AT A GLANCE - Delta Discovery Voyage

IMPORTANT #S AND WEBSITES

- Marine Science Institute Website: www.sfbaymsi.org. Email Karen Peluso-Galaviz, Head of Program Department/Ship Program Manager, at karen@sfbaymsi.org with questions, or call 650-364-2760 x 15 or cell (650)455-8113
- Contra Costa Water District Website: http://www.ccwater.com
- Central Contra Costa Sanitation District Website: www.centralsan.org.

PROGRAM LOGISTICS

- Programs are a full 3.5 hours long and run from 9:00 AM - 12:30 PM, and from 1:30 PM - 5:00 PM.
- Please arrive 15 minutes before program to use bathrooms, have snack, check-in etc.
- Please call the cell (650-455-8113) if you are going to be late.
- There are four total groups and stations. If you are sharing with another class, communicate with the other teacher to divide all students into four even groups (no more than 15 students per group).
- Chaperones/ Adults (teachers included): optimal 4, no more than 8. (per program, not per class)
- Total number of students per program: no more than 60 (unless pre-approval and special accommodations were arranged with MSI.)
- **YOU WILL BE OUTSIDE REGARDLESS OF WEATHER CONDITIONS, including rain**! PROGRAMS DO NOT CANCEL AND ARE NOT RESCHEDULED. Dress appropriately and warmly.
- There is NO SMOKING during program.

PRE-TRIP CHECKLIST

- **Warm clothes** and many layers. Best to wear old clothes that can get muddy and wet. Hats that won't blow off. Sunscreen. Gloves. Rain jackets or ponchos are extremely smart. No umbrellas in windy conditions.
- Closed-toed, closed heeled **sneakers** on everyone. No sandals.
- Nametags are helpful
- You can bring a non-messy **snack** such as granola bar/ fruit roll up. Wrappers, littering, and crumbs left behind are *not tolerated*.
- Do the drivers know how to get to the Marina? 51 Marina Blvd, Pittsburg, CA 94565.
- Do you know when your busses are coming and going?
- Where are you eating lunch? What will you do if it is raining?

IMPORTANT POST-TRIP NOTICE

- Have students acknowledged the financial sponsor? Thank-you letters are not only courteous, but also help ensure future sponsorship for the program. You will be emailed your class's primary sponsor

THE PROGRAM FORMAT

- **Introduction**: Students and adults listen to an introduction and safety talk. Once completed, students will divide into four cooperative learning groups and rotate through four stations
- **Ichthyology Station**: Students will: use a pictorial fish key to identify fish species, learn about adaptations, health and fishing regulations.
- **Plankton Station**: Students will: perform a plankton tow to obtain a sample from the Delta, discuss the importance of plankton to the environment, and view the sample which is routed through a microscope onto a screen.
- **Benthic Station**: Students will: perform a mud grab, inspect mud sample, learn about non-native and native invertebrates, and discuss human impact on Delta geography.
- **Hydrology Station**: Students will: discuss stewardship, household hazardous waste disposal, local drinking water sources, recycled water, conservation of resources, and more.
- **Closing Activity**: Trivia, review, emphasis on conservation and stewardship activities will tie the learning objectives together.

PROGRAM SPONSORS

- Marine Science Institute: www.sfbaymsi.org
- Contra Costa Water District: www.ccwater.com
- Central Contra Costa Sanitation District: www.centralsan.org
- Delta Diablo Sanitation District: www.ddsd.org
- Mt. View Sanitary District: www.mvsd.org
- Lesher Foundation: www.lesherfoundation.org
- Golden State Water: www.gswater.com
- Marathon Martinez Renewables: www.marathonpetroleum.com
- Corteva Agriscience: www.corteva.com
- California Environmental Protection Agency (CalEPA): https://calepa.ca.gov/

NOTE: At the end of this packet is a bilingual (English and Spanish) letter to parents. You may wish to copy this off and send home prior to the voyage to inform parents about the field trip their children will be taking.

DELTA TEACHER PACKET

THE MARINE SCIENCE INSTITUTE

- Founded in 1970, Marine Science Institute is a private, non-profit organization dedicated to providing interdisciplinary science education programs that cultivate a responsibility for the natural environment. Over the years, MSI has developed many different programs for students and adults of all ages, including a research trip called the Discovery Voyage program, an outreach program called the Inland Voyage, and various programs that occur on-site, such as, the Shoreside and Ocean Lab programs. We are continuing to grow and develop by striving to make each program a science learning experience that will be enjoyed and remembered for many years. Since 2003 we have been providing the Delta Discovery program to schools in central and eastern Contra Costa County, educating children on water and environmental issues in the Sacramento-San Joaquin Delta. This program is offered through the generous sponsorship of Contra Costa Water District, Delta Diablo, Central Contra Costa Sanitation District (CentralSan), Mt. View Sanitation District, Golden State Water Company, Lesher Foundation, Marathon Martinez Renewables, Contra Costa Fish and Wildlife Commission, Corteva Agriscience, and California Environmental Protection Agency (CalEPA).

MARINE SCIENCE INSTITUTE'S MISSION

To inspire environmental stewardship through hands-on learning and exploration of San Francisco Bay ecosystems.

EDUCATIONAL GOAL

Our goal is to actively involve students so that they develop a deeper understanding and appreciation of our environment, simultaneously defining their own role within it. Multiple California State Science, Math and Language Arts Standards are addressed by this program.

The Institute achieves this goal through innovative marine science education programs that:

- Place students of all ages in contact with the natural environment;
- Emphasize the interdependence of all living things, their connection to the physical environment, and the special responsibilities of humans to the natural world;
- Facilitate active learning through the use of observation, critical thinking, and problem-solving skills in a cooperative setting; and
- Instill confidence, encourage involvement, and inspire accomplishment by providing positive role models.

USING THIS PACKET

This packet is designed to provide the teacher with background knowledge and activities to prepare for the Delta Discovery Voyage. The best preparation consists of, at least, a basic knowledge of vocabulary, concepts, and the trip's overall purpose. We have found that students who arrive prepared for their trip enjoy and benefit more from the voyage than students for whom the trip is an isolated experience. It is extremely beneficial to take a small amount of pre-trip preparatory time to ensure your class benefits to the fullest extent possible. This packet is designed to be used in conjunction with the Delta Water Patrol Workbooks your students have received virtually. If needed, you can request a printed version of the Water Patrol Workbooks by Dec. 15, by contacting Ashley Salazar at ashley@sfbaymsi.org . We are excited to participate in the education of your students- let's get started!

PROGRAM MESSAGES

As a result of the Delta Discovery Voyage, students and chaperones should disembark from the Research Vessel Brownlee with these messages firmly in place:

1- Drinking water comes from the Delta; All Delta area residents have a special responsibility to help keep the water/ habitat clean (stewardship);
2- A watershed as an area of land that drains water, sediment, and dissolved minerals to a common outlet. The Delta's watershed boundaries are quite large;
3- Water going down storm drains is not treated before entering the environment. Contaminates need to be kept out of storm drains.
4- Household Hazardous Waste (HHW) needs to be taken to special disposal facilities; there is one in Antioch, one in Martinez;
5- Mercury, a significant Delta contaminant, is sourced from fluorescent light bulbs and elsewhere; fluorescent light bulbs are HHW;
6- Recycled water is a new cool way to conserve water; and
7- Los Vaqueros Reservoir is used by the water district to counter Delta salinity in order to insure people have access to good quality water year round.

WATER PATROL WORKBOOK ACTVITIES

PRE-TRIP ACTIVITIES

This activity book is designed to raise the student's awareness of the concepts that will be discussed on their Delta Discovery Voyage (DDV.)

THE DELTA TIMES, page 1

California State Standards in Language Arts:

Reading- Word Analysis, Fluency, and Systematic Vocabulary Development 1.0-1.4; Reading Comprehension 2.0-2.5
Listening and Speaking- Listening and Speaking 1.8

Objective: Describe the location of the Delta and discuss why the Delta is important
Highlights Program Message 2-What is a watershed.

Method: Addressing language arts content standards, the introduction has been written as a newspaper article. Classroom ideas:

1. Have a student read the articles aloud in class.
2. Use graphics (such as a map) to make information in the article usable and accessible to all.
3. Discuss what additional diagrams and pictures could be added to the articles to help them understand what a levee, canal or aqueduct is and so on.

VOCABULARY LIST, page 1

California State Standards in Language Arts:
Reading- Word Analysis 1.0
Writing- Writing Strategies 1.0, 1.5; Writing Applications 2.3a-2.3c, 2.4a-2.4d

Objective: Define and use key vocabulary related to the voyage subject matter. The definitions for these words are attached to this guide.

Method: Addressing language arts content standards, the introduction has been written as a newspaper article. These words can be integrated into your current curriculum in the following ways.

1. As spelling words.
2. Assign each child a different word, and have them look up the meaning, and then present their word to the class.
3. Make posters or small diagrams pictorially explaining the concept behind some of the words.
4. Using the computer or dictionaries, perform a search for various words to see what you can come up with, and then have the children write an in-their-own-words definition. You may also utilize the thesaurus to determine alternate synonyms. Discuss how the computer or book generated synonyms might differ from the original definition.
5. Discuss various words and why the students think they might be relevant to the Delta Discovery Voyage. These are some examples:
    a. Ecology- Why is this word important to the whole of the trip? (Links the stations together.)
    b. Bioaccumulation- We will use this word at the Benthic (mud) station in relation to mercury accumulation in predators that eat filter feeders (such as clams). Discuss the food web, and diagram how bioaccumulation can take place. Use

math applications in conjunction with this concept to elaborate and reinforce this concept (see the BIOACCUMULATION ACTIVITY section.)

c. Non-native- What do they know about the pre-fix of this word, "non." What does that mean? How about "native." Where else have they heard this word? Native Americans were the first people here. Native means they grew up here for all time. So putting the two together makes what definition (that the students can create)?

d. Watershed, wastewater, and hazardous waste are all important words as well.

6. Using the vocabulary words as a topic for study, students can write research reports about why those words are significant to Delta study. They can also frame a curiosity about a word as a question and utilize that in scientific investigation methodology (utilizing the scientific method to write a research report.)

MERCURY & POLLUTION, page 2

California State Standards in Language Arts:

Reading 1.0-1.2

California State Standards in Math:

Number Sense 2.0-2.1, Algebra and Functions 1.2, Mathematical Reasoning 3.0-3.3

Objective: To demonstrate the concept of bioaccumulation and biomagnification, and why they are important in the context of Delta pollution and food webs.

Program Messages highlighted are: 4- Household Hazardous Waste (HHW) goes to a special disposal facilities; 5- Mercury, a significant Delta contaminant, is sourced from fluorescent light bulbs and elsewhere; fluorescent light bulbs are HHW.

Method: This activity is two-fold.

1. Defining bioaccumulation and biomagnification; give examples to elaborate on the concepts.

a. To begin, discuss with the students the meaning of bioaccumulation. Bio means life. "What does accumulation mean?" (To get more of, to build up a supply of.) "Life accumulation? No… it refers to when living organisms accumulate a lot of something in their bodies." Commonly, that something is a pollutant that stays in your body, and doesn't leave. The longer an animal lives, the more it can accumulate. Some of this contaminant accumulation happens simply from existing in the environment. Just like breathing smoggy air can bring pollutants into your lungs when you breathe, animals living in water will absorb some of those pollutants simply by swimming around in contaminated water. These pollutants can affect reproduction, growth and movement of animals.

b. A bioaccumulation analogy would be: What if you had super powers? And your super power was being really sticky? You know the dust particles in the air (you see them in streams of light)? What if every time you walked, you got dust particles

stuck to you? More and more and more over time just sticking to you… You'd be the world's biggest dust bunny in a short amount of time. This is what bioaccumulation is. Pollution "sticking to you" over time without you doing anything--- just existing in your environment.

c. Biomagnification starts in plankton which absorb it from their environment (bioaccumulation). Fish will eat multiple plankton each day, slowly increasing their levels of mercury, for example. Then a fish, like striped bass, after reaching a certain size, will have enough mercury in it to harm an organism that eats it- like a human or an egret. Top predators tend to have the highest levels of contaminants in their body tissues.

d. Ask the students, "What happens to you if you eat an animal that has pollution in it from its habitat?" The students should understand that by consuming an animal that has contamination in it, they too will ingest some of that contamination. Tell the students, "If you were a bird, and you ate contaminated fish every single day, eventually, you would have contaminant levels in you that far exceed any individual fish's contamination. At some point, those substances would begin affecting your day to day activities. Maybe you couldn't hunt as well, or fly as well. Or perhaps you could get sick from these contaminants. If you laid an egg, maybe the shell would be too brittle and break. You couldn't have any babies!" Contamination that moves up the food chain is called biomagnification. It is a little different than bioaccumulation, but they are conceptually linked. It all comes from pollutants in the environment.

2. Use Water Patrol Workbook activity sheet (page 2).

a. Examine and discuss diagrams as they pertain to bioaccumulation and biomagnification. The first diagram is referring to bioaccumulation and shows a fish swimming in contaminated water (note the mercury stars). Simply by being around mercury, the fish absorbs it into its body. The second drawing illustrates biomagnification and shows a predatory fish consuming the fish from the previous illustration. This shows the process by which predators accumulate mercury over time by eating contaminated prey. Humans are considered top predators as well. Just as the predators pictured absorbed mercury from its prey, humans will absorb mercury from fish they consume as well. Although fish is generally a very healthy source of protein for humans this biomagnification is why it is recommended that people limit the consumption of certain fish caught in some bodies of water.

b. Bio-Math: Stripted Bass & Mercury: Using a real-world type example, children will calculate how many years it takes for a striped bass to accumulate unhealthy levels of mercury in their tissues, and the average yearly rate of absorption. Figures are based on actual research; however rates of absorption are not factually based. Question #3 uses figures that are fictional.

Answers:

1. Q: If a striped bass is 12 years old and it has a concentration of 0.9ppm of mercury in its blood, how much mercury in ppm has it been absorbing yearly, on average?

A: 0.9ppm/12 years= .075ppm mercury per year.

2. Q: Using your answer from #1, how many years does it take for a striped bass to reach the 0.45 ppm? (Note: the upper "safe level" of mercury is .05 ppm)

A: .075 ppm mercury per year X 6 years = 0.45 ppm of mercury in its blood..

3. Q: Assume that each plankton a striped bass eats contains 4 units of mercury that it has absorbed from its habitat (bioaccumulation.) If striped bass release half (50%) of all the mercury they consume back into the environment, how many plankton does it have to eat before it reaches 600 mercury units in its body? 256 units? 50 units?

A: 4 units of mercury X 0.5 mercury lost X ____ number of plankton = 600 mercury units in its body. 4 units X 0.5 mercury lost = 2 mercury units gained per plankton.
600 mercury units / 2 mercury units = 300 plankton.
256 mercury units/ 2 mercury units = 128 plankton.
50 mercury units / 2 mercury units = 25 plankton.

DELTA DISCOVERY CROSSWORD, page 3

California State Standards in Language Arts:

Reading- Word Analysis, Fluency, and Systematic Vocabulary Development 1.0, 1.4-1.5

Writing- Research and Technology 1.5

Objective: Reinforce learning and acquisition of vocabulary and definitions pertinent to the Delta Discovery Voyage.

Method: Once vocabulary has been reviewed, do this activity as a class or assign it as entertaining homework. The definitions can be reviewed in class, and activities or strategies outlined in the VOCABULARY LIST, page 1 portion of the guide can be employed.

The answers are as follows:

Across: 2- Producer, 5- Habitat, 6- Levee, 8- Pollution, 10- Plankton, 13- Salinity, 15- Food Web, 17- Invertebrate, 19- Watershed, 20- Photosynthesis.

Down: 1- Adaptation, 3-Ichthyology, 4- Hydrology, 7- Ecology, 9- Tides, 11- Delta, 12- Benthos, 14- Vertebrate, 16- Detritus, 18- Consumer.

WATER SOURCES, page 4

California State Standards in Language Arts:

Reading- Reading Comprehension 2.0-2.1

California State Standards in Science:

Earth Sciences- 3, 3d-3e

Objective: Follow the path drinking water takes from the point of origin to the faucet.

The program messages that are highlighted are: 1- Drinking water comes from the Delta; 2- Define watershed, and the Delta's watershed boundaries; and 7- Los Vaqueros

Reservoir is used by the water district to counter Delta salinity in order to insure people have access to good quality water year round .

Method: As a class, trace the path of a water droplet as it makes its way from the mountains to a home, school, or hospital. Students can color in all of the fact boxes with one color. Have a different student read out loud each fact box as you come upon them as a class while tracing the path of water. Discuss the facts. The California Water Facts section in the top corner of the page reinforces the Delta Discovery Voyage Program Objectives, such as the importance of the Delta to all California's water supply and the students' role in protecting the health of the Delta.

Alternative: Have students write a first person story as a water drip traveling from a cloud through the Delta watershed, to their home, and then back out into the environment.

POLLUTION PATROL, pages 5

California State Standards in Science:

Earth Sciences- 3d-3e

Objective: Identify potential sources of water pollution.

It highlights Program Messages: 3- Stating nothing should be put down the storm drain, and that storm drains lead to the Delta, the source of Contra Costa County's drinking water; 6- The use of recycled water is also highlighted.

Method: Split the children up into learning groups to perform the activities at the bottom of the workbook page.

Answers:

1. The dirty water flows from the dishwasher and toilet in the house across the street to the treatment plant. Water then flows to the Bay or is used as recycled water to irrigate park foliage.
2. The locations from where water can be polluted are as follows: 1- The oil next to the car draining into the storm drain. 2- The pile of chemicals in the garage (don't hesitate to discuss what items are in the garage. Which of these might be HHW?) 3- The fertilizer near the dog. 4- Spilled chemicals behind the house on the left page. 5- Pet waste. 6- The landfill. 7- Cars driving around releasing airborne pollutants.
3. The pile of chemicals in the garage are ALL household hazardous waste (HHW), as well as the oil and anti-freeze in front of the car in the driveway. The fertilizer is deemed HHW, as well as the paint can and car battery behind the house. Discuss why it is important to take HHW to the proper disposal facility instead of placing it in the garbage where it will be taken to the landfill. At the landfill, chemicals can seep into the ground water supply as their containers deteriorate. The ground water can connect to the Delta, taking the chemical contaminants with the water flow. Some contaminants are extremely persistent (they remain in the environment for a long time), are particularly dangerous to organisms in the habitat, or are difficult to

remove from the water supply destined to be usable water. The HHW facility will recycle and properly dispose of chemicals so that they do not pollute the environment.

4. An "X" should be marked on the HHW Collection Facility. Discuss why an "X" is not placed on the Recycle Center. Simply put, Recycle Centers cannot dispose of HHW properly. That is why HHW Collection Facilities in Martinez and Antioch exist; because those chemicals need to be handled by people who are specially qualified and trained.
5. Water is being wasted by the gentleman watering his lawn. Water is being reused (recycled water) in the park on the left page at the water fountain.

DELTA MATH, page 6

California State Standards in Math:

Number Sense 1.1-1.2, 2.0-2.5

Objective: Understand the importance of the Delta to Californians by demonstrating the magnitude of people who depend on the Delta for water. In addition students will discover that the area of the Delta watershed is much larger than the Delta itself.

Program Messages: 1- Drinking water comes from the Delta and we must all be good stewards of the environment because so many people rely on water from the Delta; 2- Define watershed.

Method: Have students complete the math problems, and then discuss the significance of those problems.

Answers:

1. Q: 2/3 of California's population gets at least part of their water from the Sacraments-San Joaquin Delta. The population of California is nearly 36 million. How many Californians depend upon water from the Delta?

   A: 2/3 X 36 million = 24 million people get some of their water from the Delta.
2. Q: California is a large state and covers 156,000 square miles. 62, 400 square miles of California is in the Sacramento-San Joaquin Delta watershed, meaning rain and melting snow drain into the Delta. What percentage of California is within the Delta watershed?

   A: 62,400 $miles^2$ / 156,000 $miles^2$ = 0.4 or 40% or $2/5^{ths}$ of California's total land area is within the Delta watershed.
3. Q: Although the Delta watershed is quite large, the Delta itself is only 1% of California's total land area. How many square miles does the Delta cover?

   A: 156,000 $miles^2$ * 0.01 = 1560 $miles^2$ is what the actual River Delta covers, despite the vastness of its watershed.

QUESTIONS FOR DISCUSSION, page 6

California State Standards in Science:

Earth Sciences 3a-3e

Objective: These questions are designed to get the students' thinking about Delta topics. Once portions of the Water Patrol Workbook have been completed, students should have some understanding as to why they are going on the Voyage.

Method: As a class, discuss these topics or complete the suggested activities.

Answers:

Some relevant concepts are outlined below.

1. Q: Discuss what would be different about the earth if there was no natural water cycle.

   A: One way to continue this questioning would be to ask, "So what do we know about the water cycle?" The answers generated from this question can lead to discussions about how it helps the environment, why it is crucial and so forth. Some points could be:

   a. Regarding the evaporation of water. When water is evaporated, any contaminants or pollutants are left behind. In some senses, evaporation is nature's own water treatment system.

   b. Water connects all living things, i.e., nothing can live without it.

   c. The water cycle connects water evaporated in one place, with the environment in another.

   d. Water has been being recycled and reused since the dawn of time. If it wasn't reused, there would be no water to fuel life now. Earth would be a lifeless desert!

2. Q: Describe how snow in the mountains ends up as the water we drink in our homes.

   A: Snow in the mountains melts during spring and flows as streams down the mountainside. These streams come together to flow as rivers. As the water flows down rivers towards the Delta, some of it is used by communities, agriculture, and industry and then treated and returned to the river. When the water reaches the Delta it is pumped out of the Delta by the Water District and either stored in Los Vaqueros Reservoir until it is needed, or transported in canal or pipes to water treatment plants. At the water treatment plant the water is treated to remove any dirt or germs. A small amount of disinfectant is added to the water as it departs the treatment plant to keep it clean as it travels in pipes to our homes. (note: this is true for the Contra Costa Water District, other water districts ' water sources and conveyances will differ.)

3. Q: What is meant by the saying "Everyone lives downstream from somebody else"- Why is that important to us?

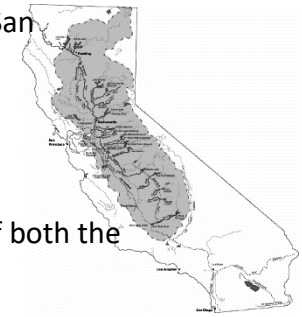
   A: "Everyone lives downstream from somebody else" means that the effect you have on your watershed isn't isolated. Thus, if I contaminate the watershed in Sacramento by pouring motor oil into the storm drain, that will contaminate the

water used in Antioch. If someone in the Sierra Nevada Mountain Range pours oil down their storm drain, and it ends up in a stream, someone in Sacramento is affected. If the water used to irrigate orange crops in the Central Valley is contaminated, then the oranges that drank that water may be contaminated, meaning someone in Germany eating a California orange could get sick because the Delta water wasn't clean. We all affect our environment, and that effect doesn't always stay at the source.

MAP ACTIVITY, page 6

Objective: Illustrate the boundaries of the Sacramento-San Joaquin watershed, and how the boundaries are truly much larger than the area of the Delta itself.

Method: Using a map of California, have students outline the Sacramento-San Joaquin River Delta watershed. Place a star on the San Francisco Bay Delta Estuary.



Answer:

The map to the right shows the outline

Wikipedia has a couple of good sites that describe the watersheds of both the Sacramento and San Joaquin Rivers. Go to:
http://en.wikipedia.org/wiki/Sacramento_River
http://en.wikipedia.org/wiki/San_Joaquin_River

WATER WISE WORD SEARCH, page 7

California State Standards in Language Arts:

Reading- Word Analysis, Fluency, and Systematic Vocabulary Development 1.0, 1.4-1.5

Writing- Writing Strategies 1.5

Objective: To reinforce vocabulary words in a fun and entertaining way.

Method: Have students use the word bank to search for hidden words in the search.

PRE-TRIP QUIZ DELTA DISCOVERY VOYAGE, page 8

Objective: To assess the effectiveness of the Delta Discovery Voyage Water Patrol Workbooks and to highlight topics that may need to be reviewed prior to their DDV trip.

Method: Have the students complete the quiz individually or in pairs. It can be either an "open" or "closed" book quiz. The quiz can be self-corrected as a class activity – or teacher graded. It is designed to introduce and reinforce (depending on their level of preparation) concepts that will be discussed on their Delta Discovery Voyage. It can also be utilized as an initial activity to introduce students to what they will be learning about on the DDV.

Answers:

1. Q: What two major California rivers form the Delta?

   A: The Sacramento and the San Joaquin Rivers.

2. Q: The water in the Delta is saltier in the fall than in the spring. Why?

   A: Not as much fresh water flows out of the Delta in the fall, which fails to push the salty bay water out of the Delta. In spring, the increased river flow due to rain and snowmelt contribute to very high river flows, and a decrease in salinity.

3. Q: How is Delta important to those who live in cities?

   A: They use the water to drink, do laundry, cook with etc.

4. Q: How is the Delta important to fish and wildlife?

   A: They use the Delta water as habitat; it is where they live.

5. Q: How is the Delta important to farmers?

   A: They use the water to irrigate their crops (Delta, Central Valley.)

6. Q: Unscramble these recreational Delta words:

   A: Fishing Boating Swimming

7. Q: Most of the water in the Delta originates as snow in the Sierra Nevada Mountains.

   A: True

8. Q: When it rains, the water that drains off my driveway and into the street is cleaned of pollution and chemicals before it empties into the Delta.

   A: False, the water that goes down storm drains is not treated before it flows out to the Delta.

9. Q: The water we drink has never been used before:

   A: False, all water being used now has been used before for millennia.

10. Q: I can make a difference in the quality of water we drink and in the quality of water available for fish and other wildlife.

    A: True, everyone can make a difference in the quality of water they drink by using less (conservation), decreasing pollution/ litter/ fertilizer that contaminates the ecosystem, not dumping anything down storm drains, and by taking HHW to the proper disposal site.

DRAIN DETECTIVES, page 10

Objective: To create an understanding of Household Hazardous Waste, what it is and where the proper disposal sites are; to educate parents and students alike to increase effectiveness of HHW programs.

Method: Students will, with their parents, go through the worksheet together.

POST- TRIP ACTIVITIES

POST-TRIP REPORT, page 9

California State Science Standards in Language Arts:

Writing- Writing Strategies 1.2a-1.2c

Objective: To reinforce, review, and reflect upon the Delta Discovery Voyage.

Method: Students should draw a picture and write a description of what they did, learned, or thought was interesting at each station. The space provided in the Water Patrol Workbooks can serve only as a guide. This should be done as soon after the trip as possible to solidify and review their experiences, and gives the students an opportunity to reflect upon what was important about the trip as a whole.

An extension to pictorial representations of their Voyage would be expository writing on their experiences. Have students compose a narrative describing what they did, saw, and learned while on the Delta. Have a class discussion asking the following questions, to jog the students' memories about the experience.

1. What did they touch that was cool?
2. What did they learn that they never knew before the trip?
3. What animals did they see? What did they feel like?
4. How were the various scientific samples collected (mud grab, plankton tow, Otter trawl etc.)

This discussion can also prepare them for the Post-Trip Quiz.

POST-TRIP QUIZ

Objective: This post trip quiz (located only in this teacher packet, see final pages) is designed to assess the quality of the student's retention of the information they learned on their Delta Discovery Voyage. This quiz can also be used as a general review once back in the classroom, or as a jumping off point for further study.

Method: Students will complete the quiz upon return to the classroom from the Delta Discovery Voyage trip.

Answers to Post-Trip Quiz:

1. Q: Where does your drinking water come from?

   A: The Delta.

2. Q: Name 3 ways you can conserve water.

   A: 1- Turn off faucet when brushing teeth. 2- Water lawn at night. 3- Take shorter showers. 4- Reuse bath towel to dry off; wash it only after it has been used a few times. 5- Store water in the fridge so it is already cold and available when you want to use it (instead of running the faucet until it gets cold enough.) 6- Cover your pool in summer to decrease evaporation. What other ideas did the students come up with?

3. Q: What is the main difference between the water in the Delta and the water in the Bay?

   A: Delta water is fresh (or with a low salinity) while Bay water is salty with a higher salinity and density.

4. Q: What is a watershed? What percentage of California is in the Delta's watershed?

   A: A watershed is any area of land that water, sediments and dissolved minerals flow to a common outlet. The Delta's watershed comprises 40% of California.

5. Q: What are the effects of mercury poisoning on people? On fish? On birds?

   A: Mercury poisoning affects the nervous system. It can cause tremors, headaches, short-term memory loss, lack of coordination, weakness, loss of appetite, altered sense of taste and smell, numbness and tingling in the hands and feet, insomnia, and excessive sweating.

6. Q: How do local birds eating mercury-contaminated fish get levels of mercury that are higher than the levels in the fish they eat?

   A: By eating many contaminated fish, all the small amounts of mercury in each one add up to a larger amount of mercury than is in just one fish. The effect is additive. (2+2+2=6)

7. Q: What everyday items can contaminate the Delta with mercury?

   A: Fluorescent light bulbs, mercury thermometers, button batteries.

8. Q: How can we properly dispose of halogen light bulbs, paint, chemicals and other pollution sources?

   A: Take those items to the special place, the Household Waste Recovery Center.

9. Top fish are generally shaped like a <u>torpedo/ hotdog/ long and skinny</u> and have a cool camouflage called counter-shading.

10. Middle fish are generally shaped like a <u>football/ hamburger</u> and are very shiny.

11. Bottom fish have their eyes located on <u>top</u> of their heads.

12. Q: Describe how one of the fish felt. Slimy? Rough? Smooth? Cold? Warm?

13. Q: What is an invertebrate? Can you name three that you saw?

    A: An invertebrate is an animal without a backbone. Asian clam, Korean shrimp, Chinese Mitten Crab, Crawfish, amphipods.

14. Q: How does a filter feeder eat, and what do they eat?

    A: They suck in water and filter the plankton out of the water.

15. Q: What do scavengers eat? Give an example of a scavenger found in the Delta.

    A: Scavengers eat dead stuff, detritus, and organic matter. A scavenger would be the Chinese mitten crab.

16. Q: How are levees important in the Delta? What creature threatens levee stability?

    A: Levees keep the river water from flowing into surrounding farm land. The Chinese mitten crab burrows into these levees and weakens them.

17. Q: What is a non-native species? Give an example of one affecting the Delta's

habitat health.

A: A non-native species is an organism that has been introduced into an environment sometime in the last two hundred years. They have not grown up here for all time. The Asian clam or the Chinese mitten crab would be examples.

18. Q: Name the two groups of Plankton.

    A: Phytoplankton (plant) and zooplankton (animal).

19. Q: By what process does phytoplankton make their food?

    A: Photosynthesis.

20. Phytoplankton in the world release 50% - 80% of the <u>oxygen</u> that animals cannot live without.

21. Plankton is also the <u>base/ bottom</u> of the food web, supporting many creatures above them.

RESOURCES AVAILABLE TO YOU

PRE/ POST-TRIP FIELD TRIPS

Contra Costa Water District offers educational programs of many types for schools within their service area. Educational tours of Los Vaqueros Reservoir and watershed, in-class presentations, Earthcapades water assemblies, canal safety presentations and water treatment plant tours. Call (925) 688-8307 for more information.

Delta Diablo Sanitation District offers a limited number of tours each year of its wastewater and recycled water treatment plants and laboratory to fifth grade students and older. Delta Diablo also provides classroom presentations to fifth grade classes. Available to students in Pittsburg, Antioch and Bay Point. Call 925-756-1945 to schedule.

Central Contra Costa Sanitation District offers fun, in-class activities like Central San's Water Wizards program which cooperates with The Gardens at Heather Farm, wastewater treatment plant tours, and Kids in Gardens teacher workshops. Many programs are free! You can call (925) 229-7310 for more information, or visit the website.

Mt. View Sanitary District offers several no-cost programs for area schools to include treatment plant and wetlands field trips for third – fifth grades for all Contra Costa County schools, in class programs for Martinez elementary schools, and educator workshops. Call 925-228-5635, ext 19 for more information, or visit the website.

VALUABLE RESOURCES:

The Marine Science Institute has several good resources available online at: www.sfbaymsi.org.

WEBSITES

- Habitat Maps:
  http://www.sfei.org/content/ecoatlas_habitats
- Water Activities:
  http://www.epa.gov/safewater/kids/teachers_4-8.html
  http://www.epa.gov/water/kids/waterforkids.html
- Water Science:
  http://ga.water.usgs.gov/edu
- The Watershed game:
  http://www.bellmuseum.org/distancelearning/watershed/watershed2.html
- General biology information about SF Bay Estuary:
  http://www.bay.org
- Mercury Information:
  https://www.epa.gov/mercury/basic-information-about-mercury

DELTA DISCOVERY VOYAGE VOCABULARY LIST
(The most important concepts are starred.)

Acre-foot: 325,821 gallons of water, or enough to cover an acre of land with one foot of water.

Adaptation: Modification of an organism in order to survive in its habitat.

Benthos: The bottom of a body of water; the adjectival form of benthos is benthic.

***Bioaccumulation:** the build up with in living organisms of toxic substances occurring in the environment

***Conservation:** The maintenance of environmental quality and resources (physical, cultural, or biological.)

Contra Costa Canal: A canal delivering water extracted from Rock Slough on the Delta to various Contra Costa cities. Delta flow amounts are regulated upstream at Lake Shasta and Lake Oroville.

Delta: Fan shaped mouth of a river emptying into a tidal marine body of water, such as an ocean.

***Density:** Mass per unit volume, such as g/mL.

Ecology: The study of relationships between organisms and their environment.

Endangered: An organism that is threatened with extinction.

Estuary: Semi-enclosed body of water where salt water and fresh water meet and mix.

Filter Feeder/ Suspension Feeder: An animal which extracts food particles by straining the water, such as clams.

Food Chain: A sequence of living organisms in an ecosystem in which members of one level feed on those in the level below and in turn are eaten by those in the level above them.

***Food Web:** An assemblage of organisms in an ecosystem, including plants, herbivores and carnivores, showing the relationship of "who eats whom".

Fresh Water: Water containing less than 1 ppt of salts, or minimal quantities of salts.

Hydrology: The study of water.

***Habitat:** The particular area in which an organism normally lives.

Ichthyology: The study of fish.

Invertebrate: An animal lacking a true backbone.

***Levee:** An embankment built to prevent a river from overflowing, often into diked farmland.

***Mercury:** A metal that is liquid at room temperature, sometimes called quicksilver.

Microscopic: Items too small to be visible with the naked eye, requiring a microscope to see them.

Nekton: Swimming animals of open water; the adjectival form of nekton is nektonic.

***Photosynthesis:** The process used by plants to make food; in this process light energy is used to

combine carbon dioxide and water to make carbohydrates (sugar and starch); oxygen gas is given off as a by-product.

***Plankton:** Drifting aquatic animals and plants; the adjectival from of plankton is planktonic.

***Reservoir:** A place, esp. an artificial lake, where a large quantity of water is collected and stored to be piped to a city or used for irrigation, hydroelectric power etc.

Sacramento River: A river comprising the northern reaches of the Sacramento-San Joaquin watershed. One of the two rivers making up the San Francisco-San Joaquin River Delta.

***Salinity:** The amount of salt in the water. Measured in parts per thousand (ppt).

Salt Water: Oceanic salt water is comprised, on average, of 3.5% salts, the most prevalent salt being sodium chloride. That means that, on average, ocean water is 35 ppt.

San Joaquin River: A river comprising the southern reaches of the Sacramento-San Joaquin watershed. One of the two main rivers making up the San Francisco-San Joaquin River Delta.

Scavenger: An organism that will eat just about anything; scavengers usually include dead and decaying animal flesh in their diets.

Tides: The alternate rising and falling of the seas; two cycles occur daily in the Estuary and Delta.

Water Cycle: The process by which rain condenses in clouds and falls to the earth, moves across land or through the land, and then evaporates as a gas to form clouds again.

Wastewater: Water that has been used, as for washing, flushing, or in a manufacturing process, and so contains waste products; sewage.

***Watershed:** The catchment area of a river system; where all water falling to the earth in that area drains to a common source.

Name:_____

Delta Discovery Voyage: Post-Trip Quiz

I. HYDROLOGY STATION

1. Where does your drinking water come from?

2. Name 3 ways you can conserve water.

3. What is the main difference between the water in the Delta and the water in the Bay?

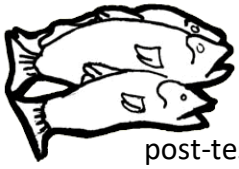
4. What is a watershed? What percentage of California is in the Delta's watershed?

5. What are the effects of mercury poisoning on people? On fish? On birds?

6. How do local birds eating mercury contaminated fish get elevated levels of mercury that are higher than the levels in the fish they eat?

7. What everyday items can contaminate the Delta with mercury?

8. How can we properly dispose of halogen light bulbs, paint, chemicals and other pollution sources?



post-test quiz, pg 2 of 2

II. FISH STATION

9. Top fish are generally shaped like a _____ and have a cool camouflage called counter-shading.

10. Middle fish are generally shaped like a _____ and are very shiny on their sides.

11. Bottom fish have their eyes located on _____of their heads.

III. BENTHIC STATION

13. What is an invertebrate? Can you name three that you saw?

14. How does a filter feeder eat, and what do they eat?

15. What do scavengers eat? Give an example of a scavenger found in the Delta.

16. How are levees important in the Delta? What creature threatens levee stability?

17. What is a non-native species? Give an example of one affecting the Delta's habitat health.

IV. PLANKTON STATION

18. Name the two groups of Plankton.

19. By what process does Phytoplankton make their food?

20. Phytoplankton in the world release 50% - 80% of _____ that animals cannot live without.

21. Plankton is also the _____ of the food web, supporting many creatures above them.

Dear Parents,

Your child will be participating in a field trip with his/her class on _____. They will be participating in 3.5 hour discovery program to learn about the marine ecology and water quality of the Sacramento/ San Joaquin Delta.

The students will be spending much of the day outside. It is very important that they are prepared with the right clothing. Please make sure your child dresses appropriately for the day. They should wear layered clothing, including a coat, and have a rain jacket if needed. Warm hats and gloves are also a good idea if it is a cold day. Your child may also wish to have a small bottle of water to bring along.

The program that your child is participating in is a lot of fun, as well as being educational. Please contact your child's teacher with any additional questions. Thank you.

This field trip is being offered to your child's school through a partnership of the following organizations:

Martinez Renewable Fuels · Golden State Water Company · Delta Diablo · Mt. View Sanitary District · Contra Costa Water District · Lesher Foundation · Central Contra Costa Sanitary District

Estimados padres,

Su hijo(a) estará participando en un paseo con su clase el día _____. Ellos estarán participando en un programa de descubrimiento de 3.5 horas para aprender sobre la ecología marina y calidad del agua de la delta de Sacramento/San Joaquín.

Los estudiantes pasaran una gran parte del día afuera. Es muy importante que estén preparados con la ropa apropiada. Por favor asegure que su hijo(a) estén vestidos apropiadamente para el clima del día. Deberían usar varias capas de ropa, incluyendo un abrigo y tener una chamarra para el agua en caso de que sea necesaria. Gorros y guantes para el frio también son una buena idea si el día esta frio. Su hijo(a) también debería tener un bote de agua para tomar.

El programa en cual participara su hijo(a) es muy divertido y también educativo. Por favor contacte al maestro(a) de su hijo(a) con preguntas adicionales. Gracias.

Este paseo es ofrecido a la escuela de su hijo(a) por parte de una colaboración de siguientes organizaciones:

Delta Diablo · Golden State Water Company · Martinez Renewable Fuels · Central Contra Costa Sanitary District · Mt. View Sanitary District · Contra Costa Water District · Lesher Foundation