Using REEF.org Data in the Classroom

Created by: Hilary Penner
Grade: 7
Duration:

ENGAGE- 20 minutes " One Fish Two Fish, Red Fish Blue Fish"
EXPLORE -60 minute class period "Virtual Fish Counts"
EXPLAIN- 60 minute class period "(Bio)Diversity comparisons"
ELABORATE- 2, 60 minute class periods "Create a SuperFISH"
EVALUATE- 1, 60 minute class period "Comparing fish at two locations"

Materials needed:
Digital : Projector, internet access, calculators
Colored card stock, construction paper, scissors, tape, stapler, colored pencils
Classroom set of Fish Anatomy charts (see specific lesson)
Device Ratio: 1 per two students

Rationale for using real data in the classroom: Using real-time and real data is a crucial step to have students understand major scientific skills such as reading graphs, understanding variables, and error margins. When students see real data and use real data they are experiencing the results of the scientific method. It gives students a tangible way to see what scientists did and what they found out. The rationale behind using this data is that it shows how science is a human endeavor. It adheres to many tenants of the Nature of Science. It can help them process what is the information that the scientist is seeking versus the extraneous information-what is relevant data to collect and what is not.

Teacher Resource Page

Interpreting REEF Data

https://www.reef.org/interpreting-reef-data

After REEF field surveys have been completed, the forms are electronically scanned. A computer program is then used to process the resulting datafile to generate summary reports. On the top of every report the number of surveys and total bottom time (hours) are given. Two parameters are presented in standard summary reports. These are Den and %SF. The density index (Den) and percent sighting frequency (%SF) parameters provide a measure of the relative density of species and the frequency with which these species were observed. In addition, there are two categories of observers for which data may be reported. These experience categories are Novice and Expert. Data recorded by all observers (Total) is listed as well as the number of species recorded by Expert and Novice observers.

Survey Type (SO and SA)

Most surveys completed are Species and Abundance (SA) surveys. These surveys record the species seen and an abundance category for each species. The categories are order of magnitude estimates of the number of individuals signed during the survey: Single=1, Few=2-10, Many=11-100, and Abundant=over 100.

Species Only (SO) surveys record only the presence of the species with no abundance information. On the survey form, the Species Only category in the Survey Type section is filled in and the Single category is used to indicate the presence of the species. A single SO survey may span multiple dives (or even an entire dive trip). Its primary use is to list species that were sighted outside of dives where SA surveys were taken. These surveys help to fill in the distribution data for species but contribute nothing to the survey bottom time or to the Sighting Frequency or Density calculations. For species that are included on a report only because they appeared in a SO survey, the %SF and Den columns are filled in with the text "----SO----".

Density Index (Den)

This is a measure of how many individuals of a species are observed based on a scale of 1-4. It is representative of the abundance category (1-4) which was most frequently recorded for the species when it was observed. Abundance category weights are Single=1, Few=2, Many=3, and Abundant=4.

This number indicates which abundance category the species was most often recorded in when it was recorded. For example, Den=2.2 would be reflective of a species that was most often recorded in category 2 (Few) but because the density index is greater than 2, there were some abundances recorded for this species in the other, larger abundance categories (either category 3 or 4). The density index should be used as an abundance guide because area is not

rigorously controlled in the RDT method. It should also be kept in mind that the density (Den) parameter is reflective of sighting distributions in the four different abundance categories (S, F, M, and A) and different distributions of sightings in each abundance category could potentially give similar values of Den (in other words, it does not account for non-sightings).

Sighting Frequency (%SF)

This is a measure of how often the species was observed. It indicates the percentage of times out of all surveys that the species was recorded.

By simultaneously examining the sighting frequency (%SF) and density index (Den), data summaries can be interpreted for fish species. The Den and %SF scores could be multiplied to provide a measure of species abundance which includes zero observations.

Teacher Resource Page

Engage: One Fish, Two Fish, Red Fish, Blue Fish,

Duration: 15 minutes

Phenomena: Short Video Clip of coral reef fish:
https://www.youtube.com/watch?v=vrOCZRalLTs&t=93s

Purpose the following questions to your students. Write questions on board for EL students.

- ➔ How many fish did you see?
- ➔ How many different types of fish did you see?
- ➔ Why would scientists want to know what types of fish there are and how many?
- ➔ How could they go about counting fish?
- ➔ How do people use fish as a "resource"?
- ➔ What do fish need as a "resource" to survive?

Show video clip again and ask students to pick a fish and count fish (when they see a school of fish) to see how it is a challenge to count fish.

How do Scientists Count fish?

Today, we will be looking at the "roving diver method, RDT" of counting fish, where divers and snorkelers can swim anywhere they like (as opposed to a line transect).

During RDT surveys, divers swim freely throughout a dive site and record every observed fish species that can be positively identified. Species and approximate abundance scores are recorded on an underwater slate. The search for fishes begins as soon as the diver enters the water. The goal is to find as many species as possible so divers are encouraged to look under ledges and up in the water column. In some regions, sea turtle species seen during your dive should also be marked (www.reef.org)

Teacher Resource Page
Explore: Virtual Fish Counts

Module 1: Understanding how to create species and abundance data summaries

Activity: "Virtual Fish Count" and "Summarizing and Interpreting Data"
Duration: 60 minutes
Teacher Preparation:

Estimated Time: Time to make copies (10 minutes)

Materials:

- ❏ Class set of Calculators or allow students to use phone calculator
- ❏ Print out Student copies:
  - ❏ CLASS Set of FISH IDENTIFICATION GUIDE in color
  - ❏ "**Explore:** Virtual Fish Counts"
  - ❏ "**Summarizing and Interpreting Data:** Determine Sighting Frequency"
  - ❏ **"Summarizing and Interpreting Data:** Determine Density Index"
- ❏ *Powerpoint Slides* (see additional attachment)

Estimated Cost: none

Standards:
NGSS MS-LS2-1 Ecosystems: Interactions, Energy, and Dynamics
Analyze and interpret data to provide evidence for the effects of resource availability on organisms and populations of organisms in an ecosystem.

CCSS: MATH
CCSS.MATH.CONTENT.7.RP.A.3
Use proportional relationships to solve multistep ratio and percent problems. Examples: simple interest, tax, markups and markdowns, gratuities and commissions, fees, percent increase and decrease, percent error.

CCSS.MATH.CONTENT.7.EE.B.4
Use variables to represent quantities in a real-world or mathematical problem, and construct simple equations and inequalities to solve problems by reasoning about the quantities.

CCSS.MATH.CONTENT.7.SP.A.1
Understand that statistics can be used to gain information about a population by examining a sample of the population; generalizations about a population from a sample are valid only if

the sample is representative of that population. Understand that random sampling tends to produce representative samples and support valid inferences.

CCSS.MATH.CONTENT.7.SP.C.6
Approximate the probability of a chance event by collecting data on the chance process that produces it and observing its long-run relative frequency, and predict the approximate relative frequency given the probability.

Technological Literacy Grades 6-8

Standard 2: Students will develop an understanding of the core concepts of technology **M:** Technological Systems include input, processes, output, and at times, feedback.

Standard 4: Students will develop an understanding of the cultural, social, economic, and political effects of technology. **G:** Economic, political, and cultural issues are influenced by the development and use of technology

Vocabulary : sighting frequency, density, density index, populations, individuals, communities, adaptations, habitat, roving diver method,

Objectives: Students will be able to:

- Identify 4 species of fish and record abundance categories through “Surveys”
- Differentiate between sighing frequency and density index
- Explain other habitats and situations that may use sighting frequency and density index to examine populations
- Interpret data

TEACHER KEY:

Teacher Note: Students may get different numbers than the "Number of Fish" and that is ok. Underwater it is not possible to count every fish- that is why there are abundance groups. You *may* want to give students a set amount of time to count (1 minute) to eliminate students trying to count EVERY fish.
It is not important if the students do not have the same number of fish. For ease of computing problems as a class- it is better if the students DO have the same Abundance Category.

1.Determine Fish Abundance Category:
Single= 1, Few= 2-10, Many= 11-100, Abundant= 101+

2.Assign abundance category weight:
Single=1, **F**ew=2, **M**any=3, and **A**bundant=4.

Survey #1

Fish Species	Number of Fish:	Fish Abundance Category S,F,M,A	Abundance Category Weight 1,2,3,4
Pennantfish	16	Many	3
Milletseed Butterflyfish	26	Many	3
Ornate Butterflyfish	2	Few	2
Pyramid Butterflyfish	1	Single	1

Survey #2

Fish Species	Number of Fish:	Fish Abundance Category S,F,M,A	Abundance Category Weight 1,2,3,4
Pennantfish	41	Many	3
Milletseed Butterflyfish	3	Few	2
Ornate Butterflyfish	0		
Pyramid Butterflyfish	2	Few	2

Survey #3

Fish Species	Number of Fish:	Fish Abundance Category S,F,M,A	Abundance Category Weight 1,2,3,4
Pennantfish	0		
Milletseed Butterflyfish	0		
Ornate Butterflyfish	1	Single	1
Pyramid Butterflyfish	2	Few	2

Survey #4

Fish Species	Number of Fish:	Fish Abundance Category S,F,M,A	Abundance Category Weight 1,2,3,4
Pennantfish	26	Many	3
Milletseed Butterflyfish	2	Few	2
Ornate Butterflyfish	2	Few	2
Pyramid Butterflyfish	0		

Sighting Frequency:

$$\%SF = 100 * \frac{S + F + M + A \text{ (for each species)}}{\text{(Number of surveys)}}$$

Example: Pennantfish (all)

$$\%SF = 100 * \frac{1+ 1+ 1+ 0 \text{ (for each species)}}{\text{(Number of surveys } \mathbf{4} \text{)}} = 75\ \%SF$$

Density Index:

$$\text{Den} = \frac{(S * 1) + (F * 2) + (M * 3) + (A * 4)}{\text{(Number of surveys in which species was observed)}}$$

Example: Pennantfish

$$\text{Den} = \frac{\mathbf{(3 * 3)}}{\mathbf{(3)}}$$

Pyramid butterflyfish
(1 *1)+ (2*2) / 3 = 1.66 Den

Explanation: (1 survey with Single= 1* the value of Single which is 1) = (1 *1)
(2 surveys with Few =2 * the value of Few which is 2) = (2*2)

Ornate Butterflyfish
1,2,2,0
(1 *1)+ (2*2) / 3 = 1.66 Den

Milletseed Butterflyfish
3,2,0,2,
(2 Surveys with Few= 2 * the value of Few which is 2) (1 survey with many= 3 * the value of May which is 3)
(2*2) +(1*3) /3 = 7/3= 2.3 Den

FISH IDENTIFICATION GUIDE

Pennantfish

Milletseed Butterflyfish

Pyramid Butterflyfish

Ornate Butterflyfish

Virtual Fish Counts

Student Sheet

Name_____pd_____

Procedures:

1. Identify fish.
2. Count how many of each fish. Only count fish you can positively identify.
3. **Determine Fish Abundance Category:**
   Single= 1, Few= 2-10, Many= 11-100, Abundant= 101+
4. **Assign abundance category weight:**
   Single=**1**, **F**ew=**2**, **M**any=**3**, and **A**bundant=**4.**

Survey #1

Fish Species	Number of Fish:	Fish Abundance Category S,F,M,A	Abundance Category Weight 1,2,3,4
Pennantfish			
Milletseed Butterflyfish			
Ornate Butterflyfish			
Pyramid Butterflyfish			

Survey #2

Fish Species	Number of Fish:	Fish Abundance Category S,F,M,A	Abundance Category Weight 1,2,3,4
Pennantfish			
Milletseed Butterflyfish			
Ornate Butterflyfish			
Pyramid Butterflyfish			

Survey # 3

Fish Species	Number of Fish:	Fish Abundance Category S,F,M,A	Abundance Category Weight 1,2,3,4
Pennantfish			
Milletseed Butterflyfish			
Ornate Butterflyfish			
Pyramid Butterflyfish			

Survey #4

Fish Species	Number of Fish:	Fish Abundance Category S,F,M,A	Abundance Category Weight 1,2,3,4
Pennantfish			
Milletseed Butterflyfish			
Ornate Butterflyfish			
Pyramid Butterflyfish			

Summarizing and Interpreting Data: Determine Sighting Frequency

Student Sheet

Name_____pd_____

Sighting Frequency (SF %)

This is a measure of how often the species was observed. It indicates the percentage of times out of all surveys that the species was recorded.

The %SF parameter is calculated as:

$$\%SF = 100 * \frac{S + F + M + A \text{ (for each species)}}{\text{(Number of surveys)}}$$

Show all work:

Pennantfish: Sample as a class

Milletseed Butterflyfish: With a partner

Pyramid Butterfly: on your own

Ornate Butterflyfish: on your own

Summarizing and Interpreting Data: Determine Density Index

Student Sheet

Name_____pd_____

Density Index

This is a measure of how many individuals of a species are observed based on a scale of 1-4. It is representative of the abundance category (1-4) which was most frequently recorded for the species when it was observed. Abundance category weights are Single=1, Few=2, Many=3, and Abundant=4.

This weighted density average is calculated as:

$$\text{Den} = \frac{(S * 1) + (F * 2) + (M * 3) + (A * 4)}{\text{(Number of surveys in which species was observed)}}$$

Show all work:

Pennantfish: Sample: as a class

Milletseed Butterflyfish: with a partner

Pyramid Butterfly: on your own

Ornate Butterflyfish: on your own

Data Analysis :

1.Order the fish species from highest to lowest in *sighting frequency*

2. Order the fish species from highest to lowest in *density index*

3. What are some possible reasons or adaptations that make a fish have a high sighting frequency?

4. What are some possible reasons or adaptations that make a fish have a high density index? (Highest possible is 4)

5. What other types of ecosystems and situations could use sighting frequency and density index to examine individuals and populations?

Teacher Resource Page
Explain: (Bio)Diversity comparisons

Geographical Zone code- choose 2 locations to compare the biodiversity
Activity: Data analysis, TED TALK, CER (homework)
Duration: 2, 60 minutes
Teacher Preparation:

Estimated Time: Time to make copies (10 minutes)
Additional time if laminating classroom sets (20 min)

Materials:

- ❏ Maps or Atlas if possible
- ❏ Ted Talk : Why is Biodiversity so Important? By: Kim Preshoff https://ed.ted.com/lessons/why-is-biodiversity-so-important-kim-preshoff

Estimated Cost: none

Standards:
NGSS MS-LS2-2 Ecosystems: Interactions, Energy, and Dynamics
Construct an explanation that predicts patterns of interactions among organisms across multiple ecosystems.

CCSS: MATH
CCSS.MATH.CONTENT.7.SP.A.1
Understand that statistics can be used to gain information about a population by examining a sample of the population; generalizations about a population from a sample are valid only if the sample is representative of that population. Understand that random sampling tends to produce representative samples and support valid inferences.

Technological Literacy Grades 6-8

Standard 4: Students will develop an understanding of the cultural, social, economic, and political effects of technology. **G:** Economic, political, and cultural issues are influenced by the development and use of technology

Objectives: Students will be able to:

- Prove and show evidence in a claim
- Compare and Contrast species of fish in the same family
- Generalize about a population

TEACHER KEY

Biodiversity Background Information/ notes from TED TALK:

- Genetic Diversity
- Species Diversity
- Ecosystem Diversity

Can be resilient, if only one species is removed but more difficult when more species are removed from ecosystem.

Data Table

Location	Number of Species	Number of Surveys (Expert)
Ex: Roatan, Honduras	399	1,729
Ex: Cozumel, Mexico	382	4,830
	-	-
	=17	=3,101

TEACHER KEY

CLAIM, EVIDENCE, REASONING (CER) Homework Due_____

Name_____Pd_____

Question: Does the biodiversity of fish species increase with the number of surveys submitted?

(This key is only using the two examples from the data table. Results will vary)

Claim

The biodiversity of the fish species does not depend on the number of surveys submitted by scuba divers.

Evidence

The data chart show a difference of only 17 fish species between the two locations, Cozumel and Roatan. However, there is a large difference in the number of surveys submitted with Cozumel having over 3000 more surveys submitted.

Reasoning

Biodiversity depends on factors such as: ecosystem diversity, species diversity, and genetic diversity. The biodiversity of fish species is higher in Roatan than Cozumel. The biodiversity of the fish species does not depend on the number of surveys submitted by scuba divers because Roatan had 3000 less surveys than Cozumel.

(Bio)Diversity Comparisons

Student Sheet

Name_____pd_____

Diversity Reports

Go to: https://www.reef.org/database-reports

Select the following:

Database Report: **Diversity Report**

Region: **Tropical Western Atlantic**

Experience Level: **Expert**

Geographic zone codes : **Pick <u>ONE</u>** from **1-8**

Region **1**- Bermuda

Region **2**- Gulf of Mexico

Region **3**- Florida- east coast and Keys

Region **4**-Bahamas, Turks & Caicos

Region **5**-Mexico, Honduras, Belize

Region **6-**Haiti, Dominican Republic, Puerto Rico & Virgin Islands

Region **7-** Lesser Antilles

Region **8**- Continental Caribbean & Brazil

Directions:

Pick **Geographic zone code** (four numbers) Record number of species and number of (expert surveys) in data table,

Pick a different **Geographic zone code** (four numbers), Record number of species and number of (expert surveys) in data table, continue until the data table is complete.

Use the data table and biodiversity notes as reference for your CER .

Biodiversity Background Information/ **notes** from TED TALK:

Data Table

Location	Number of Species	Number of Surveys (Expert)
Ex: Roatan, Honduras	399	1,729
Ex: Cozumel, Mexico	382	4,830

Ways to analyze your data table for your Evidence: Look at averages, differences, rank from high to low, examine the range of surveys versus range of fish species.

CLAIM, EVIDENCE, REASONING (CER) Homework Due_____

Name_____Pd_____

Question: Does the diversity of fish species increase with the number of surveys submitted?

Claim

Evidence

Reasoning

CLAIM, EVIDENCE, REASONING (CER)

Make sure to check your work quality and completion by checking all boxes!

Claim: what is it? A statement that you believe to be true. It answers a scientific question. A statement of your understanding about the results of an investigation.

HOW TO WRITE THE CLAIM:

- ❏ Answer the question (all parts) in ONE sentence. **1 pt**
- ❏ Restate question - (Do not start sentence with because). **1 pt**

Evidence: what is it? Factual information/data from YOUR experiment or observation. This information helps back up the claim. It is scientific data used to support the claim.

HOW TO WRITE THE EVIDENCE:

- ❏ Write a sentence that includes observations, information, or data from the lab/experiment. **2pts**
- ❏ It should be relevant to the claim and provide enough information to make sense. **2pts**

Reasoning: what is it? Shows **how** or **why** the data count as evidence to support the claim. Provides the justification for why **this** evidence is important to **this** claim. Includes one or more scientific **principles** that are important to the claim and evidence.

HOW TO WRITE THE REASONING:

- ❏ Write a sentence that connects your claim with the evidence. (yes, this might feel redundant). **2pts**
- ❏ Also, write a sentence that includes the scientific concept and how it relates to the claim and evidence. **2 pts**
- ❏

_____/ **10 Content points**

Adapted from: https://www.chemedx.org/article/implementing-claim-evidence-reasoning-framework-chemistry-classroom

Teacher Resource Page

Evaluate: Comparing fish species abundance in two locations

Comparison Data -Comparing Fish species abundance in two locations
Activity: Comparing fish species / Analyzing Data
Duration: 60 minutes
Teacher Preparation:

Estimated Time: Time to make copies (10 minutes)
Materials:

- ❏ Print out Student copies "Comparing fish species abundance in two locations"
- ❏ Use ppt Slides for Examples to explain alongside students.
- ❏ Maps or Atlas if possible

Estimated Cost: none

Standards:
NGSS MS-LS2-4 Ecosystems: Interactions, Energy, and Dynamics
Construct an argument supported by empirical evidence that changes to physical or biological components of an ecosystem affect populations.

CCSS: Math
CCSS.MATH.CONTENT.7.RP.A.2.B
Identify the constant of proportionality (unit rate) in tables, graphs, equations, diagrams, and verbal descriptions of proportional relationships.

CCSS.MATH.CONTENT.7.SP.A.1
Understand that statistics can be used to gain information about a population by examining a sample of the population; generalizations about a population from a sample are valid only if the sample is representative of that population. Understand that random sampling tends to produce representative samples and support valid inferences.

Technological Literacy Grades 6-8 Standard 3: Students will develop an understanding of the relationship of technologies and the connections between technology and other fields of study. **E:** A product, system, or environment developed for one setting may be applied to another setting

Objectives: Students will be able to:

- Self guide through online data
- Compare and Contrast fish species at two different locations
- Formulate ideas on the reasons similarities and differences
- Summarize data into categories

TEACHER KEY? Explanation:

Bahamas, Turk/Caicos ↓ **Bermuda** ↓

Rank	Common Name (Scientific Name)	Family	Total		4		6	
			%SF	DEN	%SF	DEN	%SF	DEN
1	Blue Tang (*Acanthurus coeruleus*)	Surgeonfish (*Acanthuridae*)	91.36	2.71	89.56	2.62	94.96	2.87
2	Bluehead (*Thalassoma bifasciatum*)	Wrasse (*Labridae*)	89.35	3.13	89	3.09	90.06	3.22
3	Stoplight Parrotfish (*Sparisoma viride*)	Parrotfish (*Scaridae*)	85.08	2.51	83.25	2.46	88.72	2.61
4	Foureye Butterflyfish (*Chaetodon capistratus*)	Butterflyfish (*Chaetodontidae*)	80.28	2.21	75	2.12	90.8	2.36
5	Yellowtail Snapper (*Ocyurus chrysurus*)	Snapper (*Lutjanidae*)	76.29	2.72	74.91	2.76	79.04	2.65
6	Blue Chromis (*Chromis cyanea*)	Damselfish (*Pomacentridae*)	76.27	3.27	76.49	3.28	75.84	3.26

REGION: 4

Bahamas, Turks Caicos

1. **Blue Tang**
2. **Bluehead**
3. **Stoplight Parrotfish**
4. **Blue Chromis**
5. **Four eye Butterfly**

REGION: 6

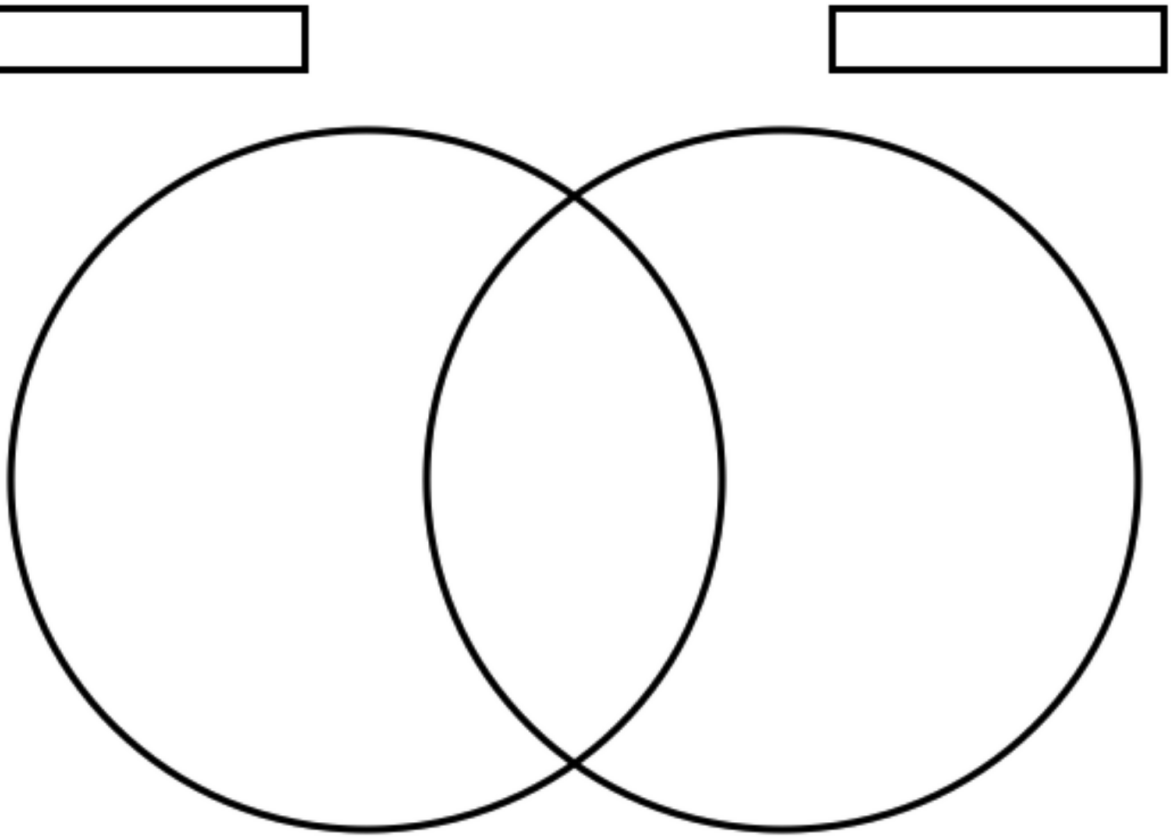
Bermuda

1. **Blue tang**
2. **Four eye Butterfly**
3. **Bluehead**
4. **Stoplight Parrotfish**
5. **Stoplight Parrotfish**

TEACHER KEY

REGION:
Location:

REGION:
Location:



Answer questions below with partner - Hint: Think about food webs/chains, habitat, geographic distribution. Use **RACE** for your answers. (RACE: reword, answer, cite and explain)

1. What are some possibilities as to why a fish is in the "top 5" ?

Answers will vary: Predators are absent for some reason, the fish have abundant food, fish live in a marine protected area.....

2. What are some reasons that a fish would be last on a list?

Answers will vary..... It is a small fish and hard to find. It is rare. Predators ate all of them. Live in only special, certain habitats. Live too deep for most divers to go.

3. Analyze your venn diagram- explain any similarities and possible ideas to why they may have certain fish species in common.
Answers will vary... may have a large distribution area, common habitat, same latitude or longitude, same water temp .....

4. Analyze your venn diagram- explain any similarities and possible ideas as to the “bottom 5”

5. How does this information help scientists?
Answers will vary: Scientists can look at reasons why a fish is so common and see what happens if it “loses its place.” Ex. disease, new predator, invasive species, too much fishing of that fish or it food or its predator.

6. What types of questions can scientists ask with the data that you have observed in this entire unit?

7. How does this information help policy makers?
They can make informed decisions to protect certain fish species.

8. Why are you using data from the Expert level instead of Novice level fish identification?
Expert level fish identification divers have more experience and can tell differences between fish better than a novice. They have passed level 4 and 5 tests.

Comparing fish species abundance in two locations

Student Sheet

Name_____pd_____

Comparison Report - Go to: https://www.reef.org/database-reports

Select the following:

Database Report: **Comparison Report**

Region: **Tropical Western Atlantic**

Experience Level: **Expert**

Geographic zone codes : **Pick TWO 1-8 Zone Codes: (Example- 4,6)**

Region **1**- Bermuda

Region **2**- Gulf of Mexico

Region **3**- Florida- east coast and Keys

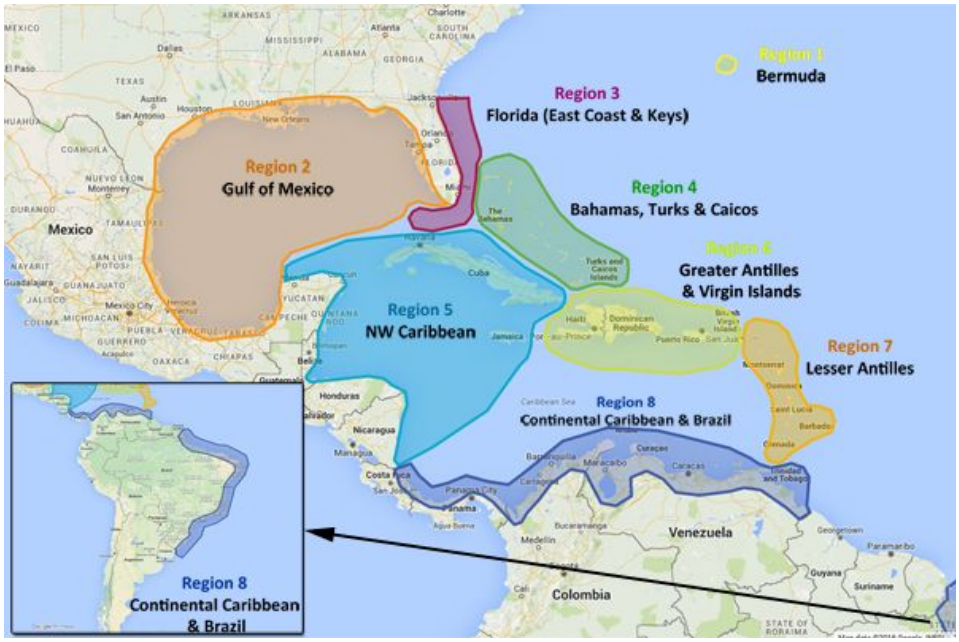
Region **4**-Bahamas, Turks & Caicos

Region **5**-Mexico, Honduras, Belize

Region **6-**Haiti, Dominican Republic, Puerto Rico & Virgin Islands

Region **7-** Lesser Antilles

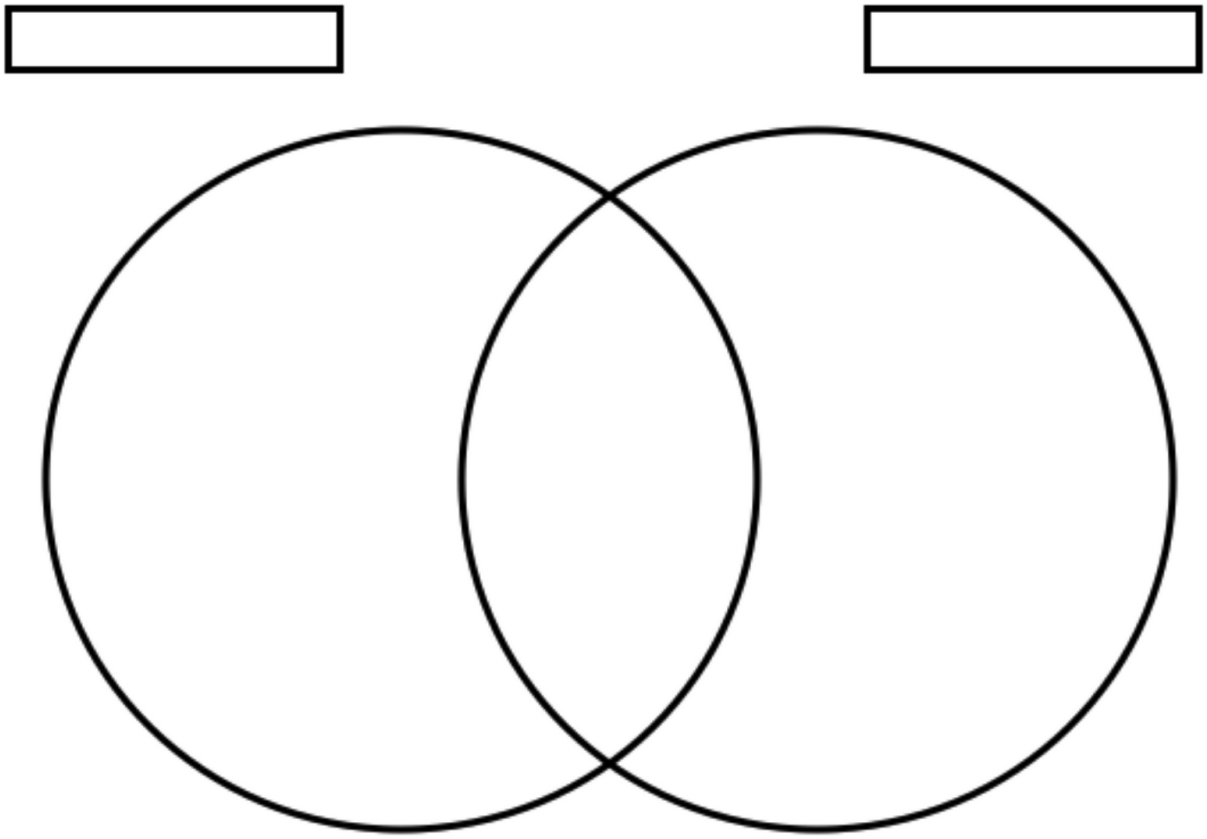
Region **8**- Continental Caribbean & Brazi



Directions: With a partner: Using *Sighting Frequency percentages*- Compare and contrast the **top five** and **bottom five** fish species at each of the two locations you picked as a team.

REGION: REGION:

Location: Location:



Answer questions below with partner - Hint: Think about food webs/chains, habitat, geographic distribution. Use **RACE** for your answers.

1. What are some possibilities as to why a fish is in the “top 5” ?

2. What are some reasons that a fish would be last on a list?

3. Analyze your venn diagram- explain any *similarities* and possible ideas to why they *may* have certain fish species in common.

4. Analyze your venn diagram- explain any similarities and possible ideas as to the “bottom 5”

5. How does this information help scientists?

6. What types of questions can scientists ask with the data that you have observed in this entire unit?

7. How does this information help policy makers?

8. Why are you using data from the Expert level instead of Novice level fish identification?

Teacher Resource Page
Elaborate: Create a SuperFISH

Module 4: SuperFISH
Activity: Make a fish
Duration: 2, 60 minute Classes
Teacher Preparation:

Estimated Time: Time to make copies (10 minutes)
Additional time if laminating classroom sets (20 min)

Materials:

- ❏ Card Stock, Construction paper, provide many colors
- ❏ Classroom Set- Copies of "Fish Anatomy Charts"
- ❏ For additional diagrams go to: https://www.koaw.org/fishes-conent
  - ❏ One device for group needed if using above website

Estimated Cost: paper costs- up to $10
Budget option: Use white or colored printer paper and students can color it

Standards:
NGSS MS-LS2-5 Ecosystems: Interactions, Energy, and Dynamics
Evaluate competing design solutions for maintaining biodiversity and ecosystem services.*

CCSS: MATH
CCSS.MATH.CONTENT.7.SP.B.3
Informally assess the degree of visual overlap of two numerical data distributions with similar variabilities, measuring the difference between the centers by expressing it as a multiple of a measure of variability.

Technological Literacy Grades 6-8

Standard 9: Students will develop an understanding of engineering design **E:** Models are used to communicate and test design ideas and processes

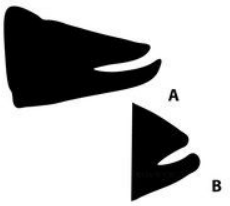
Standard 8: Students will develop an understanding of the attributes of design. **E:** Design is a creative planning process that leads to useful products and systems

Objectives: Students will be able to:

- Create and Design a fish with “super survival powers”
- Critique their design and revise
- Cite evidence for choosing the anatomy they did

Mouth, Snout, & Jaw Comparison

of Certain Fishes



superior (upturned)
A. pointed & flat B. pointed
Lower jaw extends more anterior than upper jaw.
A. Muskie B. Largemouth Bass

terminal
blunt
Lower and upper jaw align.

subterminal
mostly blunt
Upper jaw extends over lower jaw.

subterminal
elongate and sharp
Stretched and thin while upper jaw extends over lower jaw.
C. Gar D. Billfish

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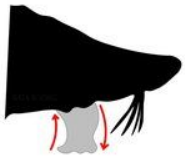
E. slightly superior
F. slightly subterminal
tubular
Long snout with jaw articulating well anterior.
E. Pipefish F. Seahorse

inferior
conical
Mouth set on underside of head.
(Most sharks, skates, rays, and bottom feeding fishes).



inferior
slightly elongate
Protrusible jaw and barbels.
Jaw capable of projecting outwards to filter the benthic.
(Sturgeon depicted).

KEY
bold describes mouth
italic describes snout (rostrum, beak, or nose)

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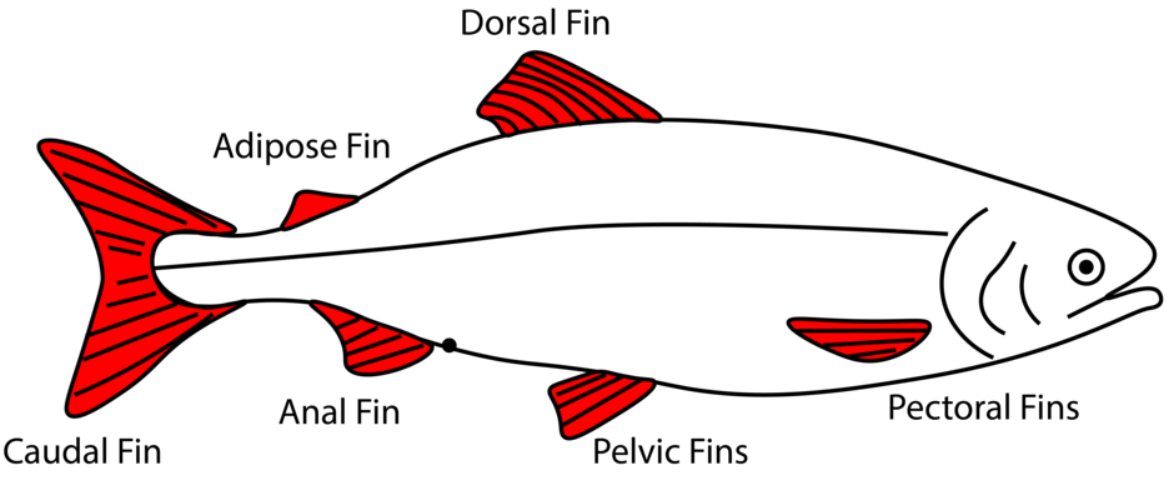
Fins of Fishes

A Basic Illustration



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Representation of a salmonid

Tails of Fishes

Some Common Names

Pointed

Naked & pointed

Pointed (undifferentiated)

Rounded

Rounded (unevenly)

Truncate, flat, square, or straight

Truncate; slightly emarginate

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Emarginate, indented, or concave

Double emarginate or biconcave.

Forked (lightly)

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Forked (unevenly)

Forked (deeply); can also be considered lunate

Lunate; (looks like a crescent moon)

Create a SuperFISH

Design Parameters:

- Create and Design a fish with “super survival powers” due to its anatomy
- Should be as big as body shape of chosen fish (length, width)
- Fins should be moveable

Constraints: Paper, tape, stapler, string, scissors, one partner

Timeline:

- 30 minutes to analyze fish features, human impact, plan what to build
- 60 minutes to build, test, modify
- 30 minutes to share with class

Directions:

1. Take the top 5 “sighting frequency” fish (from one location on your Venn Diagram) and sketch it on your “Design Notes page”
2. At random choose an Human Impact CARD and then build a SuperFISH would have any of the five fishes characteristics that make them so abundant/common.
3. You will pick from a variety of dorsal fin shapes, tail and body shapes, coloration and mouth shape (indicating their diet).
4. Be able to justify why your <u>new</u> SuperFISH will continue to stay as a frequently sighted fish and how it evades predators and tribulations in its ecosystem.

Rubric for Design Challenge: Building a Super FISH

	20 points	10 points
Justification for choosing parts	YOU can explain why each anatomy part was chosen and what it does for your fish. YOU can explain how your fish overcame the Human Impact	YOU can explain half of the parts of anatomy and what they do. Your model doesn’t clearly explain how your fish changed by Human Impact
Creativity	Your fish excels in details and demonstrates a followed plan	Minimal details and shows lack of planning
Moveable Parts	At least one fin moves on the fish	No moving parts on the fish (Bending fin does not count)

Design Notes

Partner(s):_____
Pick one the top 5 “sighting frequency” fish:_____

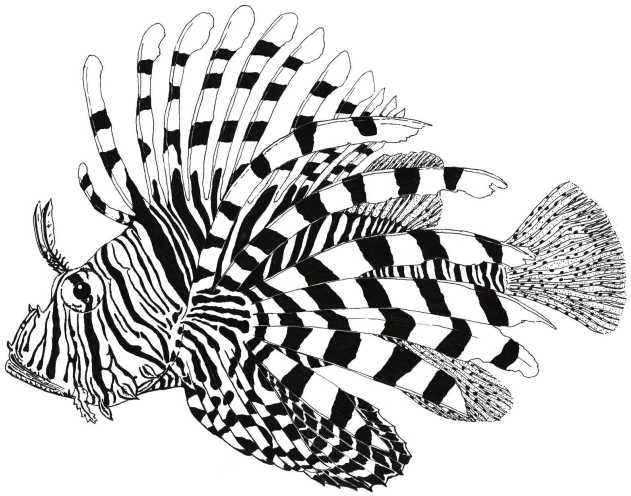
Sketch below noting details of mouth shape (indicating diet), body shape, and fin shape:

How do you think this fish stays in its place as a “Top five?” What adaptations does it have?

Draw a **Human Impact Card** and re-design your fish into a SuperFISH so that it can survive these environmental threats. Sketch below. Then build.

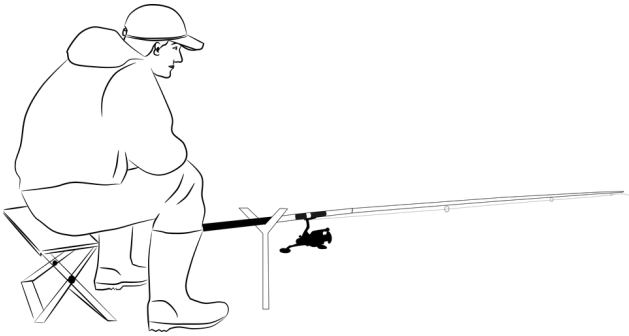
Human Impact CARD:

Someone dumps a Lionfish from their aquarium into the ocean. Now they are abundant and eat everything! How will your fish survive the LIONFISH INVASION?



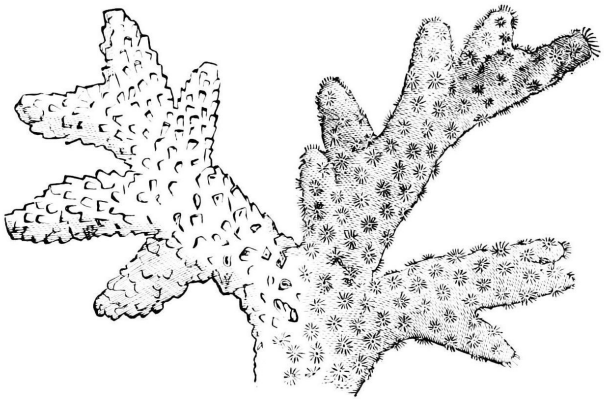
Human Impact CARD:

You are a tasty fish! Humans keep fishing when you are trying to meet at spawning aggregations to reproduce. How will you survive the HUNGRY HUMANS?



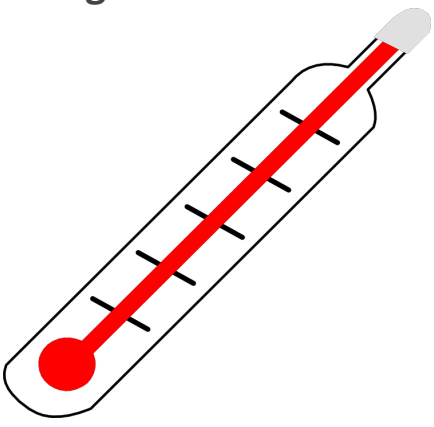
Human Impact CARD:

You love to eat the tasty coral. The ocean temperature is warming and therefore your food is dying. How will you overcome CLIMATE CHANGE that reduces your food supply?

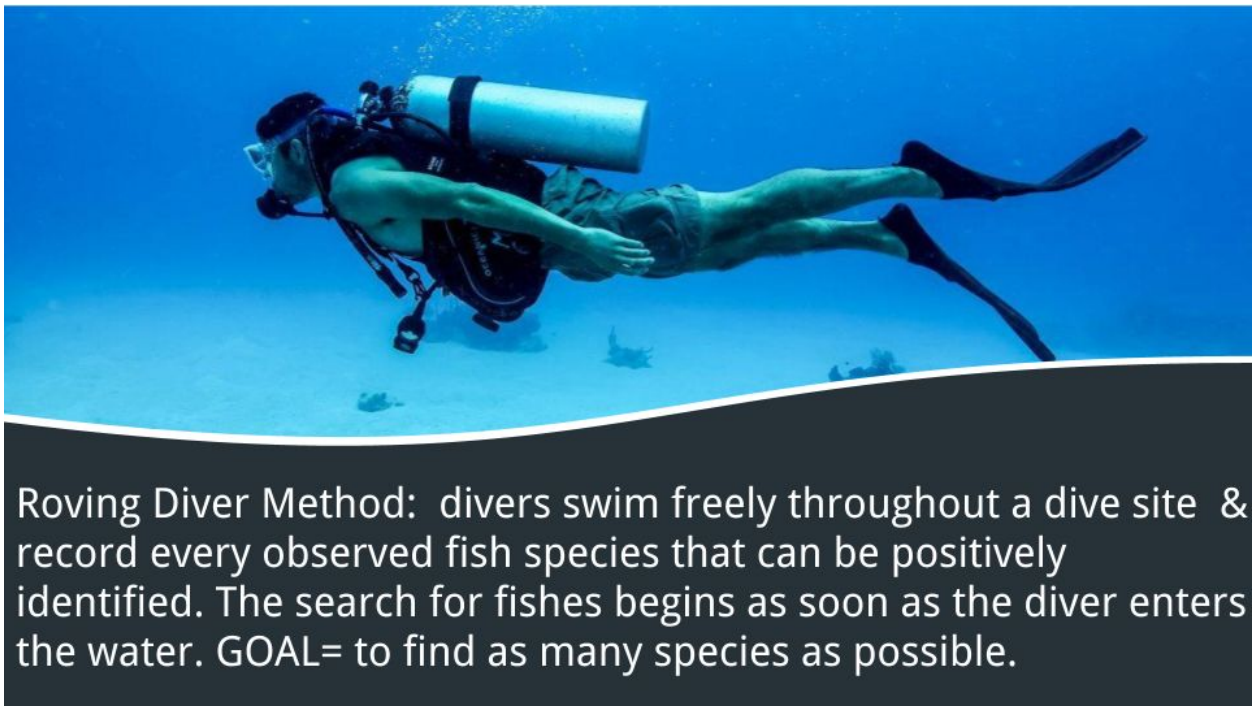


Human Impact CARD:

Humans like hot tubs, but not fish. The water temperature is raising and it is making you more prone to disease. ClIMATE CHANGE is making you move, how will you change to fit into a new habitat?



Slides for Virtual Fish Counts / Accompany Teaching



Maui County

Surveys				Bottom Time
Expert		Novice		
SA	SO	SA	SO	(H:M)
1516	55	5287	455	7496:41
1516	55	5287	455	7496:41

Survey Type- (SO= Species Only) (SA=Species and Abundance). We will be working with SA

Region: HAW
Geographic Zones: Maui
Survey Types: Species & Abundance, Species Only
Dates: 1/1/93 - 4/9/19
Total Surveys: 7313
#Species Reported: 345
Average Species Reported on a Survey by Expert Surveyors: 53.79
Average Species Reported on a Survey by Novice Surveyors: 43.97

Experience Categories-
Novice Level- Passed Level 1, 2, 3 Fish ID test
Expert Level - Passed Level 4,5 Fish ID test

Explore: Virtual Fish Counts: How to create species and abundance data summaries

Milletseed Butterflyfish

Pyramid Butterflyfish

Pennantfish

Ornate Butterflyfish

Survey #1

Identify fish and count as best as you can

Survey #2

Identify fish and count as best as you can

Survey #3

Identify fish and count as best as you can

Survey #4

Identify fish and count as best as you can

Species

%SF = Sighting Frequency; DEN = Density Score[2]
Bar length corresponds to sighting frequency
Color saturation corresponds to density score

Convict Tang - Surgeonfish (*Acanthurus triostegus*)	SF: 74.19% | DEN: 2.95
Saddle Wrasse - Wrasse (*Thalassoma duperrey*)	SF: 74.19% | DEN: 2.77
Yellowstripe Goatfish - Goatfish (*Mulloidichthys flavolineatus*)	SF: 64.52% | DEN: 2.74
Hawaiian Sergeant - Damselfish (*Abudefduf abdominalis*)	SF: 61.29% | DEN: 2.41
Raccoon Butterflyfish - Butterflyfish (*Chaetodon lunula*)	SF: 61.29% | DEN: 1.72

Sighting Frequency: How often the species was observed

$$\%SF = 100 * \frac{S + F + M + A \text{ (for each species)}}{\text{(Number of surveys)}}$$

Determining Sighting Frequency

Species

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What is Density Index?
How many individuals of a species are observed

This weighted density average is calculated as:

$$\text{Den} = \frac{(S * 1) + (F * 2) + (M * 3) + (A * 4)}{\text{(Number of surveys in which species was observed)}}$$

Determining Density Index

Explain: Comparison Data Comparing Fish species abundance in two locations

Region **1**- Bermuda

Region **2**- Gulf of Mexico

Region **3**- Florida- east coast and Keys

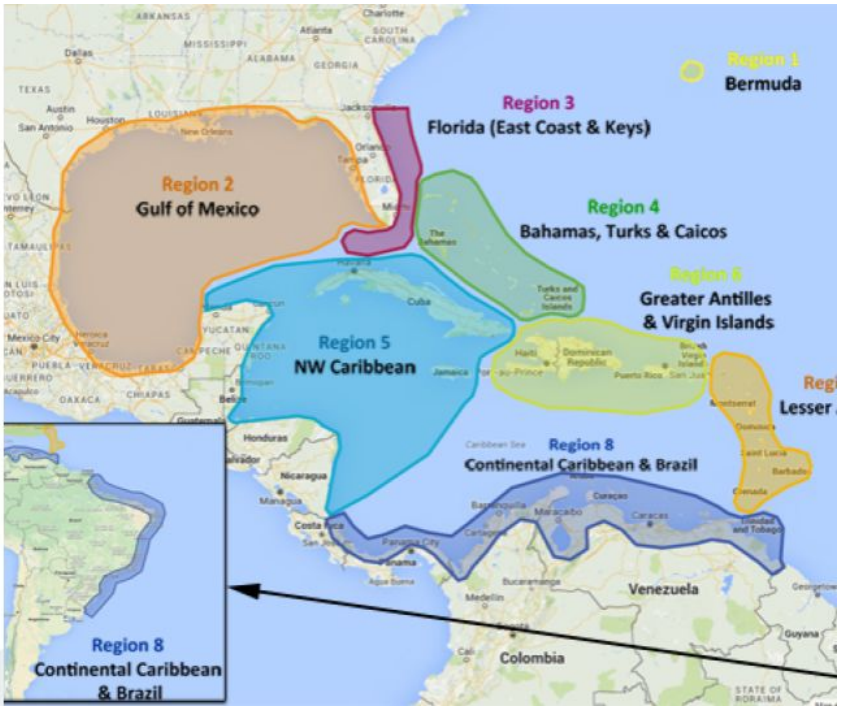
Region **4**-Bahamas, Turks & Caicos

Region **5**-NW Caribbean

Region **6-**Greater Antilles & Virgin Islands

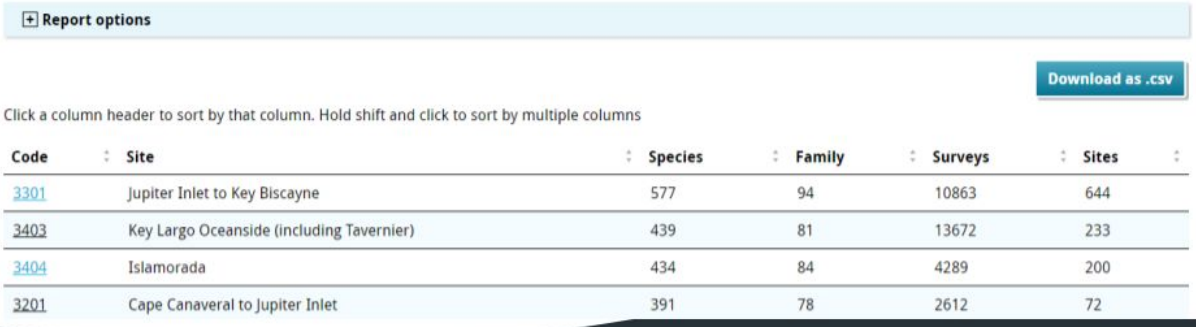
Region **7-** Lesser Antilles

Region **8**- Continental Caribbean & Brazil



Geographical Zone code- choose 2 locations to compare the biodiversity

Diversity Report



Report options

Download as .csv

Click a column header to sort by that column. Hold shift and click to sort by multiple columns

Code	Site	Species	Family	Surveys	Sites
3301	Jupiter Inlet to Key Biscayne	577	94	10863	644
3403	Key Largo Oceanside (including Tavernier)	439	81	13672	233
3404	Islamorada	434	84	4289	200
3201	Cape Canaveral to Jupiter Inlet	391	78	2612	72

Diversity Report- choose 2 locations to compare the biodiversity

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3201	Cape Canaveral to Jupiter Inlet	391	78	2612	72
3408	Key West	384	75	4116	163
3405	Marathon	353	68	1943	94
3410	Dry Tortugas	353	67	2534	439
3302	Biscayne National Park	346	72	1058	239
3406	Looe Key NMS	269	64	540	24
3101	St. Mary's R. to Cape Canaveral	249	61	313	65
3407	Long Key	227	58	217	20
3409	Marquesas Keys	220	49	181	44

Photo credits:

Logo, Map, Diversity Screenshots- Reef.org

Moorish idol, background fish scenes from: google.com images

Pyramid butterfly:
https://fishybusinessaquatics.com/fish/butterflies/pyramid-butterfly/

Resource Page:

Koaw Nature.org (2019) Retrieved from: https://www.koaw.org/fishes-conent

Standards for Technological Literacy (2007) Retrieved from:

https://www.iteea.org/File.aspx?id=67767&v=691d2353

REEF. 2019. Reef Environmental Education Foundation Volunteer Fish Survey Project Database. World Wide Web electronic publication. www.REEF.org, (20 February 2019).

APPENDIX L – Connections to the Common Core State Standards for Mathematics 1. (2013, June 3). Retrieved from: https://www.nextgenscience.org/sites/default/files/Appendix-L_CCSS%20Math%20Connections%2006_03_13.pdf

The Next Generation Science Standards. (2013, April 3). Retrieved from: https://www.nextgenscience.org/sites/default/files/Appendix%20H%20-%20The%20Nature%20of%20Science%20in%20the%20Next%20Generation%20Science%20Standards%204.15.13.pdf