AMP IT UP

Advanced Manufacturing & Prototyping Integrated to Unlock Potential

7TH GRADE SCIENCE

Data Visualization

UNDER THE SEA

Deep Sea Challenge

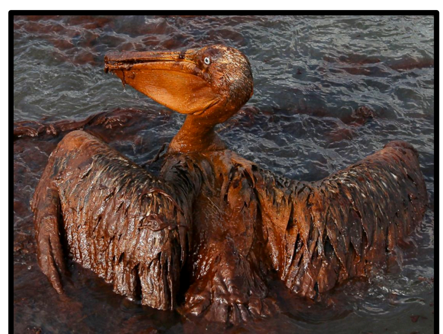
7DVS

SECTION 1 – THE DEEPWATER HORIZON ACCIDENT

1.1 INTRODUCTION

Watch ***Explosion of Deep Water Horizon Oil Rig*:** Video 1

All was not well on the offshore oil well drilling unit called the *Deepwater Horizon* on the evening of April 20th, 2010. The electric lights flickered, and the workers felt two sharp vibrations. They knew something was very wrong. Then a large bubble of methane gas escaped from the oil well they were drilling on the ocean floor. It shot up the drill column, and exploded, engulfing the drilling rig in flames. The 126 crew members had less than 5 minutes to escape. Lifeboats and helicopters rescued 115, but 11 workers were killed. And 5,000 feet below, one of the largest environmental disasters in U.S. history was just beginning. The broken oil well, called the Macondo Well, was spewing massive amounts of crude oil into the waters of the Gulf of Mexico, and couldn't be stopped.



In the following days, pictures of birds with oiled feathers and of dead fish floating in pools of oil clearly showed the damage to the beaches, marshes, birds, and marine mammals. However, the damage to the ecosystem on the ocean floor was not as obvious. The well that blew out in the accident was in the deep sea, about 5,000 feet below the ocean surface. At those depths it is very cold and dark, and the pressure is almost 1,000 times higher than on land. It will crush an unprotected human body. Fixing the broken well would take months. And in the meantime, more oil than from any previous accident in history was spilling out onto the ocean floor and into the fragile deep sea ecosystem.

1.2 INVESTIGATING WHAT HAPPENED ON THE OCEAN FLOOR

In the months after the Deepwater Horizon accident, a research team made up of oceanographers, marine biologists, and chemists came together and formed the ECOGIG project. ECOGIG stands for **Ec**osystem Impacts of **O**il and **G**as **I**nputs to the **G**ulf. The goal of the project was to investigate the damage the Deepwater Horizon accident and the clean-up efforts had done to the plants, animals and other organisms that make up the deep sea ecosystem in the Gulf of Mexico.

A unique community of coral lives on the deep ocean floor. They are different from corals that live near the surface of the ocean. They are very slow growing and long lived. Some might be over 500 years old. If these coral are damaged, they take a long time to recover. But at the time of the Deepwater Horizon spill, very little was known about how corals are affected by oil and by the chemicals used to clean up oil spills. Finding that out would be the job of the scientists.

The following video shows how the ECOGIG team began to explore the deep sea ecosystem.

Watch ***ECOGIG Deep Sea Life: Corals, Fishes, Invertebrates:*** Video #2.

Discuss these questions as a class:

1. In exploring the effects of oil on the deep-sea ecosystem, what were the scientists' first steps?
2. What characteristic of deep-sea corals make it very difficult to measure the impact of the oil spill?

1.3 THE CHALLENGE

To determine the long-term impact of something like an oil spill, scientists watch and record what happens over time. The evidence they gather is called a data time-series. The ECOGIG team wanted to investigate the effect of the oil spill on the health of the deep sea corals. Their research plan was to visit the corals every year using special remote controlled vehicles, take pictures of the same coral each time, and then evaluate the coral's health. They did this for 6 years following the accident.

Watch ***ECOGIG in 60 seconds*** video #3.

The ECOGIG team now has a time-series of images of different coral colonies for the six year period after the Deepwater Horizon oil spill. So how are the coral doing? Are they recovering from the oil spill? You and your class have been charged to find that out. But how can you do that with a bunch of photos?

Discuss these questions as a class:

1. What type of information, or data, can you get from a photo?
2. Why is it important to take photos of the same coral every year?

SECTION 2 – ANALYZING IMAGES

As part of your challenge, you will need to analyze the photos of deep sea coral communities taken by the ECOGIG team. There is a phrase – "A picture is worth 1,000 words". Why is this? What type of information do photos provide? You probably look at many photos every day—on your phone, on Instagram, on Facebook. What do you see? You may notice that a friend is wearing a certain color shirt or that your eyes are closed in your latest selfie. But is that data? And if it is, how can you analyze it and draw conclusions?

When you look at a picture, you are making an observation. Based on other information that you know, you can sometimes **infer** more about what is going on. In other words, you draw a conclusion. For example, if the picture is of a person in bed with a thermometer in their mouth, you infer that the person is sick. Or if you observe a picture of a person in a T-shirt that features a particular sports team, you infer that the person is a fan of that team. This is called **inference**.

2.1 WOULD YOU EAT THIS BURGER?

Let's look at a photo of a hamburger from a fast food restaurant.

Procedure:

1. Brainstorm and discuss with your partner or group what you infer from the photo below and answer the following questions:
   a. What do you see when you look at this photo?
   b. What evidence pops out at you?
   c. What can you infer about how good a burger this would be?
   d. Do you think you would want to order this burger for dinner?
   e. What evidence did you get from the photo to make this decision?

2. Share your answers to the questions with the class.

You have just used words to describe the burger and the conclusions, or inferences, you have made about how good it would taste. But to compare the hamburger to a different burger, you need a rating scale. How would you rate this burger? You could do it on a 1-5 star rating, like you would when rating a movie or a new pair of shoes. Or on a different scale. In this case, let's rate it on a scale of 1-10.

Procedure:

1. Observe the hamburger on the previous page. Give it a rating on a scale of 1-10, where 1 is the lowest score, and 10 is the highest.
2. Report your rating to your teacher. Your teacher will plot your rating and all of your classmates' answers on the board.

Discuss these questions as a class:

1. What evidence did you use to assign a number to this image?
2. Did everyone in the class all agree on the same rating of the burger?
3. Is your burger rating a type of data?

2.2 ADD TO YOUR UNDERSTANDING: ANALYZING NON-NUMERICAL DATA

Data is information. It can be measured, collected, analyzed, and visualized. Data can sometimes be collected in the form of numbers—like temperature, time, velocity, and other physical things you can measure. Numerical data can be put in a table, or made into a graph. These graphs can help scientists organize and interpret data and can help them communicate their results to other people.

In the ECOGIG project, the data consists of photographs of coral. This is **non-numerical** data—in other words, the data is not in the form of numbers. You can see differences in the coral when you look at the different pictures. However, as a scientist, you need to be able to say more than "this coral looks bad" or "this coral looks good." You need a good rating scale so you can compare photos and be able to report **how much better** or **how much worse** the coral in one photo looks from the coral in another. You need to **quantify** the differences—to change visual data into number data. How do you do that in a way that allows many people to all evaluate the photographs in the same reliable and consistent way?

One way is through the use of a **scoring rubric**. Scoring rubrics lay out specific criteria that are important. Teachers often use rubrics to grade assignments fairly across all students. Rubrics ensure fair grading by making clear the scoring criteria for each part of the assignment.

	Criteria				Points
	4	3	2	1	
Body language	Movements seemed fluid and helped the audience visualize.	Made movements or gestures that enhanced articulation.	Very little movement or descriptive gestures.	No movement or descriptive gestures.	
Eye contact	Holds attention of entire audience with the use of direct eye contact.	Consistent use of direct eye contact with audience.	Displayed minimal eye contact with audience.	No eye contact with audience.	
Introduction and closure	Student delivers open and closing remarks that capture the attention of the audience and set the mood.	Student displays clear introductory or closing remarks.	Student clearly uses either an introductory or closing remark, but not both.	Student does not display clear introductory or closing remarks.	
Pacing	Good use of drama and student meets apportioned time interval.	Delivery is patterned, but does not meet apportioned time interval.	Delivery is in bursts and does not meet apportioned time interval.	Delivery is either too quick or too slow to meet apportioned time interval.	
Poise	Student displays relaxed, self-confident nature about self, with no mistakes.	Makes minor mistakes, but quickly recovers from them; displays little or no tension.	Displays mild tension; has trouble recovering from mistakes.	Tension and nervousness is obvious; has trouble recovering from mistakes.	
Voice	Use of fluid speech and inflection maintains the interest of the audience.	Satisfactory use of inflection, but does not consistently use fluid speech.	Displays some level of inflection throughout delivery.	Consistently uses a monotone voice.	
				Total	

The picture above shows what a rubric looks like. There are categories down the left column, and there are rankings within each category, called the criteria, that are assigned numbers. Finally, there are descriptions of the criteria for each ranking. When using a rubric, you give a score for each category, based on the criteria. You then add up the scores from all the categories to find the total score.

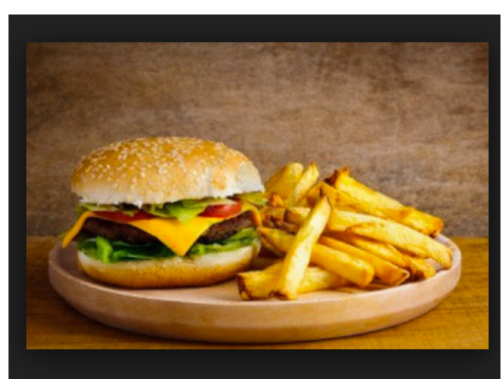
2.3 RATE THAT BURGER!

Now that you have some background on rubrics, let's assign the hamburger a rating or score by using a rubric. As you develop and use this rubric, remember the purpose of the rubric is to allow multiple people to develop fair scores across different images of hamburgers. You will create this rubric based on your class's knowledge of what a "good hamburger" would look like.

Procedure:

1. The *Creating a Rubric: Student Sheet #1* includes a list of five categories that might determine the rating of a hamburger: bun, toppings, meat, size and presentation. There are a few blank boxes if your class would like to add additional categories.
2. This rubric will have 3 rating levels, or criteria. In each category, the burger can receive a score between 0 (lowest) and 2 (highest) depending on how it ranks on the criteria that you determine.
3. Write a decription of each ranking (0,1,and 2) in each category. See the examples provided on the *Creating a Rubric: Student Sheet #1* and fill in the missing boxes with your class. (You can also add to the existing boxes.)
4. To put your rubric to use, tranfer any class-created rubric categories from *Creating a Rubric: Student Sheet #1* onto *Evaluating Images: Student Sheet #2.*
5. For the two images below, work with your group and use your rubric to assign a rating for each category on *Evaluating Images: Student Sheet #2*.


Hamburger Image #1


Hamburger Image #2

6. Add your Hamburger ratings from each category for the Hamburger #1 column and the Hamburger #2 column. Record your scores in the total hamburger score row in the chart on the *Evaluating Images: Student Sheet #2.*
7. What do these scores tell you about each Hamburger? Record your answer to the question on *Evaluating Images: Student Sheet #2*
8. Share your scores with the class and see if you have similar hamburger scores for each picture.

Discuss these questions as a class:

1. Why is the score on a rubric more accurate than a simple rating of 1-10?
2. Do you think your initial rating of the first hamburger picture would change if you used a rubric?

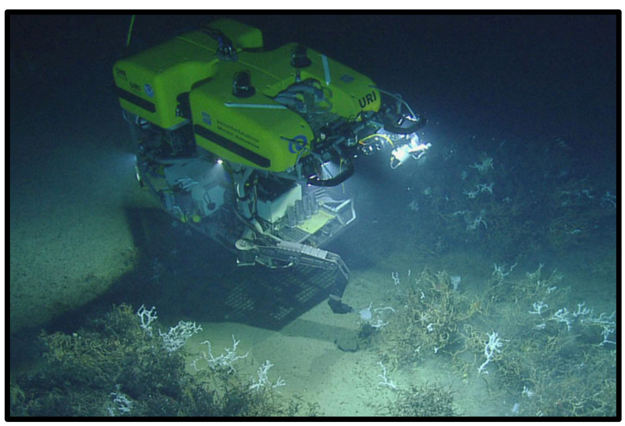
Congratulations. You are now ready to evaluate the coral time-series photos for the ECOGIG team.

SECTION 3 – STUDYING CORAL COMMUNITIES

3.1 TAKING PICTURES OF CORAL COMMUNITIES

To investigate whether, and how fast, the deep sea coral are recovering or dying, you will need to analyze images of the corals over time and compare them. How can you do this? People can only scuba dive a couple of hundred feet below the surface of the water. Below that, the pressure is too large. Most of these coral colonies are almost 5,000 feet beneath the surface of the ocean, where a human diver would be crushed. So how do scientists take photos of them? Watch the video to see how the ECOGIG team investigates the deep sea coral.

Watch ***ECO ROVs in STEM ED*** video #4.

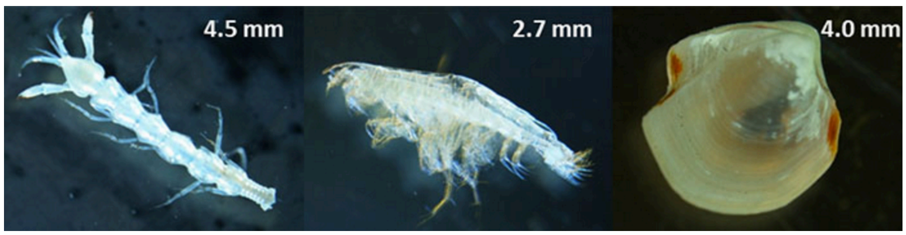


Front view of the Remotely Operated Vehicle (ROV) Hercules collecting a glass sponge froma thicket of coral in the Northern Gulf of Mexico.
(Credit: Ocean Exploration Trust and ECOGIG)

To explore the sea floor, the ECOGIG team used a **Remotely Operated Vehicle (ROV)** that can operate at high pressures below the surface of the water. One example, the Hercules, is pictured above. Scientists attach video cameras to the vehicle so they can take photos of the corals at different angles and distances. The ECOGIG team visited and photographed the same coral every year to create a time-series of photographic data.

3.2 ADD TO YOUR UNDERSTANDING: THE DEEP SEA ECOSYSTEM

The deep sea corals on the ocean floor are part of an extremely diverse and complex **ecosystem**. They provide home to a wide array of organisms that live in the sediment of the ocean floor—animals such as fish, sponges, bivalves (clams, oysters), and crustaceans (crabs, barnacles, krill). These organisms are known as **benthic organisms** and depend on the corals for food and habitat. If the corals die, they will probably die too.



Examples of Benthic Organisms on the Sea Floor

These living organisms are called the **biotic factors** in the ecosystem. There are also many nonliving, or **abiotic,** factors that affect how well corals grow and survive. These include things such as light, pressure, ocean currents, oxygen, temperature, nutrients and various chemicals in the water. Any change in these abiotic factors, such as by an oil spill in the deep sea, will affect how well the corals and the deep sea ecosystem survive.

KEY TERMS

Ecosystem: is a community of organisms interacting with each other and with their environment such that energy is exchanged

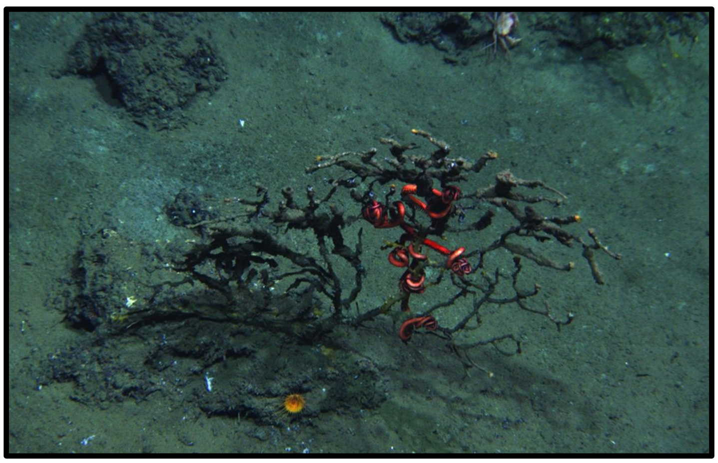
Benthic: bottom sediments and other surfaces of a body of water such as an ocean or a lake

Biotic Factors: living organisms in an ecosystem

Abiotic Factors: non-living (physical or chemical) components of an ecosystem

3.3 CHANGES IN THE ECOSYSTEM AFTER THE OIL SPILL

What did the ECOGIG scientists find when they first explored the ocean floor in the months after the Deepwater Horizon accident? First, they observed oil extending around ten to fifteen miles from the Maconda Wellhead, and inferred that it was there because of the explosion. They also found a community of coral about seven miles away that was heavily damaged. Many of the corals were covered with a clumpy brown material containing oil that scientists call "**floc**." The scientists could also see dead tissue and mucus on these corals.

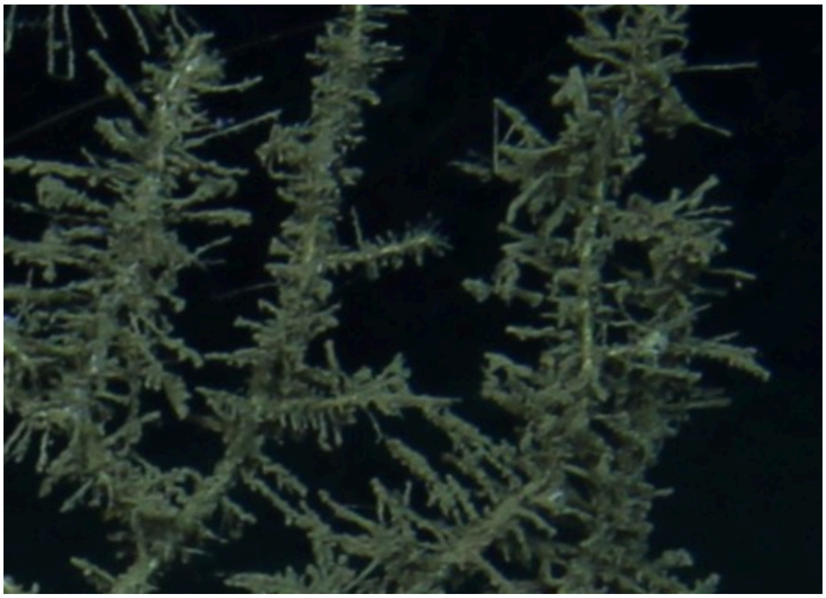


This coral is covered in "floc" and located about 7 miles from the Macondo Wellhead.

Brittle Stars, which are similar to starfish, are a benthic organism that normally live on these corals. At this study site, the Brittle Stars were behaving abnormally. They were attached to the coral in different ways than they would have been on healthy coral. When a brittle star is on a healthy coral, it will have its tentacles extended as shown in the picture below. Unhealthy corals had no brittle stars living on them, or the tentacles of the brittle stars were curled tightly around the coral (like the one in the photo above.)

Brittle Star with extended tentacles on healthy P.Biscaya Coral

ECOGIG scientists also observed **hydroids** on the damaged coral. Hydroids are small predators related to jellyfish. Hydroids are a sign of coral stress and do not live on healthy corals. Hydroids look like there is "fuzz" covering the coral. The picture below identifies an unhealthy coral covered by hydroids.



Hydroid growth on a coral

Lastly, the scientists saw fewer types of other living organisms, or biotic factors, around the coral. They inferred that the diversity of the marine life in the ecosystem had decreased. But was this damage permanent? Only time, and your scientific analysis, will tell.

SECTION 4 – EVALUATING THE HEALTH OF CORAL COMMUNITIES

4.1 DEVELOPING A RUBRIC

Your teams' challenge is to investigate how much damage the Deepwater Horizon oil spill caused to the corals on the ocean floor, and to determine whether the coral recovered over time. The evidence, or data, you will have are photes taken by the ECOGIG scientists using the ROV.

Like all scientists, your team will need a consistent way to analyze the images to determine whether a coral is healthy, recovering, or damaged. You will therefore work with your class to develop a rubric for the health of a coral. To help you, the ECOGIG team has provided the two images below of coral colonies from 2010, right after the oil spill.

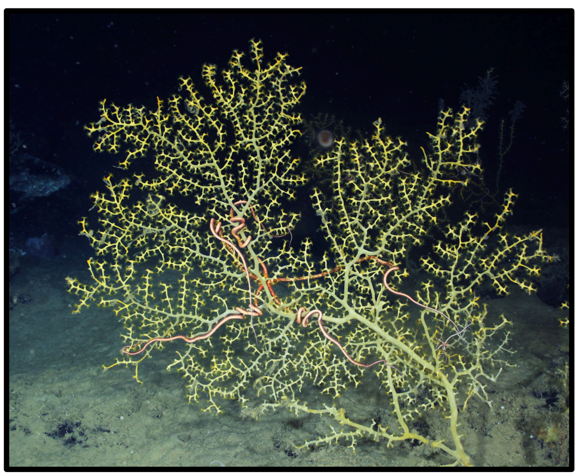


Image of Healthy Coral


Image of an Unhealthy Coral

Watch the video to learn more about the characteristics of a healthy coral environment.

Watch ***Diversity of Deepwater Corals*** video #5.

Procedure:

1. Work with your group to create a list of characteristics using the images of the healthy and unhealthy coral on page 13 in your *Student Edition*.
2. Record these characteristics in the comparison chart on your *Coral Characteristics: Student Sheet #3.* You may want to refer back to what you have learned about the damaged deep sea ecosystem.

4.2 CREATING AND STANDARDIZING YOUR RUBRIC

It is important to develop a standardized rubric for the whole class to use because the ECOGIG team needs your class to evaluate time-series images from several different colonies of coral near the Macondo Wellhead. If different groups use different rubrics, the ECOGIG team will not know how to compare them. Each group needs to judge their coral colony using the same scale.

Follow the procedure below to create a standardized class rubric:

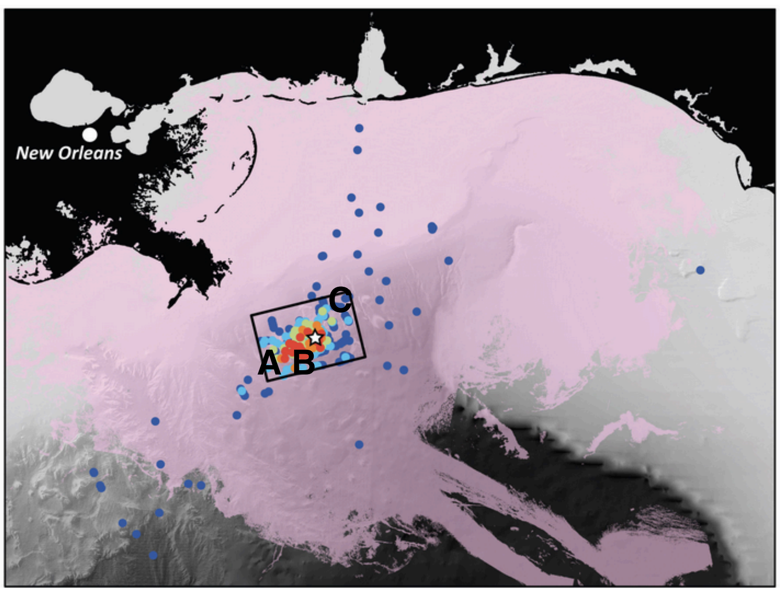
1. To develop your teams' rubric categories, compare the characteristics of a healthy coral and an unhealthy coral that you wrote on *Coral Characteristics: Student Sheet #3*. As an example, you probably noticed that the healthy corals have a bright yellow/green color, while unhealthy corals have a brown color. "Color" would therefore be a category on your rubric. "Bright yellow/green" and "Brown" could be two of the criteria descriptions for that rubric category. A short list of categories has been created for you. Your group may add additional categories.
2. Fill in the criteria descriptions for each category.
3. Report your group's categories and characteristics of each type of coral to the class.
4. Your teacher will help the class create a standardized class rubric. Write the categories and criteria for evaluating the health of a coral on *Class Rubric: Student Sheet #4.*

4.3 APPLYING YOUR RUBRIC

The ECOGIG scientists have chosen three different sites for your class to evaluate. They photographed these corals every year for six years to check to see if the coral is recovering. They chose these sites because:

- The coral was covered in floc six months after the oil spill,
- The site was within 20 kilometers of the Macondo Wellhead, and
- The ECOGIG team was able to take clear photographs of the corals and create a time-series.

View the map below to see the location of the three sites (A, B, C) in relation to the Macondo Wellhead.



Map of the Northern Gulf of Mexico with sampling sites in the study. Hotter colors equal more oil. The white star indicates the location of the BP Macondo well.

Figure courtesy of Proceedings of the National Academy of Sciences:
Fallout plume of submerged oil from Deepwater Horizon – *Valentine et al.*

Your group will be assigned either site A, B, or C to evaluate. You will view three images from the time-series: one from 2011, one from 2013, and one from 2015. Using your standardized class rubric, your task is to quantify the health of the coral in each image and compare them. Based on your observations and analysis, see if you can infer whether the coral is recovering or not.

Procedure:

1. Record your site location on *Evaluating Images: Student Sheet #5*.
2. Copy the categories from your *Class Rubric: Student Sheet #4* to your *Evaluating Images: Student Sheet #5*.
3. Evaluate the image from 2011, 2013, and 2015 using the standardized rubric that your class created on *Class Rubric: Student Sheet #4*.
4. Look at your 2011 image and identify your first category. Review the criteria and decide which set of criteria best matches your coral image.
5. If the coral matches the criteria of the **healthy** coral, place a 1 in the 2011 column for the first category. If the coral matches the criteria of the **unhealthy** coral, place a 0 in the 2011 column for the first category.
6. Repeat steps 4 and 5 for each category for the 2011 image.
7. Repeat the process for the 2013 and 2015 images.

Categories	2011	2013	2015
Floc	1	0	0

4.4 CALCULATING THE HEALTH SCORE

The *health score* is an example of how you can take a visual and extract numerical data from it. This score can then be used to infer the impact of the oil spill on the health of the coral. The lower the score, the less healthy the corals are. Corals with a high score are healthier or are returning to health.

Procedure:

1. To determine the health score for each image, add the numbers in each column on *Evaluating Images: Student Sheet #5*.
2. Record the health score for each image in the row marked “Total Points- Health Score” on *Evaluating Images: Student Sheet #5*.
3. Compare your health score for each of your coral images.
4. Answer the following discussion questions with your group.

Discuss these questions as a group:

1. What looked different in the photos of your corals over time?
2. Were there differences in the health scores of your three images?. Was there a trend upward or downward from 2011 to 2015?
3. What inferences about the **recovery of the** ecosystem can you make from this data trend?

4.5 SHARING YOUR DATA

Share your health scores and the location of your coral colony with your class. Your teacher will project the images as you share your score and record the scores on a chart on the board.

Discuss these questions as a class:

1. Were the health scores from different groups for the same sites similar?
2. Did images with a high health score look healthier than images with a low health scores?
3. Were there differences in the health scores at the three different sites?
4. Did you notice any trends in the health scores from the different sites? What can you infer from these trends?
5. What factors might have affected how the oil impacted the coral ecosystems in different locations?
6. Do you think the health scores accurately quantified the data in the images and reflected a consistent method of evaluating the images?

SECTION 5 – REMEMBERING DEEPWATER HORIZON

5.1 LOOKING AT THE WHOLE ECOSYSTEM

Ten years after the oil spill, many communities still feel the effects of Deepwater Horizon. Although the oil coming from the well was stopped after 87 days, the impacts on the wetlands and the barrier islands of southern Louisiana have lasted a lot longer. The oil spill did not just damage the environment, but it hurt the local fishing, sporting and tourism industries as well.

Watch ***Remembering Deepwater Horizon*****-Video 6**

5.2 ADD TO YOUR UNDERSTANDING: TEMPORAL AND SPATIAL DATA

The ECOGIG team and other scientists have spent many years assessing the long-term impact of the oil spill on the deep sea ecosystems in the Gulf of Mexico. To do that, they have collected and looked at data over a long period of time. Data collected over time is called **temporal data**.

KEY TERMS

Temporal data: data over time

Spatial data: geographic information or data that can be mapped

Your group evaluated temporal data about one specific coral colony, in one location. For scientists to develop a broader picture of the impact of the oil spill, it is important to look at data from different places on the seafloor, and from different parts of the ecosystem. By looking at data from multiple sites with different distances and directions from the spill, scientists can get a much more complete picture of the impact of the oil spill. They can also determine where the worst impacts were, and perhaps figure out why certain areas were more impacted than others. Data collected across multiple geographic locations is called **spatial data.** It is important to keep evaluating the effects of this spill over both time and space. The data collected will help the community and ecosystem recover.

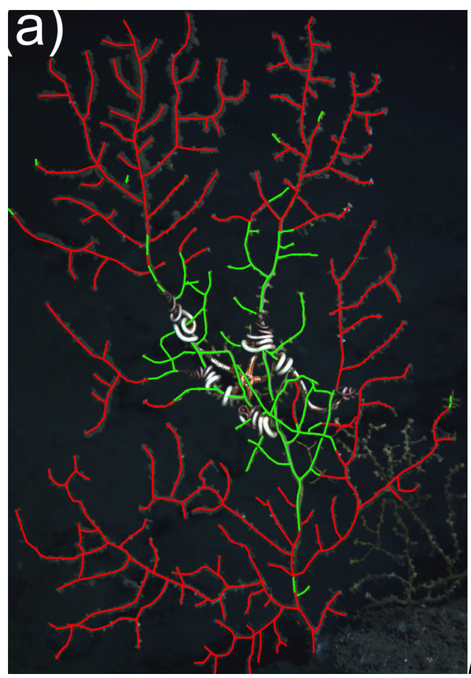
SECTION 6 – MAKING MORE MEANING OUT OF DATA: CODING CORALS

6.1 MAKING YOUR RESULTS MORE VISUAL

The health score that you calculated provided a snapshot of the health of the coral at a particular point in time. However, the health score is a pretty crude measure, and only tells you about the general health of the whole coral. It can be hard to infer the health of the coral if part of the coral is showing regrowth while other parts are still showing damage or are dying. As a result, two corals that look very different might have the same health score. Scientists sometimes need to dig deeper in the images to discover more detailed data. Is there a way to look at the image and analyze the individual branches of the coral for recovery?

A graduate student who was part of the ECOGIG team came up with an idea to code the images of the coral to determine which parts of the coral are unhealthy, healthy, or recovering. He developed this idea initially to see if branches that were covered in oily floc six months after the oil spill were able to recover. He took each image of coral and coded all of the unhealthy branches in **red** and all of the healthy branches in **green**. Then, he used a computer to digitally code these images.

2010 – Actual Coral Image



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2010 – Coded Coral Image

When you examine these two pictures, you will see everywhere that there is Floc; it is coded in **red** and the parts of the coral that are still healthy are coded in **green**. This is a different type of visualization of data that allows you determine how much of the coral has been damaged by looking at the difference between the **red** and **green** coding.

6.2 CODING YOUR CORAL

You will now use the ECOGIG team's method to code your team's coral images. In addition to using **red** and **green**, you will also add a **black** color to show areas of possible recovery on the coral.

Procedure:

1. Review the legend on *Coding Corals: Student Sheet #6* to code the coral as healthy, unhealthy, or recovering.
2. Place your transparency on your assigned image.
3. Use your **red** marker and trace over the X's in the corners of your transparency.
4. Write your name, the location, the year, and the picture ID number on your transparency.
5. Use the legend on *Coding Corals: Student Sheet #6* to trace the coral image.
6. Find all **unhealthy** areas of the coral – such as bare skeleton and/or hydroid growth – and trace them in **red**.
7. Find all the **healthy** areas of the coral – such as being yellow, branching, and/or polyp extension – and trace them in **green**.
8. Find all areas of the coral that may have some regrowth – such as **schlerites** enlarged (see definition), some yellow color, and/or a little branching – and trace that section in **black**.

KEY TERMS

Schlerites: Elements or outgrowths of the coral skeleton. When they are enlarged, they look like bumps on the coral. They would not have polyps or extensions on them.

6.3 SHARE AND COMPARE

You will now compare your time-series of images across each location.

Procedure:

1. Organize the images in time order. Look for differences and trends in the coded images over time. This is an example of **temporal data.**
2. Look at your health score for the same image. How does your health score compare to your coded image?
3. Share your group's coded images with the class.
4. Tape your image to the board and write the health score next to each image.
5. Compare your images to groups who coded the same images and groups who coded images from different locations. This is an example of **spatial data**.
6. Record information about your coral colony and other groups' coral colonies in table provided on *Student Sheet #7: Data Visualization Questions.*
7. Think about the differences in information provided by the health score and the color coding diagram and answer the questions on *Student Sheet #7: Data Visualization Questions.*

Discuss these questions as a class:

1. Are there trends in data in your color-coding from 2011-2015? Are the trends similar or different from different sites? What inferences can you make about the health of the coral over time?
2. Were these trends similar to your health scores? If not, why do you think there are differences
3. What evidence does the color coding method provide you as a researcher?

6.4 ADD TO YOUR UNDERSTANDING: ANALYZING IMAGES USING COMPUTING AND ARTIFICIAL INTELLIGENCE

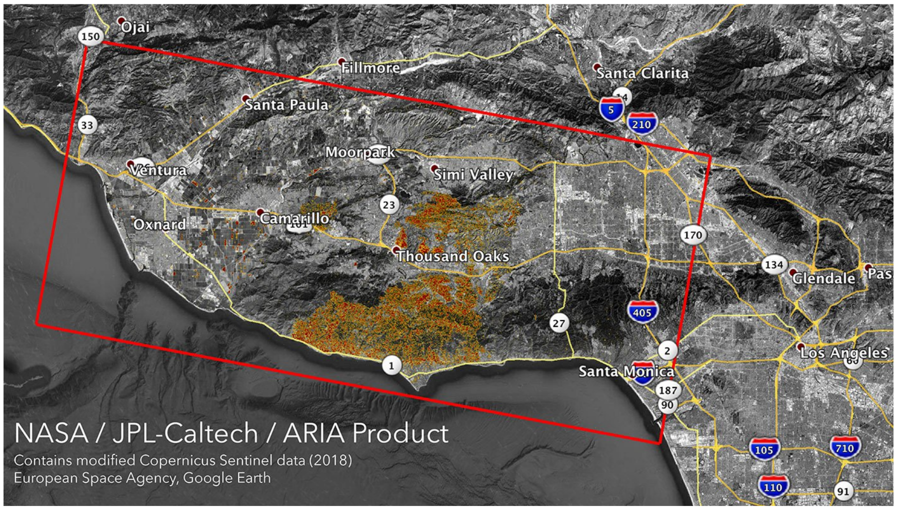
Coding pictures by hand can be very time consuming. In the previous example, the picture of coral was digitally coded red or green by highlighting the branches of coral on a computer screen. The computer added up the amount of area that was healthy vs. unhealthy and provide a numerical score. The picture might then be described as 20% healthy. But pictures can be very complicated. Is it possible for the computer to actually analyze a photo with no human help?

Artificial Intelligence (AI) is when a computer uses data to make decisions and inferences on its own. When the computer added up all the green coral areas and calculated the percentage healthy, it was not being "intelligent". It was simply doing as it was told, just like a calculator does when you punch in 2 + 2 and it gives you 4. But we can now "teach" a computer to recognize what healthy coral looks like by showing it lots of pictures of healthy coral, and to also teach it what unhealthy coral looks like. This is called "**Machine Learning**". Once the computer "knows" what to look for, it can analyze pictures all by itself, without a person digitizing anything. This is an example of Artificial Intelligence.

You have probably experienced AI. When programs like Facebook or Google Photos use facial recognition to point out all the pictures of you, they are using AI. They have "learned" what you look like, and can identify you in all sorts of pictures. And all those Smart Personal Assistants, like Siri and Alexa, use AI to understand what you are saying so they can set your timer, turn on the right music, or buy something online. This is called Voice Recognition. When doctors view X-ray or other types of medical scans, they are often helped by computers that have been taught to recognize tumors and other diseases. This can save the doctors a lot of time and improve our healthcare system.

Pictures of the environment can also be analyzed using AI, to help scientists and the public understand changes that have occurred. The picture below is of Los Angeles after a large forest fire.

The computer has highlighted all the newly burned areas in orange/yellow. This helps to reveal the extent of the damage, and can help people plan for recovery.



SECTION 7 – THE RECOVERY EFFORT

7.1 MAKING YOUR EXPLANATION

Using the data you and your classmates have collected during the Deep Sea Challenge, you can now describe the recovery of the coral at different sites over a five-year period, and make some inferences about the health of the ecosystem. The ECOGIG team is interested in your findings!

On *Construct Your Explanation: Student Sheet #8,* construct an explanation for the ECOGIG team that describes how the health of the P. Biscaya Corals have changed over time at the three sites you compared. Use the data that you collected from the images of the corals as evidence to support your explanation. Refer to the table on *Student Sheet #7: Data Visualization Questions* to help construct your explanation.

Your explanation should include:

1. A description of coral recovery in the Gulf of Mexico using both temporal and spatial data.
2. Examples of evidence to support the description (health scores of the coral and/or the visual color representations of coral recovery).
3. A description of the process you used to obtain that evidence.
4. A conclusion to your explanation, which includes your prediction about the chance for future recovery of the corals.

7.2 RESTORATION EFFORTS

Watch ***Deepwater Horizon: The Science Behind NOAA's Unprecedented Response*: Video7**

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