Lesson Plan

Grade/Subject: Grade 6 Life Sciences 5b& 5d 7. Investigation & Experimentation
Grade 4 Life Sciences 2b & 3b 7. Investigation & Experimentation
Grades 1-8 7. Investigation & Experimentation Standards

Unit: Ecology/Life Sciences Experimentation and Investigation

Lesson Title: The Case of the Dead Birds

Lesson Objectives:

1. Describe the relationships between consumers in sandy beach ecosystem food web (Grade 4)
2. Apply critical thinking to solve a scientific problem through using the scientific method (All Grades)
3. Evaluate the effect of population size of animals in their environment (Grade 6)
4. Demonstrate how to use Probes to measure water quality (All Grades)

Done in the classroom the morning of the Fieldtrip

Time Lesson Content	Materials/Equip Ref
I. Introduction (Hook) 10 min. A. Q & A w/ pic's passed out to pairs of students. Answer questions found on the back of Discussion/picture cards	Discussion Cards Computer w/ Screen Saver Students projected onto Whiteboard

II. Development

40min.

B. Introduce Activity - Hand out problem solving scenario - Read the scenario and the task - Put students into groups of 5 Have students choose roles (See - Table to hold laptops student lesson pages) -Go over Directions (Project - Practice Directions once through to Model how the equipment works	- Student Lesson Pages - GPS Units - Vernier Probe Ware- - Lap Tops & Carrying Case 2 - LiMPET's Group Equipment Kits plastic shoebox containers Lap Top boxes to shield light onto screen if possible) - Dissection kit

Do this in the classroom the day before the field trip to practice before arriving at sampling site.

90 – 120 min. C. Activity

Performed the day of the field trip upon arrival at sampling site.

20 min 1. Review Directions

- Have students reassemble into their groups
- Go over the directions again pointing out the equipment to be used in each part of the lesson and modeling one last time how to use equipment.
- Point out the boundaries within which the experiment will be done.
- Choose two students to set up 50 meter transect line parallel to the water. Put one orange flag at each point where the groups will set up their 10 meter transects numbered on it for each group.
- Answer any questions

- Assign a number to each group. Tell the group to find the orange flag with their number on it.
- Remind students that there will be a water quality station set up and that one student will be pulled, from each group throughout the lesson, to conduct a water sample sample to test the water quality of the ocean at their sample site.
- Pass out the equipment to each group

1 GPS unit

1 box of LiMPET's supplies (1 ten meter rope marked at each meter, 2 sieves (one small mesh and one larger mesh), 1 bucket,1 ruler, 1 clipboard, 1 small plastic collection container)

1 soil core

60 - 90 min. 2. Begin Activity

- Have the two chosen students set up the 50 meter transect and direct groups to their point on the 50 meter transect line.
- Have groups begin to set up their own transect and collect data.

1. Students will set up one orange flag at each black mark on their 10 meter transect rope line.
2. At each orange flag, starting with the flag closest to the water, they will use the soil core to collect a sample of sand. To collect a sample the students will put the soil core into the sand 10 cm, or up to the black line around the soil core. They will then pull out the soil core and release the sand into the sieves.
3. To find the sand crabs in the sand, they sift the sand in the sieves with the large meshed sieve sitting in the small meshed sieve.
4. Any sand crabs found will be collected and held in the small plastic collection containers with water until they can be measured.
5. To measure the sand crabs, one student will hold the

sand crab at each end of its body with its shell facing up. The students will measure the carapace length of the sand crabs with the ruler to the nearest mm and the recorder will record their data on the data collection sheet next to the appropriate flag.

6. To sex the sand crabs, the students will gently lift up the triangular piece of shell on the underside of the sand crab called the telson. If the sand crab is a female it will have large pleopods to hold the eggs. If the sand crab is a female with eggs it will have bright orange eggs under the telson. If the sand crab is male, you will see small pleopods.

7. The recorder will use the GPS unit to record the latitude and longitude of their sample site on the data sheet.

- Repeat each step at each flag working your way up from the flag closest to the water to the flags on the dry sand.
- Have students collect and clean off all equipment with fresh water when finished and check to make sure their data sheet is correct.

<u>Water Quality Station:</u>

Set up a water quality station on a sand free surface such as a table on the sand away from the water. The recorder from each group will collect a water sample and take it to the water quality station to analyze the data.

1. Place at least two laptops onto the water quality station with large plastic storage containers to shield the light to make seeing the screens easier.
2. Connect the Vernier Probeware to the laptops and start the Logger Pro3 program.
3. Connect 2 temperature probes to each logger pro, one salinity or conductivity probe, one nitrate probe, and one phosphate probe.
4. Set up the collection procedures to take one continuous sample from each

probe for 30 sec.
5. Set up measurement containers inside a plastic shoebox to prevent equipment damage as a result of spilling water.
6. Have the student collect a water sample at their sample site and place the water sample in the shoebox collection container.
7. Press the collect button on the Program and allow the computer to collect the data.
Try to collect sand crabs that are injured or dead but still have their bodies intact to be taken back to the classroom for dissection. During the dissection the students will look for the spiny headed worm to see if it is present and a possible cause explaining a decline in the number of sand crabs or the death of birds nearby.

To be done back in the classroom the same day or the following day.
40 min. I V. Optional Dissection

- Bring back any sand crabs with the carapace intact for dissection with the purpose of looking for the spiny headed worm.
- Dissection Directions:
    1. Using dissection scissors,, and wearing plastic gloves, cut open the sand crab from the posterior end of the carapace to the anterior end. Be careful to cut only through the carapace.
    2. Looking into the abdomen of the sand crab, if a spiny headed worm parasite is present, you should find a small football shaped white object.

Carefully remove this from the abdomen of the sand crab using tweezers and place it in
warm water under a microscope. The spiny headed worm will exocyst, or move out of its
encasement when placed in warm water.

40 – 60 min. III. Closure

- Students come in to discuss the student activity sheet
- One student will report back to the classroom from each group
- Each student will record the data from their group.
- The class will count and graph the total number of sand crabs found from each group.
- The class will discuss possible causes for the observed number of sand crabs found in light of the water quality data collected, the possible nitrate related pollution, phosphate related pollution, the presence or lack thereof of the spiny headed worm found during the dissection, environmental conditions such as the presence of predators on the sampling date, etc.
- The class will fill out a lap report to explain the procedures they conducted, report and analyze their results and offer possible directions for future research.
- More information on procedures and the Pacific Mole Sand Crab is located on the following website: http://limpets.noaa.gov/monitoring/sandyBeach/procedures.html

Problem Solving Scenario:

The Case of the Dead Birds

Sandy Banks, the local surfing champion, is frantic. The surf contest he is scheduled to be in next week has been cancelled because of many dead birds showing up on Imperial Beach where the contest will be held.

The Sweetwater Authority claims that the cause is pollution coming from the Tijuana River. Sandy does not believe it. He has been surfing at the Imperial Beach Pier every day for the last two weeks to prepare for this contest and he has not gotten sick.

Sandy heard about the research your class is doing and he thought you might be able to help. He knows that some birds are dying up north because their population numbers have increased. As a result too many sand crabs are being eaten at one time within the ecosystem. Birds are dying because there are not enough sand crabs left to keep all of them fed. He heard your class was studying food webs and he thought he could help

When you have completed your study, decide whether or not the beach should be closed and explain why your data confirms your decision.

Solving The Mystery:

1. How can the number of sand crabs be related to the deaths of shore?
2. What would high numbers of sand crabs found mean for the bird population at the beach?
3. What would low numbers of sand crabs mean for the bird population at the beach?
4. What did your class find at the beach? How many sand crabs did you find in all?
5. If typical sand crab populations can be described as 60 - 100 total per sampling site, what do your results tell you?
6. What would you recommend to Sandy Banks? Should the surf contest be cancelled? Explain your answer using the data you collected.
7. What does this tell you about the relationships of animals in ecosystems?
8. How do humans affect the health of beach ecosystems?
9. What would you recommend to keep the beach ecosystem

healthy?

Problem Solving Scenario: The Case of the Dead Birds.

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Sandy heard about the research your class is doing with water samples and he thought you might be able to help. He knows that some birds are dying up north from eating sand crabs infected with a parasite called the spinyheaded worm. Sandy would like you to catch the Pacific Mole Crabs (sand crabs), check them out to see if they are infected with the spinyheaded worm parasite, and compare that with your water quality results.

When you have completed your study, decide whether or not the beach should be closed and explain why your data confirms your decision.

Background Info: Clues to Help With Your Investigation

Effects of the Spiny-Headed Worm: The spiny-headed worm infects the Pacific Mole Crab (sand crab) and lives inside its stomach. The sand crab is able to stay alive, but it is sometimes slowed down. When the infected sand crabs are eaten by shore birds, the spiny-headed worm stays in the bird's stomach. This causes their stomachs to become infected and they die.

Parasites:

An organism that must live off of another organism to survive.

Host:

An organism that parasites live off of in order to survive.

Student Page 1: Procedure

Adapted from Farallones Marine Sanctuary Association. Sandy Beaches of the Gulf of the Farallones National Marine Sanctuary and Sandy Beach Monitoring.

The Investigation Overview:

With your class set up a 50-meter line transect parallel to the shoreline. At random points along the transect put up an orange flag. At each flag, each of 5 teams will make a 10-meter transect perpendicular to the first line, going towards the water. This transect should be placed 5 meters above the top of the swash zone and go into the water to a depth of 0.25 meters. This rope will be marked at every meter. You will take a soil core at each black mark

on the rope. The soil cores will go into a bucket. The bucket will be dumped into sieves, which will sift out the sand crabs from the sand. The sand crabs will be placed with seawater in small plastic containers and given to the measurer. The measurer will measure the sand crabs and identify if they

are male, female, female with eggs, or a recruit. The recorder will record the length of the sand crabs carapace (the shell on the outside of its body) and if it is a male, female, female with eggs, or a recruit onto the data sheets. The measured sand crabs will be returned back to the water away from your transect so you don't measure them again. Your teacher will collect a few sand crabs to take back to the classroom to dissect in order to look for parasites (See the procedure sheets that are attached).

Group Jobs:

Each group will have:

1. Soil corer/Bucket Holder
2. Bucket holder/Soil Corer
3. Sifter
4. Sifter
5. Sand Crab Measurer/ Identifier
6. Sand Crab Measurer/Identifier
7. Water Quality Tech
8. Water Quality Tech

Student Page 2: Job Descriptions

Soil Core/Bucket Holder Team:

You will work with the bucket holder to make sure that you push the soil core into the sand next to each black mark on the rope. You will then and pull the soil core out of the sand and let the sand fall into the bucket that is held by the bucket holder.

Sifters:

You will work together to get the sand from the bucket and sift it through the sieves. You must be looking for sand crabs, and baby sand crabs

(recruits). You will put the sand crabs you find into the plastic box with a little bit of water for the measurers to use.

Sand Crab Measurers/Identifier/Recorders:

You will be working with the recorder. You will take the sand crabs from the plastic shoebox. You will record how many males, females, females with eggs and recruits you find. You will measure them using the calipers to find out how long the carapace (the shell on its back) is to the nearest millimeter. If you are a recorder, you will work with the sand crab measurer to record how large the sand crab is and if it is a male/female/female with eggs/ or a recruit on the data sheet.

When you are done measuring and identifying the sex of the crabs return them to the water away from your transect line so they will not be counted again.

Water Quality Tech:

The water quality techs will be responsible for collecting the temperature of the water, taking the dissolved oxygen measurements, measuring salinity with the probes, and measuring the nitrates. One person is always responsible for making sure the computers don't get in the water. The other is responsible for taking the measurements. You can switch jobs at any time.

Student Page 3: How to Collect and Record Data

Monitoring Protocols:

Adapted from Farallones Marine Sanctuary Association. Sandy Beaches of the Gulf of the Farallones National Marine Sanctuary and Sandy Beach Monitoring.

A. Collecting a Soil Core Sample:

• The soil corer will hold onto the duct taped end of the soil core tube

• Push the tube gently into the sand next to the black mark on the rope.

• Press the tube 10cm into the sand, using the marker on the side of the tube as a guide.

• Use one hand to hold the tube and one hand to keep the sand in the tube.

• Dump the sand into the bucket. Take the bucket to the people holding the sieves.

• Keep the sand from different black marks on the rope in different buckets. You may have to wait until the sieves have sifted all the sand until you can continue.

B. Finding the San d Crabs in the Sand

• Dump the sand slowly a little at a time into the sieves.

• Shake the sieve to help the sand go through the mesh. Add a little bit of water to the sand to help it go through the wire mesh.

• Place all crabs found into a small plastic container with seawater. Don't mix the crabs from different buckets.

• Keep the crabs from different buckets separate.

C. Measuring the Crabs

• Measure the length of the carapace (the shell on its back) to the nearest millimeter for each crab.

• Record the length on the data sheet. Make sure that you are recording the data for each sample site in a different row on the data sheet

• A crab with a carapace length less than 9 mm is a Recruit (a baby).

D. Identifying if the Crabs are Male or Female

• GENTLY lift the Telson with your pencil.

• A female crab has pleopods, or white, thread-like things that look kind of like legs There should be three pairs of pleopods, or six of them total, with three on each side.

• The bright orange eggs that are seen when the Telson is lifted will identify a female crab with eggs.

• A male will not have pleopods or eggs.

E. Recording The Data

• When recording the data make sure you are placing the data in the right spot on the data sheet.

• Make sure you are using the following abbreviations:

M – Male

F – Female

FE – Female with eggs

R – Recruit

• Make sure you don't record the data from sand crabs from different plastic containers in the same spot on the data sheet.

Sand Crab Data Sheet 1

Site Information:

Beach Name: _____ Recorder Name: _____

Class Name: _____ Team Members: _____

Date: _____ _____

Transect #: _____ _____

# of Samples Along Transect: ___ _____

Latitude: _____ Longitude: _____

Site Conditions:

Approximate Cloud Cover (circle one): partly cloudy completely cloudy

no clouds

Water Temperature: _____

Air Temperature: _____

Approximate Beaufort Wind Scale Wind Speed: _____

Water Quality Data:

Dissolved Oxygen _____ ppt Salinity: _____ ppm

Nitrates _____ ppm

Draw Water Quality Graph:

Can save and print graph from computers and attach later.

Sand Crab Data Sheet 2:

Important Reminders:

• The lowest sample in the Water = Sample # 10 . The highest sample on dry sand = Sample # 1..

• When listing the sample number write D = a sample taken in dry sand or W = a sample taken in wet sand.

• Remember to use these symbols: M = Male, F = Female, FE = Female with eggs, and R = Recruit.

• Make sure you don't record the data from sand crabs from different plastic containers in the same spot on the data sheet.

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Beach Name: _____ Recorder Name: _____

Class Name: _____ Team Members: _____

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Data Table:

Sample #	Dry/Wet Sand	Males size	Females size	Females W/ Eggs size	Recruits size

Ex.1	Dry	0	1 20mm	2 24 mm 25mm	3 5 mm 3 mm 4 mm
1.	Dry				
2.					
3.					
4.					
5.					

6.					
7.					
8.					
9.					
10.					

(To be completed after the student field experience and the in class dissection. The in class dissection can be done whole class with the aid of a flex cam, or in groups depending on the age level, materials available, and maturity level of the students.)

2. Nitrates indicate pollution from untreated sewage. What does the level of nitrates tell you?

3. Did you find any sand crabs with a parasite? What does this data tell you?

4. What could high numbers of parasites in sand crabs mean for the bird population at the beach?

5. What would you recommend to Sandy Banks? Should the surf contest be cancelled? Explain your answer using the data you collected.

6. What does this tell you about the relationships of animals in ecosystems and an ecosystems health?

The Swash Zone, is the area that extends from the lowest to the highest reaches of the waves at any given time.

Acanthocephalans (thorny head worms)

Dinoflagellates, floatingin the water.

fish, water birds, shorebirds, and the larger spiny sand crab.

one clutch per month

spring through fall.