EAT MY RUST!

FOR THE TEACHER

Discipline
Earth Science

Theme
Systems and Interactions

Key Concepts
Metals tend to corrode and weaken in the presence of seawater. Marine debris can be many types of materials; most will not dissolve or decompose for a very long time.

Synopsis
Students observe the chemical and biological processes of corrosion and degradation on several materials. They use these observations to learn about how long marine debris persists in the environment and the harm to marine life that the debris can cause.

Note: This activity takes several weeks or months of ongoing observations to complete.

Science Process Skills
observing
comparing
categorizing
relating
inferring
communicating

Social Skills
cooperation
discussing
checking for understanding

Vocabulary
seawater
saltwater
corrosion,
marine debris

erosion
rust
biodegradable

MATERIALS
INTO
• pictures of littered beaches
• pictures of rust or corroded metals (or actual samples if possible)
• butcher paper, markers
optional:
Marine Debris and Entanglement Slide Show from the Center for
Marine Conservation at
580 Market St.
Suite 550
San Francisco, CA 94104
(415) 391-6205
available with script in English and Spanish
Also available for loan from MARE library

THROUGH
• 3 clear plastic tubs—at least one gallon each
• scale or balance
• salt
• butcher paper
• debris—any of the following: plastic wrappers, plastic containers, small glass bottles, pieces of rubber, Styrofoam, packing material, six-pack holders, bottle caps, popsicle sticks, broken plastic toys, newspaper, writing paper, cardboard cast iron pan, brass nails or brass tacks, paper clips, aluminum cans (soda cans), tin cans, steelsilverware, pieces of zinc or nickel, copper pennies or wires, etc.
• key concept written in large letters on a strip of butcher or chart paper
optional
12-volt battery and lead wires for each tank

INTRODUCTION
On every coastline in the world, structures made of metal fall apart due to the continual exposure to the elements. The harsh conditions of coastline environments create a serious problem for engineers and architects who build and design the numerous structures, as well as every person who uses them. This breakdown is called corrosion, which is the deterioration of a metal through a chemical reaction with its environment. This chemical reaction is a transfer of electrons from the metal atoms to the surrounding environment. When the metals are exposed to salts, in the presence of moisture, corrosion is stimulated and the rate of degradation increases.

One way marine engineers deal with corrosion is to sacrifice a less-resistant metal to the seawater instead of the original metal. The less noble metal, as it is called, corrodes quicker than the original metal because the less noble metal gives off electrons more freely than the original metal. The saltwater absorbs those electrons and thus corrodes the less noble metal first. By keeping less noble metal near the original metal, and by replacing it when it is corroded away, marine engineers preserve the original metal from corrosion.

While corrosion is the chemical process that breaks materials down, there are several other types of degradation that occur and contribute to the break down of materials. The physical action of waves crashing, sand particles scratching away, and wind blowing cause near shore structures and the coastline to erode away. There is also photodegradation—a process by which the intense heat and light energy from the sun causes objects to break down into smaller particles. Many items that are nonmetals will simply dissolve over a period of time by reacting with the seawater, sun, and waves.

Although many building materials are destroyed by corrosion and degradation, these processes can be very useful when dealing with marine debris. Every year, millions of tons of solid waste, such as metal containers, glass, and plastics, are discarded into the ocean. Some is left as litter on beaches by visitors, and some is dumped from boats and ships of all types offshore. This debris can take hundreds of years to dissolve, be broken down, or removed from the environment by several different processes, and it causes irreparable damage to the environment before it is gone.

Marine debris is distributed throughout the water depending on the density of the object. Metals and glass tend to sink, while most plastics float. The placement of the objects in the water is related to the amount of time it takes them to break down. The objects that float will degrade faster than the ones that sink because they are exposed to the sun and winds.

Plastics dissolve into small pelets quickly. However, the pelets persist for longer than metal and glass before they are completely broken down. Most of the time it takes for an object to break down in the ocean is many years long. The amount of time that the debris takes to break down is important because although the trash is out of sight, it continues to harm marine life.

For example, aluminum cans in the ocean take up to 100 years to degrade, plastics on the beach take up to 50 years, fishing nets lost in the ocean take up to 75 years, and the brittle plastics that are in sunlight take up to 25 years to degrade. This debris causes much damage to marine life: plastic strangles seal and seal lions, pieces of sharp plastic cut fish and dolphins, and plastic bags get caught in the throats and digestive tracts of sea birds, whales, and sea turtles resulting in strangulation or starvation.

INTO
THE ACTIVITIES

Think, Pair, Share
1. Have students think about the following questions, jotting down some ideas in words or pictures:
a. What is Rust?
b. Where have you seen rust before?
c. What are all the different types of metals you know?
2. Now have each student pair up with another student and compare/ discuss their ideas. They can add to their notes after discussion with their partner if they like.
3. Finally, have each pair share their ideas with another pair of students.
4. Lead a class discussion and record the group's responses on a class chart.

Sketch a Scene
Place pictures of marine debris and trash around the room. Have students draw a scene showing how marine debris can get to the beach. It could be scene they witnessed at a beach or in a boat or one that they found in a picture. Post all the pictures on the wall and have the students take a walk around the room.

Metal Detectors
Have students bring all the different types of metal they can find from home. Ask every student to bring at least three samples. Have the students compare them all:
• Which are heaviest, lightest, shiniest, hardest, smoothest
• Can students name what the metals are?
Now bring out the items from the materials list (metals and nonmetals) for students to compare with the items they brought.
• Can you sort all the objects into groups of metals and nonmetals?
• Into other subgroups based on the different properties that the students came up with?

Assessment
• Participation in Partner Parade
• Individual and group recording of Think, Pair, Share; Sketch A Scene, and Metal Detectors
• Participation in the comparison of items in Metal Detectors
• Participation in the explanation of their sketch

THROUGH
THE ACTIVITIES

1. If possible, show the CMC Marine and Entanglement Slide Show to students. Be aware that the slide Show is quite graphic, and occasionally gruesome, showing animals that have died from strangulation in plastic debris. You may want to edit the slides for young children. After the slides, discuss with students how the marine debris is removed from the environment and it stays in the ocean and on the beach until it degrades, dissolves, or corrodes from natural causes.

2. Set up the plastic tubs in a place that is easily observable and will not be disturbed.

3. Fill each plastic tub about 3/4 full of tap water, but make sure that the water will not overflow when the items are added or if hands are placed in the tank to move things around.

4. Add salt to two of the tubs. Put two tablespoons of salt into the first tub to simulate seawater, and 10 ten tablespoons of salt into the second tub to simulate hypersaline water—add salt until no more will dissolve to the second tub.

5. Have students check the density of the objects by seeing if they float or sink. Do this in the seawater container as this would be the most similar to the real environment.

6. Allow the students to touch the objects so that they can become familiar with all the properties and the way that each one feels.

7. Have students sit in small groups where they can quietly compare the items and discuss these similarities. Create a matrix chart for each group like the one below with the types of objects across the top and the properties down the left side. Have the students answer the questions in the chart and then group the items based upon what they saw, felt, and observed of the materials.

8. Encourage students to share their reasoning for their particular grouping of the items. Make sure that all the members of each group agree on the groupings. The questions in the chart should pertain to the specific materials that you use in your classroom.

ANSWER YES (Y) OR NO (N)
1. Can it bend?
2. Does it float?
3. Is it heavy?
4. Is it hollow?

5. Can you see through it?
6. Will a magnet pick it up?
7. Is it hard?

	Metal#1	Metal#2	Metal #3	Glass	Plastic(hard)	Plastic(soft)
1.						
2.						
3.						
4.						
5.						
6.						
7.						

9. After the students have grouped the items from their observations and the chart, have them predict what will happen (i.e. which materials will break down first) when they are submerged for a long time in saltwater.

10. Now that the children have predicted what will happen to the objects, place one of each of the objects into each of the tanks, making sure that none of the objects touch each other.

11. Allow several weeks for the objects to break down and dissolve. Some will start much sooner and some will not start to dissolve for much longer. Allow several months for the entire experiment to go on.

Charting the Breakdown
Place simple questions near the tanks that can only be answered by observing the experiments over time.
a. What color is the object (is it the same or different from last time you looked)?
b. Is the object the same size as it was before? Or is it in pieces?
c. Does the object still feel the same as it did last time?
d. Does the object look the same?
e. If the object was floating, Is it still floating or has it sunk?

Create a chart to record the results week after week.

Debriefing
Hold up the key concept on butcher paper and have one or more students read it aloud. Post the concept on the wall.

Assessment
- Participation throughout the activity
- Cooperation
- Completed Observation chart

BEYOND THE ACTIVITIES

Field Trips
Visit a local beach to observe all the debris on the beach. Find trash that is still intact and some that is breaking down. Join the Adopt-A-Beach program to show the children how important the beach is and how threatened the beach and ocean is by marine debris. Arrange a field trip to a steel company (i.e. U.S. Steel) so that the children can see the ways people fight corrosion in near shore buildings.

Student Creations
Have the children propose:
a. new ways to fight corrosion
b. new ways to deal with trash in the ocean; either to keep it out of the ocean or how to have the trash break down if it gets into the ocean.

The adaptations can be as creative as possible, the main concern is to have the children start to think about ways to keep the ocean clean and debris free.