Biscayne

National Park Service
U.S Department of the Interior

Indo-Pacific Lionfish Invasion Guide for Teachers 2014-2015

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INDO-PACIFIC LIONFISH INVASION
WORKSHOP AGENDA

9:00 A.M. Sign-in, logistics, and Pre-Test

9:30 A.M. Talk with a Ranger: Tour of the Visitor Center

- Introduction to the National Park Service and Biscayne National Park through the "Spectrum of Life"
- 2016 Call to Action – Stewardship and Engagement (Citizen Science) Celebrating 100 Years of the National Park Service

10:00 A.M. Indo-Pacific Lionfish Invasion

- Discuss Program Goals
- Biscayne National Park's Role
- Teacher's Role and Responsibilities
    - Data Collection and Reporting (spreadsheet and photographs)
    - Maximum Impact (enrichment opportunities)
    - Promote Citizen Science opportunity
    - Teacher created lesson plan (due October 3, 2014)

10:30 A.M. Building Background Information - PowerPoint Presentation

11:00 A.M. Break (5 minutes) Meet in "Think Tank" downstairs

11:05 A.M. Getting to The "GUTS" of The Matter: Dissection Procedures

- Student Guide for Lionfish Dissection Lab
- External Anatomy Card
- Internal Anatomy Card
- Lionfish Data Collection Sheet
- Reporting whole class results (Excel spreadsheet)

12:00 P.M. Break for Lunch

12:45 P.M. Lionfish Dissection

- **Safety first: Avoiding the venomous spines**
- **Let's get our hands dirty!**
- **Q & A**

1:45 P.M. Clean-up detail & proper disposal of spines

2:15 P.M. Wrapping It Up

- **Safely transporting and storing your Lionfish**
- **Lionfish Dissection Agreement**
- **Teacher created lesson plan: Due _____ (See example and template)**
- **Q & A**
- **Post-Test**

3:00 P.M. Distribution of Lionfish and Additional Resources

ACKNOWLEDGEMENTS

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Caitlin Johnson, Field Biologist

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Student Conservation Association:

Amanda Lawrence
Kara Wall

Miami-Dade County Public Schools

Ana Lissette Casanova – M.S. Science Teacher
W.R. Thomas Middle School Cambridge Program
(Biscayne National Park's Teacher-Ranger-Teacher)

Mr. Marshall Ruffo, COAST Lead Teacher
Cutler Bay Academy of Advanced Studies, Centennial

Introduction

This workshop was developed by Biscayne National Park Education Staff and made possible through the NPS Teacher-Ranger-Teacher Program and the Student Conservation Association.

The park education rangers wanted to develop a new program specifically designed for middle and high school students (7^{th}-12^{th}). By entering into a partnership between BNP and science teachers, we hope to raise more awareness about a serious problem affecting our protected and fragile marine ecosystem. The culprit is the beautiful, but invasive Indo-Pacific Lionfish: a predator without limits.

Program's Goal:

To assist teachers in providing an exciting opportunity for students to learn about how this invader is adversely affecting our marine ecosystems. During the course of this workshop you can expect to:

- Learn about your National Park Service and Biscayne National Park
- Find out how a species becomes invasive
- Gain in-depth knowledge regarding the Indo-Pacific Lionfish
- Find out how park biologists and university interns are studying Lionfish
- Learn how to encourage students to become Citizen Scientists by gathering data for park scientists (sample lesson activity will provided)
- Comprehend the difference between venomous and poisonous
- Understand the proper safety protocols that should be followed when handling and dissecting Lionfish with students.

Biscayne National Park's Role:

- Provide teachers with a ready-made PowerPoint presentation on the Lionfish Invasion
- Assist you in performing your first Lionfish dissection during the workshop
- Offer dissection instruction/demonstration video (available online for your classroom)
- Provide data collection sheet for student use and excel spreadsheet to input class data
- Supply each teacher with 7 lionfish specimens for use in the classroom
- Suggest pre and post activities to enrich your lesson
- Availability of park staff to answer any questions that may arise

Teacher's Role and Responsibilities:

Data Collection:

The program is designed to be a partnership between the teacher and Biscayne National Park scientists. The data gathered by your students will then be sent to scientists and uploaded in our database. This information is used by scientists and academics worldwide and therefore requires a serious commitment on your part to send the data and photographs to the park contact once your class is done with the dissection activity.

Transporting Lionfish:

Lionfish will be frozen so you must be ready to transport them with you at the end of the workshop. Please note:

1. You will need to bring along a cooler capable of holding 7 Lionfish (we will provide the ice)
2. Secure a section in your freezer to store Lionfish until your dissection activity
3. Wrap Lionfish well enough to avoid any spines from piercing through the plastic bag (ex: plastic container, bubble wrap, towel, etc.)
4. It is suggested that you place a note on the bag as a warning to anyone who opens the freezer
5. Any and all precautions should be taken in order to avoid injury from the venomous spines

Suggestions for Student Pre-lab Preparation

To enrich your student's dissection experience, it is highly recommended that you use the PowerPoint presentation and select from the resources we've provided to build background knowledge (See "Digging Deeper" in the Resources section of this guide). The more students know about the Lionfish and the impacts on our marine ecosystem, the more their interest will spark during the activity.

1. Enrich your students' experience by incorporating areas of Reading, Language Arts, Math, Social Studies as well as the Fine Arts
2. If you and your students have Internet access, visit the park web-site at www.nps.gov/bisc and participate in an e-field trip to our coral reefs
3. Involve your group/class in planning an actual field trip to the Florida Keys Marine Sanctuary
4. Assign a research project (see "Digging Deeper" resources section in this guide)
5. Set up a "Skype with A Ranger" session

6. Investigate careers in maritime science

Teacher Created Lesson Plan

In order to receive professional education credit, we request that you create a lesson plan related to the Indo-Pacific Lionfish for use in your classroom. We would prefer that your lesson plan's focus be on the preparation of your students for the dissection or an extension activity. An example and template has been provided for you. You may email these lesson plans to maria_beotegui@nps.gov

Student Guide for Lionfish Dissection Lab

BACKGROUND:

Lionfish is an invasive exotic species threatening our local marine ecosystem. By participating in this dissection lab, you will be gathering important data as a Citizen Scientist for Biscayne National Park. All the data your class collects today will be used by park scientists and biologists to learn more about the Lionfish's feeding habits and reproductive stages. This is important work and an opportunity for you to help scientists develop a solution to the problem. You will be a Citizen Scientist.

PURPOSE:

1. To examine the internal organ "stomach or gut" of the Lionfish to determine which organisms the Lionfish had been feeding on.

2. To determine whether the Lionfish is a male or female by identifying the gonads (reproductive organs).

MATERIALS: Dissecting pan, dissecting tools, Petri dish, hand lens, safety glasses, apron, gloves, fresh Lionfish, lab notebook and/or data collection handout.

PROCEDURE:

1. Use the **External Anatomy** card to become familiar with the structure of the Lionfish. In your notebook, glue the picture of the lionfish provided to you by your teacher then label your Lionfish based on the External Anatomy card. Place an **"X"** on fin locations that are venomous. Prepare to discuss your observations with the rest of the class.

2. Gather and put on all safety equipment including safety glasses, glove and apron.

3. Obtain a Lionfish from the teacher.

4. Collect measurements (cm) of your fish as specified in the data collection sheet.

5. Find the mass of your fish then record the measurement (g). Remember to tare the scale first.

6. Carefully follow each step provided in your **Dissection Guide**

7. Once you have opened the body cavity, use the **Internal Anatomy Guide** to identify your fishes' internal organs.

8. Next, locate the gut (stomach) and notify your teacher.

9. Once the teacher has confirmed the location of the gut, cut it off and remove it.

10. Gently cut the gut open on one end and squeeze out the contents onto your petri dish (make sure to remove all the material and liquid inside).

11. Find the mass of the gut material (remember to tare the scale) and record.

12. Slowly try and separate material from inside the gut (use forceps, toothpicks, or simply use your fingers to feel for small bones or other hard pieces).

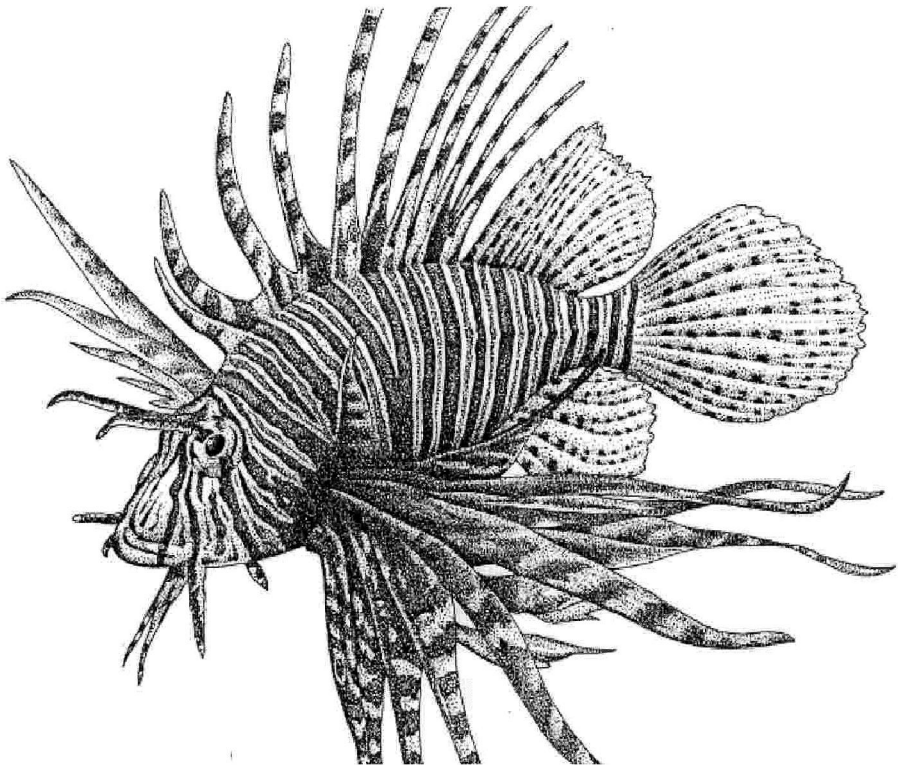
13. Once material is separated, try to identify any organisms found. Record any findings and observations in your notebook/data table.

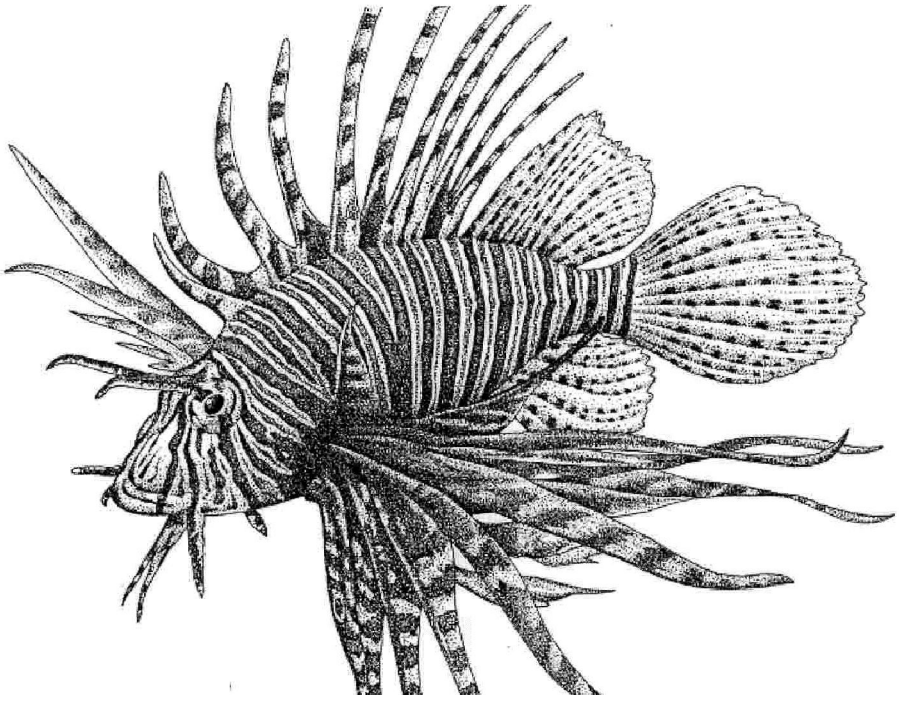
14. Identify the reproductive organs (testis or ovaries). Take a picture of the organs and include the identification tag that came with your fish in the picture. Record your data (This picture will be sent to park scientists).

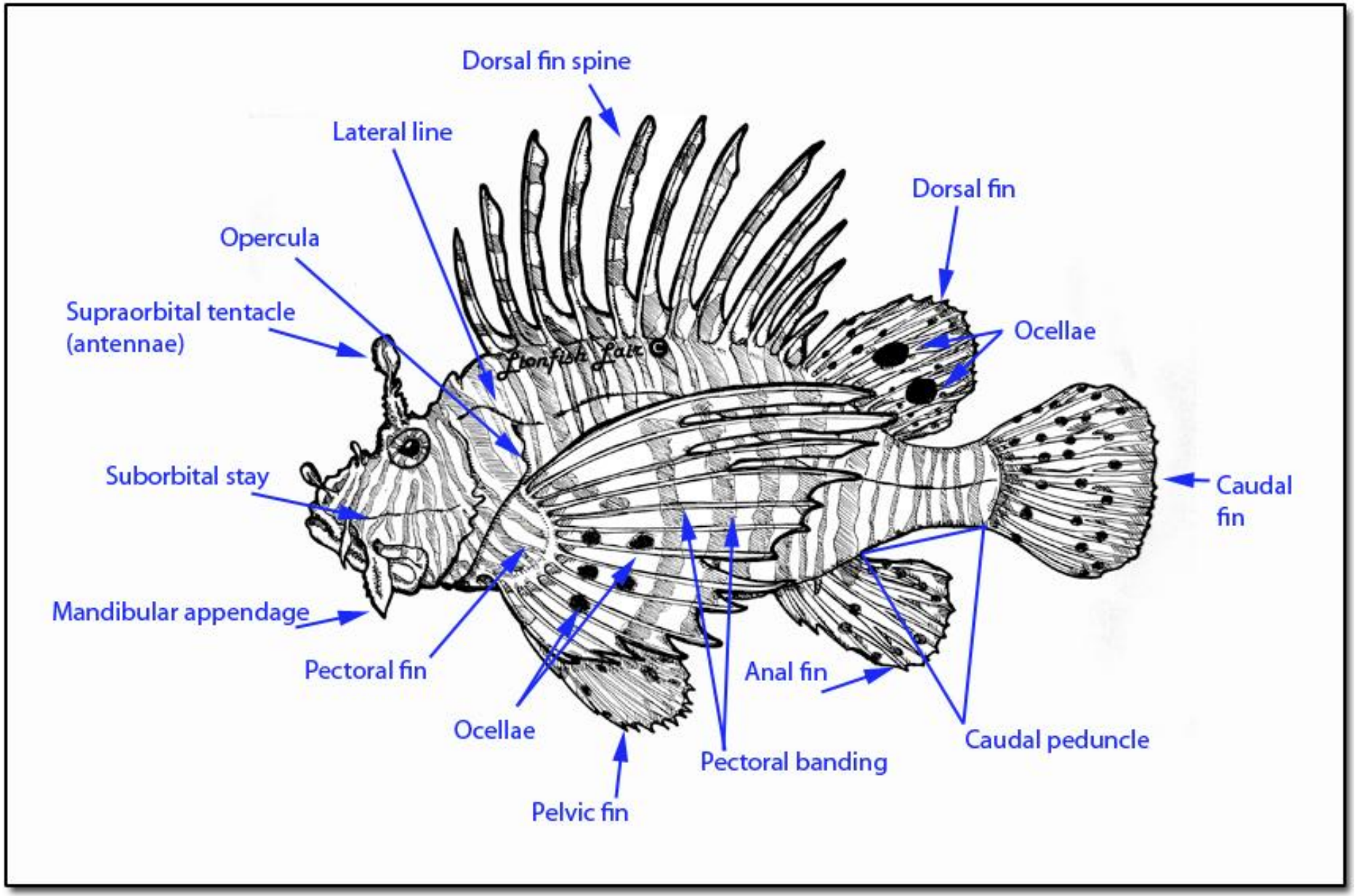
15. Check that you have gathered all of the data required. Clean-up your work station, return dissection tools, and dispose of Lionfish in the designated waste container.

EXIT SLIP: Answer the following question on your Lionfish Data Collection Sheet

How could performing a gut analysis dissection on the Lionfish help scientists predict the impact this Invasive Exotic species is having on native populations?







This diagram depicts all of the key anatomical landmarks spoke of throughout the guide.

***Name:* _____ *Date:* _____ *Period:*_____**

LIONFISH DATA COLLECTION SHEET

Carefully record both the qualitative and quantitative data **during** the dissection process.

	OBSERVATIONS & MEASUREMENTS	DATA
EXTERNAL	Total Length (cm) mouth-tail	
	Total Length of Pectoral Fin (cm)	
	Mouth Gape (opening) width (cm)	
	Mouth Gape (opening) height (cm)	
	Weight (grams)	

Additional Observations:

	OBSERVATIONS & MEASUREMENTS	DATA
INTERNAL	Determine gender • Male: Testis • Female: Ovaries	
	Gut contents (small bones, flesh, eyes, etc.)	
	Weight of Gut contents (grams)	
	Swim bladder (deflated or inflated)	

Additional Observations:

EXIT SLIP:
How could performing a gut analysis dissection on the Lionfish help scientists predict the impact this Invasive Exotic species is having on native populations?

ADDITIONAL RESOURCE MATERIALS & ACTIVITIES

1. **Next Generation Sunshine State Standards (NGSSS)**

2. **Digging Deeper: Extensive list of Internet websites and other resources available for in-depth study across all areas of the curriculum**

3. **Reading Passage & Questions: "The Measures of Science"**

4. **Introduction to Statistics:**
    a. **Calculating Measures of Central Tendency using Indo-Pacific Lionfish data**

5. **Reading Passages: Focusing on the relevance of the "dreaded" Science Fair Project**
    a. **Science Scope Magazine Article and handouts "Eating the Enemy"**
    b. **How a 12 Year Old Girl's Science Project Changed the Way Scientists See Lionfish (www.care2.com)**
    c. **Researcher disputes account of sixth-grader's "Scientific Breakthrough" (CBS Interactive News)**
    d. **Lionfish Ban in South Florida Pet Stores (South Dade News Leader)**

6. **Sample Lesson Plan and Template**

New Florida Standards Applicable to This Unit

SCIENCE

The Nature of Science

SC.7.N.1.1	The Practice of Science
SC.7.N.1.2	The Characteristics of Scientific Knowledge
SC.7.N.1.3	The Role of Theories, Laws, Hypotheses, and Models
SC.8.N.1.1	The Practice of Science
SC.8.N.1.2	The Characteristics of Scientific Knowledge
SC.8.N.1.3	The Role of Theories, Laws, Hypotheses, and Models
SC.8.N.1.4	Science and Society
SC.912.N.1.1	The Practice of Science
SC.912.N.1.2	The Characteristics of Scientific Knowledge
SC.912.N.1.3	The Role of Theories, Laws, Hypotheses, and Models
SC.912.N.1.4	Science and Society

Life Science

SC7.L.15	Diversity and Evolution
SC7.L.17	Interdependence
SC.7.E.6	Human Impact
SC.8.L.18	Matter and Energy Transformations
SC912.L.14	Organization and Development of Living Organisms
SC912.L.15	Diversity and Evolution
SC912.L.17	Interdependence
SC912.L.18	Matter and Energy Transformations

Earth Structures

SC.7.E.6.6 Human Impact

MATHEMATICS

MAFS.7.SP.1,2,3	Statistics and Probability
MAFS.8.SP.1	Statistics and Probability
MAFS.912.S-CP	Probability and the rules of probability
MAFS.912.S-ID	Interpreting categorical and quantitative data
MAFS.912.S-IC	Making inferences and justifying conclusions
MAFS.912.S.MD	Using probability to make decisions

LANGUAGE ARTS

LAFS.68.RST 1,2,3,4	Reading Standards for Literacy in Science & Technical Subjects
LAFS.68.WHST.1,2,3,4	Writing Standards for Literacy in Science & Technical Subjects
LAFS.910.RST 1,2,3,4	Reading Standards for Literacy in Science & Technical Subjects
LAFS.910.WHST.1,2,3,4	Writing Standards for Literacy in Science & Technical Subjects

Digging Deeper
Resources to Help Enrich Your Lessons

Topic: Lionfish

www.oceanservice.noaa.gov – NOAA

This website provides for a wealth of resources to use with your students. These are just a few examples:

- NOAA Ocean Service Education: The Lion Fish Invasion (For Teachers)
- Lionfish Biology Fact Sheet
- A Chronicle of Lionfish Sightings in U.S. Waters
- Thinking Like a Scientist (for Students) Interview with a Lionfish Chaser (movie)
- Take the Quiz (for students)
- Ask an Expert: students can write to scientists and either ask questions or make suggestions on how to address the problem

www.floridakeys.noaa.gov - Florida Keys National Marine Sanctuary

- Type in "The Science Behind Sanctuary Lionfish Derbies" to learn about what is being done about the problem
- Florida Keys Eco-Discovery Center and Mote Marine Laboratory – ***Field Trip opportunity in Key West*** (free)

www.bios.edu - Bermuda Institute of Ocean Sciences

- HSBC Explorer Lesson Plans
- "Becoming a Fisheries Biologist: Sizing Lionfish in the Atlantic" Grades 8-12 Students become fisheries biologists and use real data and Image J freeware to estimate age of Lionfish

www.flmnh.ufl.edu - Florida Museum of Natural History: Ichthyology Education
Biological profile of the Indo-Pacific Red Lionfish

www.reef.org - Lionfish Research Program
Established in 1990, REEF's mission is to help conserve marine ecosystems with the help of citizen scientists. Valuable data is collected and shared with the scientific community, resource managers, and conservationists in an effort to promote active stewardship of our oceans.

http://lionfish.co/im-not-lyin-the-10-most-common-lionfish-myths-busted/
Lionfish Hunters Lodge

www.foxnews.com – "Chefs Cooking Up New Ways to Prepare Venomous Lionfish"
By Chelle Koster Walton – Published October 30, 2011

http://www.southdadenewsleader.com/news/state/lionfish-banned-from-florida-pet-shops-starting-today/article_632a7ed5-1ca1-5497-adde-3f08dfecfd5b.html
The South Dade News Leader: Lionfish Banned from Florida Pet Shops (August 1, 2014)

Books:

- *Fish Invaders at Gypsy Point* (Picture Book: Grace V. Nimnualrat, Anne M. Wotkyns, and George H. Zaleski)

- *The Lionfish Cookbook* – Tricia Ferguson, Lad Atkins, and David Stone

Topic: Coral Reefs

http://www.nps.gov/bisc/naturescience/coralreefs.htm - Biscayne National Park
Visit Biscayne's website and experience "Coral Reefs of Biscayne National Park" which provides additional background information about corals.

http://www.nps.gov/bisc/naturescience/coralnurseryclub.htm - Biscayne National Park
Restoration efforts being carried out at Biscayne National Park - "The Coral Club"

www.dep.state.fl.us – Florida Department of Environmental Protection
Christopher Boykin, Coral Reef Conservation Program (305)795-1222 / Christopher.Boykin@dep.state.fl.us

www.coralreef.noaa.gov – NOAA Coral Reef Conservation Program

www.photolib.noaa.gov/reef/index.html - NOAA Coral Kingdom Photo Library
Extensive photo gallery

www.reefbase.org – Reefbase
Data and information on coral reef resources: status, threats, maps, and photos

Books:

- *Coral Reefs* (World Life Library)
- *Coral Reefs* – by: Gail Gibbons
- *The Coral Reef* – by: Jerry and Idaz Greenburg
- *Coral Reefs* (Peterson Field Guides) – by: Eugene H. Kaplan
- *One Small Square "Coral Reef"* - by: Donald M. Silver and Patricia Wynne
- *Florida's Fabulous Fishes* - by: Gary Cochran and Doug Perrine

Topic: Marine Ecosystems

www.pbs.org/kqed/oceanadventures/educators - **Ocean Adventures for Educators with Jean-Michael Cousteau**

www.oceanservice.noaa.gov/education/yos/lesson/lesson.html - **NOAA "Year of Science"**
Lesson plans for K-12

www.education.nationalgeographic.com – **Marine Ecology Video Scavenger Hunt**
Interactions among marine communities and how humans impact marine ecosystems

Books:

- *Going Blue: A Teen Guide to Saving Our Oceans, Lakes, Rivers, and Wetlands* - by: Cathryn Berger Kaye, Phillippe Couseau, and EarthEcho International
- *Extreme Oceans* - by: Seymour Simon
- *Commotion in the Ocean* - by: Giles Andreae and David Wojtowycz
- *The Cay* - by: Theodore Taylor (Novel)
- *Reef Rescue* - by: India Evans (Novel)

Topic: Invasive Species (various)

http://www.cbd.int/doc/bioday/2009/idb-2009-childrens-booklet-en.pdf
Living in an ecosystem near you: Invasive Alien Species

http://www.nwf.org/Wildlife/Threats-to-Wildlife/Invasive-Species.aspx
National Wildlife Federation

http://myfwc.com/wildlifehabitats/nonnatives/invasive-species/
Florida Fish and Wildlife Conservation Commission

Topic: Marine Science Related Careers

www.marinecareers.net - *Sea Grant Marine Careers*

www.oceanlink.island.net/career/career2.html – *OceanLink: All about the Ocean*

www.hopkins.standford.edu/careers.htm – *Stanford University*

www.dnr.sc.gov – *South Carolina Department of Natural Resources*

www.marine-conservation.org – *Career Resources of Marine Science & Conservation*

The Measures of Science

By Trista L. Pollard

[1] Imagine a world where we did not know the boiling point of water. What if we could not record growth of plants and animals? How would you know the weekend had begun if you could not keep count of days, weeks, and months? **Measurement** has been an important part of our lives for centuries, and it is the reason that scientists are able to compare objects and events **quantitatively**. Scientists rely on measuring to describe comparisons numerically by using standard tools, models, scaling, sampling, and estimating.

[2] Before standard tools like rulers, clocks, and scales, people used everyday objects to help find measurements or quantities of other objects. A simple example would be using an average adult foot to represent one foot in English or customary units of measurement. Large stones may have been used in simple balances to help measure the weight of objects. Even the sundial, the earliest form of the clock, used the shadows from the sun to help keep track of time. Today scientists use various tools like rulers, graduated cylinders, and scales to measure in English units (i.e., inches, feet, etc.) and metric units (i.e. centimeters, millimeters, etc.). Graduated cylinders are used to measure the volume of small objects in milliliters. Scales can be used to measure the weight of objects in grams and milligrams. Scientists also use thermometers and barometers to measure changes in the earth's temperature and changes in its air pressure over time.

[3] Scientists build **models** and use **scaling** to represent objects that are far too large to show at their true size. Models are smaller objects that are built to represent the detail of larger objects. Scientists use smaller measurements that are in proportion or scaled to the measurements of the larger object the model represents. Scaling is also done to represent extremely large distances between objects, such as the planets in our solar system. Another example of scaling would be when architects build models of buildings. These models may have a scale where every inch of height stands for a certain amount of feet in height for the real buildings. When scientists build models, they are providing a visual image that helps others to understand scientific concepts (such as planetary motion) and objects (such as high speed trains).

[4] There are times when scientists need to study populations of beings or sets of objects that are extremely large. **Sampling and estimating** are good methods for accomplishing this goal. When scientists sample populations or sets, they are looking at a small part of that population or set. After they have studied that small part, they use it to make **generalizations** or judgments about the whole population or set. Scientists who study events, like weather patterns, may need to estimate or form opinions about numerical data. An example would be when a meteorologist estimates the amount of inches of snow your town will receive that evening. Based on past records of similar weather patterns, he or she is able to predict a range of snowfall to come.

[5] Measurement is an important part of scientific investigating and our daily lives. When scientists measure objects and events, they are communicating comparisons that help us to better understand our world.

Name: _____ Date: _____ Period: __

The Measures of Science

1. **Scientists use measurement to _____.**

    a. **Record the procedures in their experiments**
    b. **Communicate comparisons numerically about objects or events**
    c. **Estimate the amount of hours an experiment will take**
    d. **None of the above**

2. **Scaling is a method for building models of very small objects.**

    a. **False**
    b. **True**

3. **Before there were standard tools to use for measurement, people used _____.**

    a. **Folktales to determine measurements of objects**
    b. **Scaling to determine measurements of objects**
    c. **Everyday objects to measure and compare with other objects**
    d. **Estimation to determine measurements of objects**

4. **What would be the best method for measuring the number of geese that appear every spring in a state?**

5. **How does scaling help scientists to represent models of our solar system?**

6. **When scientists estimate, they use past patterns of events to make numerical judgments about future events.**

    a. **False**
    b. **True**

INTRODUCTION TO STATISTICS

MEAN – the average of your data set. Add up all the numbers in your data set, and then divide by the number of numbers you have. The symbol for mean $\bar{x}$

Example: Let's say we have a set of numbers which represent the number of crabs seen on a particular beach over a period of five different days: {3,7,4,2,5}

We add 3+7+4+2+5 = 21 (the symbol for the total or sum is Σ)
Then we divide 21÷5 = 4.2 blue crabs

MEDIAN – the halfway point of the data set when the numbers are arranged in ascending order (from least to greatest). From our blue crab numbers, we would first rearrange the numbers to look like this: {2,3,**4**,5,7)

The median in this set is **4**, because half of the numbers are less than 4, and half the numbers are greater than 4.

** If there is an even number of numbers in the data set, then the median becomes the average (mean) of the two middle scores.

Example: {2,3,4,5,5,7} we take the mean of the two middle numbers, so (4+5) = 9, then we divide 9÷2 = 4.5 = median

MODE – the most repeated number in the data set

Example: {2,3,4,5,5,7} the Mode = 5 because the number 5 occurs most often in this data set.

** Be aware that not all data sets will have a mode!

MAXIMUM and MINIMUM VALUES

The maximum value is the highest data point in the set, and the minimum value is the lowest data point in the set.

Example: {2,3,4,5,5,7} 2 is the minimum value and 7 is the maximum value

RANGE – subtract the minimum value from the maximum value. From the previous example, the range would be (7-2) = 5

Name: _____ *Date:* _____ *Period:*_____

Statistics:
Calculating Measures of Central Tendency using Indo-Pacific Lionfish data

What is statistics?

- It is a way collecting, analyzing, and presenting data
- Shows how to gain meaningful information from a list of numbers
- Sometimes data come from planned experiments in a controlled lab
- Sometimes data come from observations of the "real world"

Population: refers to all of the organisms or things in the group you are interested in studying (example: all the invasive Indo-Pacific Lionfish in the Atlantic and Caribbean Oceans)

Sample: is a smaller group of items chosen from the entire population. (example: 20 female Lionfish captured in the waters surrounding Elliot Key)

The following are two small data sets compiled during the dissection of Indo-Pacific Lionfish. The data represent a sample collection of measurements taken of individual male and female Lionfish captured within the waters of Biscayne as of July 2014. Use the data to calculate the measures of central tendency and answer the questions on the back of this sheet.

Total Body Length - cm (Mouth to Tail)	
MALES	FEMALES
16	22
28	19
27	24
14	13
17	21
30	26
9	12
21	11
13	27
26	29
29	31
15	28
18	15
28	12
31	13
22	26
11	31
19	30
23	21
31	26
24	29
18	13
16	19
11	30

Tip: Before you try to calculate the mean, median, and mode for each set, re-organize the data in order from least to greatest value for each column. Write your re-organized data values into 2 new columns below.

Male Data **Female Data**

Part 1: *Work to find the answers to the following questions. You will need a separate sheet of paper and must show all of your work. (Calculators may be used)*

1. **Finding the *mean***
    a. **Calculate the mean length for male Lionfish _____**
    b. **Calculate the mean length for female Lionfish _____**

2. **Calculate the *median***
    a. **What is the median length for Male Lionfish _____**
    b. **What is the median length for Male Lionfish _____**

3. **Identify the *mode***
    a. **What is the mode for Male Lionfish _____**
    b. **What is the mode for Male Lionfish _____**

4. **Calculating *minimum* and *maximum* lengths**
    a. **What is the maximum length for Male Lionfish _____**
    b. **What is the minimum length for Male Lionfish _____**
    c. **What is the maximum length for Female Lionfish _____**
    d. **What is the minimum length for Female Lionfish _____**

5. **On *average*, in this data set, which gender of Lionfish is larger (the males or females)? _____**

6. **Would this always be the case? Why or why not?**

7. **What other information do you think scientists can gain from looking at this data set?**

_____

_____

_____

_____

_____

_____

Part 2: *Using Excel spreadsheet software, use the data from the Lionfish captures to create a graph representing the data collected. Don't forget to label all the parts and provide a title.*

How a 12-Year-Old Girl's Science Project Changed the Way Scientists See Lionfish

by Crystal Shepeard
July 13, 2014 / 5:30 pm

Lauren Arrington was in the process of trying to figure out her sixth grade science project when she noticed a lionfish while fishing in the Loxahatchee River in south Florida. Lionfish had been spotted in Florida as early as 2010 and have since spread to many of its waters. Surprised to find it, the 12-year-old wanted to see if a dead lionfish's spikes would still be venomous. Her father discouraged her from the idea, unwilling to be a human test subject. The daughter of two scientists began to wonder how the lionfish was surviving in the river and decided to do some investigating.

The results of her experiment would end up in a science journal and change the way scientists are dealing with a pervasive lionfish invasion in non-native waters.

A native of the Indian and Pacific Oceans, the lionfish is relatively harmless in its natural habitat. Its prey consists of other marine animals in its environment. With a stomach that can expand to 30 times its normal volume, it can consume creatures that are up to half of its body size and is only limited to prey that can fit into its mouth. Other species that include the lionfish as part of their diet include sharks, groupers, large eels and humans. The beauty of the lionfish's long mane-like spikes makes it a favorite in exotic aquariums and belies their venomous nature.

For decades, however, the lionfish has been on a path of destruction pushing our earth's waters to the brink of an ecological disaster.

The intentional release of lionfish from home aquariums has put them into non-native waters in the Western Atlantic Ocean, the Gulf of Mexico, Caribbean Sea and the Mediterranean Sea. Prolific breeders with the ability to release up to 2 million eggs per year, the lionfish population has increased exponentially in just a few decades. They feed on marine animals that keep coral reefs healthy, as well as their eggs and offspring.

Devouring the marine life in their environment is something a lionfish does really, really well.

With the help of her father Lauren captured a few to take home to observe. She was aware of the lionfish invasion and decided to see in what conditions the lionfish could survive. She called her experiment *Understanding the Limits of Lionfish Invasion*. The hypothesis was that lionfish needed a certain amount of salinity in their environment. Scientists measure water salinity by the amount of salt found in 1000 grams of water. So if there is one gram of salt in 1000 grams of water, the amount of salinity would be expressed as 1 part per thousand, or 1ppt.

The salinity of the area where Lauren found the lionfish is part of the Jupiter inlet that connects to the Atlantic Ocean and averaged the same ocean salinity of 35 parts per thousand.

For two weeks, Lauren observed the lionfish's food intake and stress levels as she reduced the salinity of the water. She believed that because of their natural ocean habitat, it would be unable to survive with a salinity of less than 13 parts per thousand. However, when that level was reached, there was no change in their behavior. She continued to lower the levels until she reached a salinity of 6 ppt. The lionfish survived.

Lauren had discovered that lionfish can survive in freshwater.

Her experiment got the attention of researchers at Florida International University and North Carolina State University. Due to the rules of the science fair, Lauren didn't take the salinity any lower out of fear that the fish would die. Other researchers took the salinity to zero, discovering that the lionfish could tolerate a minimum of 5 parts per 1000 – generally the lowest salinity of most freshwater bodies.

The discovery is significant because scientists have not thought to look for the dangerous predator in freshwater areas until now. This completely human-made threat of the lionfish to ecosystems and commercial fishing is now much greater than previous believed. They can be a threat in the freshwaters where fish nurseries are kept and feed on the eggs and juvenile fish. They could also be feeding on any number of freshwater species not previously known to be in danger.

Not to mention, there are no natural predators for the lionfish in any of these areas.

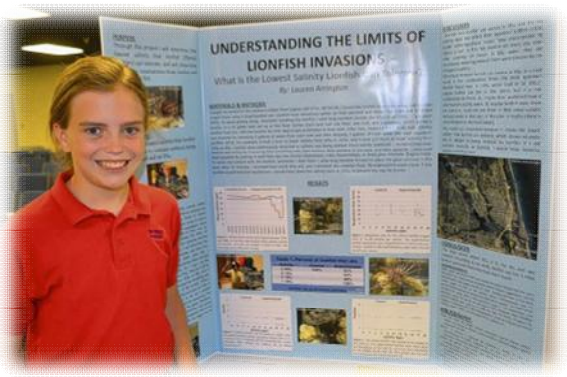
In response, the state of Florida has banned the import of live lionfish into the area as of August 1, 2014. They have also expanded the areas where people can legally spear the lionfish with a permit. Harvesting of the fish is also being allowed as part of the effort to reduce the population. Researchers have also put out an alert to be on the lookout for the fish in previously unexamined waters.

Lauren's research has since been peer reviewed three times. The results of the expanded study by Dr. Craig Layman, Chancellor's Faculty Excellence Fellow at North Carolina State University, and Zachary Jud, a graduate student at Florida International University, was published this year in the journal *Environmental Biology of Fishes*. Lauren's research was cited and credited with the initial discovery.

Not bad for a 12-year-old whose research project earned her third place in a sixth grade science fair.

Read more:
http://www.care2.com/causes/how-a-12-year-old-girls-science-project-changed-the-way-scientists-see-lionfish.html#ixzz386q4EUHx

There's something fishy about student's science fair project



Lauren Arrington's science fair project on the invasive lionfish (submitted photo, FPG)
June 11, 2014|Nadia Sorocka, nsorocka@tribune.com

Science projects used to be volcanoes, rockets and the germination of seeds. But one seventh-grader at The King's Academy, Lauren Arrington, 13, is taking science projects to the next level.

Her science project and research on the invasive fish species the lionfish – a venomous fish that devours other fish and is moving in to Florida's waterways and the Caribbean - is being hailed by some of the country's top experts.

Dr. Craig Layman, Chancellor's Faculty Excellence Fellow at North Carolina State University, said her research was one of the most influential sixth-grade science projects ever conducted, demonstrating something that scientists should have done years before.

Arrington's science fair project "Understanding the Limitations of Lionfish Invasions" was done so well it was recently referenced in a peer-reviewed scientific publication *Environmental Biology of Fishes*.

So what sparked Arrington's desire to study these non-native fish that are hurting Florida's reefs?

Arrington had speared lionfish in the Bahamas and in Florida, because they are invasive and hurt local fish. It was during this time, she started to become interested in them.

"I just wanted to learn more about this very interesting invasive predator to help our local ecosystems," she said in an email.

In her project, Arrington conducted preliminary laboratory experiments and did research for her sixth-grade science fair project. Around the same time Laymen and a graduate student from Florida International University were researching lionfish in the Loxahatchee River, where they found the fish further up the river then they had expected.

During her research she became familiar with Layman's work and wanted to figure out how far up the river lionfish could survive. She set up eight aquaria with a single lionfish living in each tank at the River Center in Jupiter.

"I had fun collecting the live fish for my experiment. I found them while snorkeling, and my dad caught them with a dip net. He wouldn't let me catch them because he didn't want me to get spined," she said in an email.

Her father Albrey Arrington helped her throughout her experiment offering support as she did the work.

"I was very excited throughout Lauren's project," he said in an email. "She really did the work, and it took a lot of effort. I couldn't believe her findings were such a surprise."

Throughout the experiment Lauren Arrington monitored the lionfish daily as she slowly lowered the salinity in the aquaria. What she discovered was that the lionfish could survive with no adverse impacts in nearly fresh water.

"The craziest part of my research was when my dad and I set off the burglar alarm at the River Center," she said in an email. "The police came and thought we were robbers. But, we showed them my lionfish and explained what we were doing. So, they were really interested in my project and left us alone."

She was excited about her finding and quickly shared them with Layman, who along with Zachary Jud, a graduate student, decided to take her study to the next level. It was printed in *Environmental Biology of Fishes*, citing Lauren Arrington's research.

"It was very exciting to know that the little project I did made a difference and affected a bigger project," she said in an email.

Her father and mother are proud of the work and energy their daughter put into the project.

"Lauren's mom and I both enjoy science. We encouraged Lauren in this project, but the work was all her," he said. "We were very proud to watch her work through the inquiry process."

She also enjoys playing tennis and the clarinet, and fishing.

"I like marine science, engineering and computer programming," she said in an email. "Maybe I can find a great job that let's me pursue all three interests."

Visit Layman's research blog to read his posts about Lauren Arrington's project:

www.absci.fiu.edu/2013/02/interview-with-a-young-lionfish-scientist/

NEWS *July 25, 2014, 4:49 PM*

Researcher disputes account of sixth-grader's "Scientific breakthrough"

A sixth grade Florida girl's science fair project on lionfish was hailed as a "breakthrough" and got media attention nationwide, but now a scientist who studied the invasive fish species for years claims it was not really her breakthrough at all.

The researcher, Zack Jud, says that Lauren Arrington based her now-viral science project on work he had previously published while obtaining his doctorate degree.

Published in 2011, the original study -- which Jud worked on with Arrington's father, Albrey, and others -- showed that lionfish had been found upriver, away from the ocean where they normally live. He established that these fish had the ability to settle well into estuarine systems, where freshwater from rivers and streams flows into the ocean.

Sixth grader credited with scientific breakthrough on lionfish

Arrington did her science project the following year, proving that lionfish could tolerate even lower levels of salinity in the water. When a later study, done by Jud and two other scientists, confirmed her results, they acknowledged the young girl's scientific contribution, setting off the recent media frenzy.

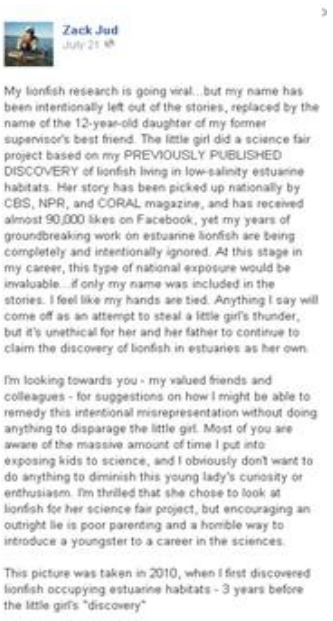
Play VIDEO

http://www.cbsnews.com/videos/sixth-grader-credited-with-scientific-breakthrough-on-lionfish/

Earlier this month, Arrington, now 13 years old, told CBS News that she came up with the idea for her science fair project after spotting a saltwater lionfish in a Florida river. Her story was also covered by many other news outlets nationwide, and as the young girl's "discovery" went viral, Jud took to Facebook, asking his friends and colleagues for advice.

"My lionfish research is going viral...but my name has been intentionally left out of the stories, replaced by the name of the 12-year-old daughter of my former supervisor's best friend," he wrote in a Facebook post dated July 21. "Anything I say will come off as an attempt to steal a little girl's thunder, but it's unethical for her and her father to continue to claim the discovery of lionfish in estuaries as her own."

Zack Jud took to Facebook, asking for advice on how to get credit for what he claimed was his already published research. **FACEBOOK**



Zack Jud
July 21

My lionfish research is going viral...but my name has been intentionally left out of the stories, replaced by the name of the 12-year-old daughter of my former supervisor's best friend. The little girl did a science fair project based on my PREVIOUSLY PUBLISHED DISCOVERY of lionfish living in low-salinity estuarine habitats. Her story has been picked up nationally by CBS, NPR, and CORAL magazine, and has received almost 90,000 likes on Facebook, yet my years of groundbreaking work on estuarine lionfish are being completely and intentionally ignored. At this stage in my career, this type of national exposure would be invaluable...if only my name was included in the stories. I feel like my hands are tied. Anything I say will come off as an attempt to steal a little girl's thunder, but it's unethical for her and her father to continue to claim the discovery of lionfish in estuaries as her own.

I'm looking towards you - my valued friends and colleagues - for suggestions on how I might be able to remedy this intentional misrepresentation without doing anything to disparage the little girl. Most of you are aware of the massive amount of time I put into exposing kids to science, and I obviously don't want to do anything to diminish this young lady's curiosity or enthusiasm. I'm thrilled that she chose to look at lionfish for her science fair project, but encouraging an outright lie is poor parenting and a horrible way to introduce a youngster to a career in the sciences.

This picture was taken in 2010, when I first discovered lionfish occupying estuarine habitats - 3 years before the little girl's "discovery"

In an email to The Scientist magazine, Arrington's father mentioned that Jud's research had not determined the lowest salinity lionfish can live in. However, Jud told The Scientist that he had planned on doing the experiment, but other projects had kept him busy.

In an email conversation with the senior Arrington, as seen by the magazine, Jud had asked if his previous work would be credited. Arrington said he did so, repeatedly, and put the blame on the media for ignoring Jud's previous work while telling the girl's story.

Another former colleague, North Carolina State University ecologist Craig Layman, agrees. One of the scientists involved in the study that confirmed Lauren's findings, Layman writes in a blog post, "I am glad tens of thousands of people now know about Zack's research and Lauren's project that never would have otherwise. But it is unfortunate how it played out in such a manner over the last few weeks."

Lionfish banned from Florida pet shops starting today

Posted: Friday, August 1, 2014 11:41 am | *Updated: 2:34 pm, Fri Aug 1, 2014.*

TALLAHASSEE, Fla. -- The waters around Florida are known as a Mecca for tropical and exotic fish, but there's one sea creature that's no longer welcome along our shores: the invasive **lionfish**.

According to the **Florida Fish and Wildlife Conservation Commission** (FWC), the lionfish was first introduced into Florida waters in the late 1980s, with populations booming in recent years, negatively impacting native wildlife and habitat.
As such, FWC has instituted several rule changes that went into effect on August 1, with an eye toward fixing the growing problem by limiting further introduction of the species into local waters and making it easier for lionfish hunters to remove the spiny predators. Per the **FWC website**, the **rule changes** include:

• A prohibition on the importation of live lionfish

• Lionfish are now permitted to be removed via spearfishing when diving with a rebreather, a device that recycles air and allows divers to remain in the water for longer periods of time. (Currently, you cannot spear any fish when using a rebreather.)

• Participants of approved tournaments and other organized events will now be permitted to spear lionfish or other invasive species in areas where spearfishing is not currently allowed (such as certain state parks or refuges). This will be done through a permitting system.

The FWC is also looking for the public's help in identifying lionfish in the wild. Have you seen one? You can **report a sighting at this page**, or by using the new Report Florida Lionfish app available for both the **iPhone** and **Android** platforms. Happy hunting.

Name of Lesson/Topic of Study: LIONFISH INVASION (Part 1) **By:** Ana Lissette Casanova

Grade Level(s) 7-8th **Duration of Lesson/Unit** 3 days

EXAMPLE

NEXT GENERATION SUNSHINE STATE STANDARDS:
MACC.6.SP.2 Summarize and describe distributions. **MACC.6.SP.2.5c** Giving quantitative measures of center (median and/or mean) and variability (interquartile range and/or mean absolute deviation), as well as describing any overall pattern and any striking deviations from the overall pattern with reference to the context in which the data was gathered. **SC.7.L.17.1** Explain and illustrate the roles of and relationships among producers, consumers, and decomposers in the process of energy transfer in a food web. **SC.7.L.17.3** Describe and investigate various limiting factors in the local ecosystem and their impact on native populations, including food, shelter, water, space, disease, parasitism, predation, and nesting sites.
LEARNING GOALS: What will your students will be able to do by the end of class?
• Given a set of data, students will be able to calculate the measures of central tendency and identify patterns or trends from their results. • Students will be able to communicate the difference between a native and non-native species • Understand the impacts of an invasive species released into an ecosystem • Based on the results of the data, determine the effect that non-native Lionfish have had on our local marine ecosystems

KEY VOCABULARY	**KEY POINTS. What three to five main ideas or steps will you emphasize in your lesson?**
Math: data, empirical data, outcomes, probability, measures of central tendency: mean, median, mode, range, population, sample Science: habitat loss, limiting factors, threatened, endangered, native, non-native, invasive, non-invasive	• What is data and why is it important to carefully collect it? • What meaningful information can we learn from looking at a set of numbers? • How can the collection of statistical data influence decision-making processes? • Analyze the data collected to help determine the effect that the invasive Lionfish has on a marine ecosystem

	Details of activity (include teacher and student notes)	**Essential Questions (Probes/Questions to ask students at every phase in the lesson)**	**MATERIALS**	**EVALUATE Performances at every phase of the lesson.**
ENGAGEMENT: Object, event or question used to engage students. Connections facilitated between what students know and can do. How will you focus, prepare and engage students for the lesson's objective?	Students will be introduced to the use of statistics as a way to acquire meaningful information from data collected either in an experiment or through observations.	What is statistics? Are there different types of data? What is the difference between a population and a sample?	• Calculators • Science Journal • Student shark data handout	Were the students able to follow the steps involved in calculating each measure of central tendency? Where did they have the most difficulty?

EXPLORATION: Objects and phenomena are explored. Hands-on activities, with guidance. How will students engage in open-ended exploration of real phenomena, discussion about their discoveries, ideas, and questions that arise?	Teacher will demonstrate how to set up the Excel spreadsheet (rows, columns, headings, etc.) Using the numerical data set provided (Lionfish captures), students will input numbers into an Excel spreadsheet. Teacher will explain how to operate the sort function and introduce the formulas to be used to make the calculations.	Were you able to correctly set up your spreadsheet? Did you double check your data for inputting errors? Did you learn how to use the sort function?	• Access to computer lab • Microsoft Excel • Calculators • Science Journal	Correctly set up an Excel spreadsheet with appropriate labels and learn to sort across columns.
EXPLANATION: Provide scientific explanation. How will you convey the knowledge and/or skills of the lesson? What will your students do to process this information?	Using the Excel spreadsheet previously created, students will correctly calculate the measures of central tendency for their population sample. They will then analyze their data and answer the essential question.	What do the results of your calculations seem to show? (CLAIM & EVIDENCE)	• Access to computer lab • Microsoft Excel • Calculators • Science Journal	Completion of self-reflection and ability to answer the essential questions using CER strategy: Claims, Evidence, and Reasoning
ELABORATION: Activities allow students to apply concepts in contexts, and build on or extend understanding and skill. In what ways will your different learners attempt the objective on their own? How will students apply the new knowledge and skills to solving a problem or meeting a challenge?	Using the results from their statistics calculations, student groups will now share and discuss their results with each other. After discussing their results, students will break off individually and complete the CER in their journals.	How do the results for your group compare to other groups? Is there a pattern that emerges? What can be concluded based on the class results? (REASONING)	• Access to computer lab • Microsoft Excel • Calculators • Science Journal	Contribution/Participation in meaningful class discussion of results. Ability to answer the essential questions using CER strategy: Claims, Evidence, and Reasoning

EXTENSION: How will you incorporate ideas for further exploration?

This lesson serves as an introduction to a unit on invasive species. The focus is on the Indo-Pacific Lionfish which was released into the south-eastern Atlantic waters and is wreaking havoc on our marine ecosystems. Students will have an opportunity to:

- Gather information about Lionfish (anatomy, behavior, reproduction, etc.)
- Perform a Lionfish dissection including gut content analysis
- Participate in a Citizen Science project with Biscayne National Park scientists and interns
- Field trip to Biscayne National Park
- Produce a PSA (public service announcement)

DIFFERENTIATION: How will you differentiate your instruction to reach the diversity of learners in your classroom (ELL STRATEGIES/IEP IMPLEMENTATION)?

The teacher will use the Smart Board (visual) to guide students through the process of setting up the Excel spreadsheet. The lesson will be broken down into multiple steps and provide step-by-step directions. Students that have a limited experience with computers will be paired up with students that are more comfortable with the technology. Extra completion time will also be offered.

Name of Lesson/Topic of Study: LIONFISH INVASION **By:** _____

Grade Level(s)_____ **Duration of Lesson/Unit:** _____

NEXT GENERATION SUNSHINE STATE STANDARDS:	
LEARNING GOALS: What will your students will be able to do by the end of class?	
KEY VOCABULARY	**KEY POINTS. What three to five main ideas or steps will you emphasize in your lesson?**

	Details of activity (include teacher and student notes)	**Essential Questions (Probes/Questions to ask students at every phase in the lesson)**	**MATERIALS**	**EVALUATE Performances at every phase of the lesson.**
ENGAGEMENT:				

EXPLORATION:				
EXPLANATION:				
ELABORATION:				

EXTENSION: How will you incorporate ideas for further exploration?
DIFFERENTIATION: How will you differentiate your instruction to reach the diversity of learners in your classroom (ELL STRATEGIES/IEP IMPLEMENTATION)?