- We will use recycled fishing line (which is collected on the beaches here in NC) to make the hair braids and kabobs (instead of cloth and ribbon); contact DUML to get some for your class before starting this activity.
- Marine debris or trash/recyclables from the trash audit (2-3 empty water bottles per student). Contact DUML to get extras (we have plenty of extra marine debris bottles!).
- Strong sharp scissors – at least one per student.
- 17 gauge wire cut into 12" pieces, loop one end, one per student.
- Several 16 penny nails.
- Large paper clips (not scored) – to use as wire.
- Wire cutters.

ART & MOSAICS: Divide and Conquer (activity)

Introduction

This activity was created by Washed Ashore (*www.washedashore.org*) and the full lesson plan is reprinted with their permission in the Washed Ashore Lesson Plan Appendix. This lesson plan allows students to continue making their masks, and focuses on the technique of mosaic to help them fill in the skin areas of their masks.

Art & Mosaics
Resourcefulness in a Bottle
► **Divide and Conquer**
Wasteland

Objectives

In this activity students will be able to:

- Describe the history of mosaic technique.
- Demonstrate the use of the mosaic technique.
- Work together to create community art.

Activity Plan

This activity takes ~65 minutes, see Washed Ashore lesson plan for detailed activity plan.

Materials

- Masks started in *Resourcefulness in a Bottle* (with hair and eyes attached and

mouth sketched in).
- Additional cardboard to create mask noses.
- Thin cardboard boxes and packaging materials (cereal boxes, egg crates, tissue boxes, etc.).
- Thin plastic containers (yogurt/dairy containers, takeout containers, etc.).
- Strong sharp scissors.
- White school glue.
- Acrylic latex caulk plus silicone in a squeeze tube (recommend Alex Plus Acrylic Latex Caulk Plus Silicone as this is the only glue that works on plastics -- white glue DOES NOT work!).
- Rocks and sand from the beach.

ART & MOSAICS: Wasteland (film)

Art & Mosaics
Resourcefulness in a Bottle
Divide and Conquer
► *Wasteland*

Wasteland is a documentary that was filmed over nearly three years, and follows artist Vik Muniz from his home base in Brooklyn to his native Brazil and the world's largest garbage dump, Jardim Gramacho, which is located on the outskirts of Rio de Janeiro. In Brazil, he photographs a group of "catadores" (pickers of recyclable materials), and then creates portraits of the catadores with garbage. This film highlights the ideas of using garbage/recycling as an art medium, and also highlights how throwing garbage "away", just means away from where you are. This is a powerful documentary, and has many social justice issues that can serve as discussion points for your class. DUML library has the 1hr 40 min minute feature length documentary for your classroom use (please make sure to reserve the film at least 2 weeks in advance).

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, learned in the Physics of Drone Flight activity, 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 beachgoer 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.
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 beachgoer.

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
- 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: Habitat and Marine Debris Sampling (activity)

Introduction

Drones can provide high-resolution aerial imagery of areas that scientists are interested in studying. Students will use imagery collected by drones on the Rachel Carson Reserve in Beaufort, NC to estimate the area of different habitat types that are found in this barrier island ecosystem and the density of marine debris within those habitats. This activity uses an orthomosaic picture. An orthomosaic picture is created from many individual photos that are stitched together by the computer and corrected for distortion caused by multiple photos.

Objectives

- Analyze an orthomosaic picture and determine habitat and marine debris areas.
- Understand the benefits and limitations of using aerial images for field studies.

Activity Plan

Using the provided Habitat and Marine Debris Identification worksheet (pg. 30), students will:

1. Estimate the area of each of the 4 habitat types.
2. Estimate the total area.
3. Count the visible trash in each habitat area.
4. Calculate the total amount of visible trash.
5. Estimate the density of trash in each habitat area.
6. Estimate the overall density of trash.
7. Compare trash density for all 4 habitat types.

Materials

- Habitat and Marine Debris Identification activity kit (Contact DUML with a week's notice before activity).
- Pencil or pen.

Extensions

- Why use drones to study marine debris? Drones can provide high-resolution imagery of the environment to help identify marine debris hotspots. Scientists are studying ways to automatically identify marine debris from drone imagery. Look at the picture below and differentiate pieces of marine debris from the surrounding environment. Have students make a list of the things they look for when spotting marine debris in an aerial photo.
- There is a possible opportunity to have a drone demonstration for your class with Duke's Marine Robotics and Remote Sensing Lab - for more information, contact your science mentor at DUML.

Picture for Habitat and Marine Debris Identification extension:

ROBOTICS: Majestic Plastic Bag (online film)

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)

Introduction

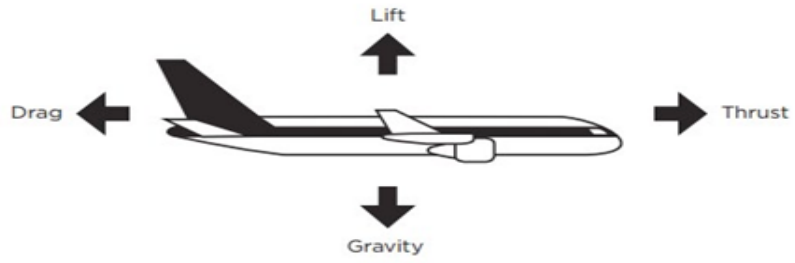
Drones have become an increasingly useful tool for scientific research and in many ways are like airplanes. The same four physical forces that affect airplanes in flight also affect drones. At DUML, both fixed-wing and multirotor drones are used in marine debris research monitoring.

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.

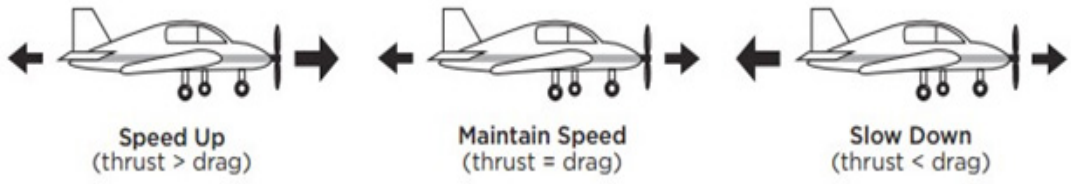
Activity Plan

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

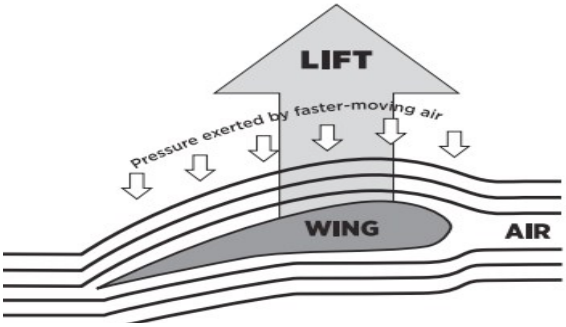
- a sheet of paper
- marker or pencil
- scissors (optional)

Extension Information



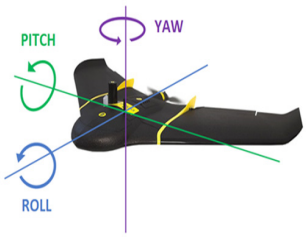
(Image courtesy of *https://www.scienceworld.ca/resources/units/flight)*

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*)

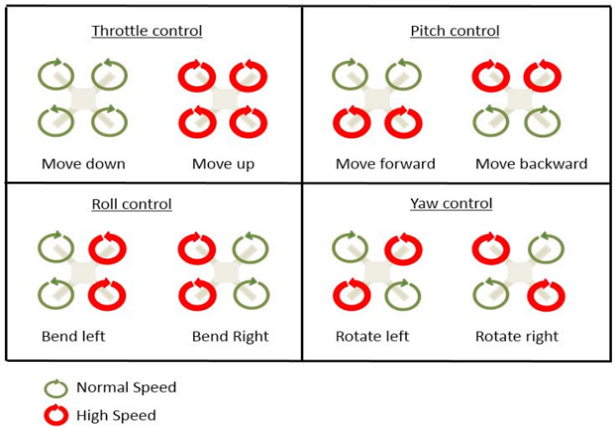
The airplane moves on three axes of flight: Yaw, pitch, and roll.



- 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 work with DUML scientists to collect and quantify marine debris data, analyze their data, and compare their research results with global estimates.

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

Beach Clean-up
- ▶ Collect & Quantify Marine Debris

Data Analysis & Quantification of Accumulated Rates

Introduction

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

Objectives

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

- Understand how to record field data.
- Apply their background knowledge of garbage, plastics, and reading remotely sensed images to collect and record marine debris.
- Understand how wind and ocean current patterns affect the location and types of marine debris in the Rachel Carson Reserve.
- Describe the different habitat areas in Rachel Carson Reserve.

Activity Plan

1. The class will meet at DUML Boathouse where DUML scientists will give a brief introduction/safety talk that includes:
   a) How to safely collect marine debris: wear gloves, leave sealed cans/bottles alone, how to collect sharps (including needles and broken glass).
   b) How to fill out ICC data sheets (each piece of garbage gets recorded with tally marks) and descriptions of the general headings.
   c) Understanding the difference between "nasty trash" and potential "art trash"; and what will happen with each bag.
   d) A description (including an image) of the area to be cleaned.
   e) How to measure the area cleaned with remotely sensed images.
2. Teachers will divide their class into groups of 4. Groups will board DUML boats and head out to Rachel Carson Reserve, clean their designated beach areas, and return to DUML with their trash.
3. After each group returns to DUML, students will weigh/record their trash and enter their data on their 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 sunhat, bring a reusable water bottle, wear sunscreen, and bring a jacket if the weather is cool). The following materials will be supplied by DUML:

- ICC Marine Debris Data Sheets printed on waterproof paper (6 per class)
- Clipboards (6 per class) with pencils attached
- First Aid Kit
- 1 bucket with handles for glass
- 30 pairs of cotton gloves
- Garbage bags (at least 12 per class- each group will need 2)
- Fish scale, clipboard and pencil for weigh station
- Area worksheet

BEACH CLEAN-UP: Data analysis (activity)

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).

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

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 (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 at DUML or 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 the whiteboard (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. Using remotely sensed images from DUML, have students estimate the total area cleaned during their Beach Clean Up. Use the Rachel Carson Reserve Clean-up: Calculating Area worksheet (pg. 34) for help with this calculation.
4. 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.
5. 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 masks, write poetry and stories, create a classroom mural, and develop public presentations for civic action.

COMMUNITY ART: Marine Debris Mosaic Masks

Introduction

This activity allows students to complete their mosaic masks 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*) and the full *Culmination* lesson plan is reprinted with their permission in the Washed Ashore Lesson Plan Appendix. Remember, this activity builds on the *Resourcefulness in a Bottle* and *Divide and Conquer*! lesson plans from the Classroom Explorations section, and uses colorful recyclable materials and garbage (cleaned!) from the Beach Clean Up for students to use in their masks -- 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 mask 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 ~60 minutes, see Washed Ashore lesson plan for detailed activity plan.

Materials

- Masks started from *Resourcefulness in a Bottle* and *Divide and Conquer.*.
- Washed Ashore lesson plan *Culmination.*.
- Cleaned marine debris from Beach Clean Up.
- Mosaic materials from Culmination list: 17 gauge wire (roughly ten feet), Wire cutters, Recycled fishing line for eyebrows (make into braids ahead of time), Several 16 penny nails, Large paper clips (not scored to use as wire).

COMMUNITY ART: Marine Debris Poetry

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

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 workshop, repeated during the field research, and also repeated during the mask 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. 36).
- Have kids go out on the docks 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 Masks
Marine Debris Poetry
► **Circle of Viewpoints**
► **Journey of X Mural**

Introduction
This activity allows 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 the point of view of the [sand, water, fish, an adult, manufacturer, person whose job it is to make the X, company, kids, local fishers, local business owners].
- 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. 37.
- Interesting pieces of marine debris for the center of each circle.
- *Journey of X* worksheet (one for each student) found on pg. 38.
- Pens, markers, crayons, blank paper for illustrations, and big mural paper to combine the stories and illustrations from *Journey of X*.

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 Masks
- Marine Debris Haikus
- Journey of X Class Mural
- Video documentary (or mockumentary) of the process (see supplemental ideas)
- Video public service announcement (see supplemental ideas)

Supplemental Ideas
This section of the program is perfect for technology extensions. Students/classes can create documentaries on the year-long program, create public service videos on marine debris in our community, create stop-gap animation videos on marine debris, use time-lapse photography to show impact, and more. If your class is interested in additional technology activities please contact your DUML scientist for more information, assistance, and technology.

CONCLUSION: Systems Thinking Activity

Conclusion
► Systems Thinking Activity

This Conclusion activity will be delivered by the DUML Community Science team and will revisit the system thinking activity from the introduction. DUML scientists (and participating students) will compare and contrast any changes in the group conversations from the introduction and conclusion activities to see: i) how/if the student's knowledge of marine debris has changed after spending a year investigating the topic of marine debris; ii) if students understand and recognize connections; iii) if students can apply lessons learned over the year and expand their descriptions of marine debris; and iv) if students can analyze the marine debris system and evaluate what is missing from the system.

Objectives

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

- Compare and contrast changes in their understanding of marine debris.
- Reflect on how their perceptions have changed over time.

Activity Plan (facilitated by DUML)

1. Small group discussion with pictures: Divide class into groups of 3-4 students (teacher can make groups ahead of time if needed), and give each group one picture. Ask each group to: "describe what you see in the photo", "what does the picture make you feel/think?". Have groups report back to whole group on their answers.
2. Small group discussion with pictures and quotes: Give each group the corresponding piece of writing for their picture. Ask students "How does this writing change how you think about the photo?" [note: this may not be needed in the conclusion].
3. Refer to systems thinking/connections discussed earlier in the year:
    - System definition: A whole that cannot be divided into independent parts. Note: Components of the system can be considered alone, but they are not independent.
    - Understand the structure of a system: Components & their relationships. Identify components of the marine debris system suggested by the images (each group posts their picture on wall/white board). Have students suggest relationships between these components. Physically connect the images with chalk lines/markers. Ask students "What does looking at all of the photos and their relationships encourage you to think about?", "What is missing from this system?".

Materials

- Laminated pictures of marine debris components (~10) & quotes for each picture.
- Masking tape, chalk (or whiteboard markers).
- Video recording device to compare introduction activity to the activity at the end of the year-long program.
- Original video of introduction activity.

Appendix

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, etc.)						
Recyclable Paper (paper, cardboard, newsprint, etc.)						
Other recyclables (car-tridges, batteries, etc.)						
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
Habitat and Marine Debris ID Worksheet

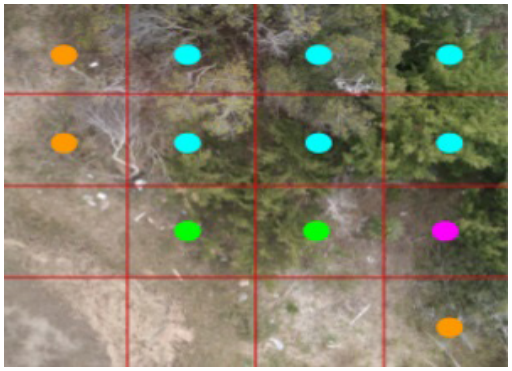
Student/Group Name: _____ Date _____

The image provided shows marine debris on the Rachel Carson Reserve in Beaufort, NC. The image shows four main types of habitat and is overlaid with a grid where each box is 2 meters by 2 meters. Each type of habitat in this image is an important part of our local barrier island ecosystems. The four types of habitat pictured are:

- Maritime forest- a woodland habitat made up of deciduous and coniferous trees that grows within reach of salt spray. Commonly found on barrier islands and other areas along the coast. Look for dense, dark green trees and shrubs.
- Marsh grass - a type of grass that grows in environments where it is exposed to salt water, including areas where it is sometimes below the tide line. Look for patches of brown or green grass with no trees or light brown mats of marsh grass.
- Sandy beach - an area with sand and sparse vegetation along the edge of an island or coastal area. Look for white sand, possibly with sparse green or brown grass.
- Tidal flat - an area that is underwater at high tide, often made of mud and with sparse vegetation. Look for bluish brown areas with sparse brown grass.

The area of one 2 m by 2 m box is 4 m². Counting the number of boxes in each habitat type, then multiplying by 4, will give you the area of that habitat in meters². Because some boxes contain multiple types of habitat, you will count boxes that are completely full, 3/4 full, 1/2 full, and 1/4 full.

Example:



Maritime forest:

# of whole boxes = 6
+ (# of 3/4 boxes)(0.75): 1 x 0.75 = 0.75
+ (# of 1/2 boxes)(0.5): 2 x 0.5 = 1
+ (# of 1/4 boxes)(0.25): 3 x 0.25 = 0.75
= # of boxes of maritime forest = 8.5

# of boxes 8.5 x 4 m² = area of maritime forest 34 m²

1. Estimate the area of each type of habitat, using the grid provided and the equations below:

   a. Maritime forest

   # of whole boxes _____
   + (# of 3/4 boxes) _____ x 0.75 = _____
   + (# of 1/2 boxes) _____ x 0.5 = _____
   + (# of 1/4 boxes)_____ x 0.25 = _____
   = # of boxes of maritime forest _____

   # of boxes _____ x 4 m² = area of maritime forest _____

   b. Marsh grass

   # of whole boxes _____
   + (# of 3/4 boxes) _____ x 0.75 = _____
   + (# of 1/2 boxes) _____ x 0.5 = _____
   + (# of 1/4 boxes)_____ x 0.25 = _____
   = # of boxes of marsh grass _____

   # of boxes _____ x 4 m² = area of marsh grass _____

   c. Sandy beach

   # of whole boxes _____
   + (# of 3/4 boxes) _____ x 0.75 = _____
   + (# of 1/2 boxes) _____ x 0.5 = _____
   + (# of 1/4 boxes)_____ x 0.25 = _____
   = # of boxes of sandy beach _____

   # of boxes _____ x 4 m² = area of sandy beach _____

   d. Tidal flat

   # of whole boxes _____
   + (# of 3/4 boxes) _____ x 0.75 = _____
   + (# of 1/2 boxes) _____ x 0.5 = _____
   + (# of 1/4 boxes)_____ x 0.25 = _____
   = # of boxes of tidal flat _____

   # of boxes _____ x 4 m² = area of tidal flat _____

2. Estimate the total area of habitat: 1a.____+1b.____+1c.____+1d. _____= _____

3. Estimate the amount of trash in each habitat:

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a. Maritime forest
   Visible pieces of trash _____
b. Marsh grass
   Visible pieces of trash _____
c. Sandy beach
   Visible pieces of trash _____
d. Tidal flat
   Visible pieces of trash _____

4. Estimate the total amount of trash visible: 3a.____+3b.____+3c.____+ 3d____= _____

5. Estimate the density of trash in each habitat type:
   (amount of trash in habitat/area of habitat)
   a. Maritime forest
      3a._____÷1a._____=_____ pieces of trash per m^2
   b. Marsh grass
      3b._____÷1b._____=_____ pieces of trash per m^2
   c. Sandy beach
      3c._____÷1c._____=_____ pieces of trash per m^2
   d. Tidal flat
      3d._____÷1d._____=_____ pieces of trash per m^2

6. Estimate the total density of trash:
   4._____ pieces of trash ÷ 2._____ m^2=_____ pieces of trash per m^2

7. Each of the 4 habitat areas has a different density of trash. Write a list of reasons why.

Helpful hints:

- Is the trash not there or just not visible?
- How did the trash get to this area of the island in the first place (e.g. carried by wind, water, etc)?
- What could carry trash away from each habitat?

When you go out to clean up trash on the reserve, do you think you will see the same pattern? Why or why not?

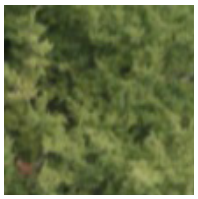
Drones provide a new perspective on the environment that can be very helpful for detecting animal or objects in certain situations. However, as with any scientific tool, they have some limitations. What characteristics of the environment might limit how effective the drones are at detecting objects?

Field Research: Beach Clean-up
Rachel Carson Reserve Clean-up- Calculating Area Worksheet

In this activity, you will use an orthomosaic created using drone imagery taken from the Rachel Carson Reserve in Beaufort, NC. An orthomosaic picture is one made from many different photos stitched together by the computer and corrected for distortion caused by different perspectives on an object in multiple photos.

1. Estimate the area of each type of habitat, using the 10m x 10m grid provided and the equations below:

   a. Maritime forest

   # of whole boxes _____
   + (# of 3/4 boxes) _____ x 0.75 = _____
   + (# of 1/2 boxes) _____ x 0.5 = _____
   + (# of 1/4 boxes)_____ x 0.25 = _____
   = # of boxes of maritime forest _____

   # of boxes _____ x 100 m² = area of maritime forest _____

   b. Marsh grass

   # of whole boxes _____
   + (# of 3/4 boxes) _____ x 0.75 = _____
   + (# of 1/2 boxes) _____ x 0.5 = _____
   + (# of 1/4 boxes)_____ x 0.25 = _____
   = # of boxes of marsh grass _____

   # of boxes _____ x 100 m² = area of marsh grass _____

   c. Sandy beach

   # of whole boxes _____
   + (# of 3/4 boxes) _____ x 0.75 = _____
   + (# of 1/2 boxes) _____ x 0.5 = _____
   + (# of 1/4 boxes)_____ x 0.25 = _____
   = # of boxes of sandy beach _____

   # of boxes _____ x 100 m² = area of sandy beach _____

d. Tidal flat

# of whole boxes _____
+ (# of 3/4 boxes) _____ x 0.75 = _____
+ (# of 1/2 boxes) _____ x 0.5 = _____
+ (# of 1/4 boxes)_____ x 0.25 = _____
= # of boxes of tidal flat _____

# of boxes _____ x 100 m² = area of tidal flat _____

2. Estimate the total area of habitat: 1a.____+1b.____+1c.____+1d. _____= _____

3. Drones are a useful tool for science because they provide a higher resolution than other types of imagery taken from the air. Resolution is the amount of detail visible in a photograph. If a photograph is high resolution, it shows a lot of detail.
   a. Go to Google Earth. Use the KML file provided to explore the area you cleaned up as a class. Zoom in as far as you can. Then remove the layer called "_" and zoom in as far as you can on the Google Earth imagery alone. Which one is clearer? _____ The clearer image has a higher resolution.
   a. The drone imagery has a resolution of about 2.5 cm per pixel.
   The Google Earth imagery has a resolution of about 15 m per pixel.
   How many times bigger than 2.5 cm is 15 m? Remember that 1 m = 100 cm! Show your work in the box below.

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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 feel to you? 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…

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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

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Activity Group	Activity Title	Education Standards
1. Introduction	Systems Thinking Activity	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.
2a. Classroom Explorations: Wastes & Plastics	Waste Audit (activity) How Long Till It's Gone (activity) What is Plastic (Activity) A Plastic Ocean (film)	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.
2b. Classroom Explorations: Arts & Mosaics	Resourcefulness in a Bottle (activity) Divide and Conquer (activity) Wasteland (film)	See Art standards for Making Mosaic Masks (these activities are the first steps for the mask project).
2c. 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 multistep 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.

Activity Group	Activity Title	Education Standards
2c. Classroom Explorations: Robotics	Habitat and Marine Debris Sampling (activity)	*(cont.)* 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. 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.
	Majestic Plastic Bag (film)	
3. 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 of Accumulation Rates	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 multistep 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.

Activity Group	Activity Title	Education Standard
3. Field Research		*(cont.)* 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 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.
4a. Creative Engagement: Community Art	Marine Debris Mosaic Masks (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

Activity Group	Activity Title	Education Standard
		(cont.) 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. 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)	
4b. 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.
5. Conclusion	System Thinking Activity	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.