

The Santa Monica Bay Game

Presented by

COSEE-West

a **C**enter for **O**cean **S**ciences **E**ducation **E**xcellence

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“Boundary Bay”/“Bountiful Bay” game, FOR SEA Institute of Marine Science, Indianola, WA.
(www.forsea.org/)

Santa Monica Bay Watershed map, courtesy of “Heal the Bay” (www.healthebay.org/)

4-6 player version developed by John Adams Middle School 2005-2006 QuikSCience Challenge
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SANTA MONICA BAY GAME

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INTRODUCTION

The Santa Monica Bay Game employs an interactive format that has been used successfully to call attention to water quality issues of watersheds around Santa Monica Bay. Although Santa Monica Bay is saltwater, the problems experienced in freshwater drainages in this game demonstrate the connection between land and sea and freshwater bodies and saltwater bodies and put watershed issues into a larger perspective. People's actions often affect more than their local neighborhood. Impacts flow downstream and accumulate, ultimately reaching the bays and coastal marine habitats.

In the Santa Monica Bay Game, students participate in a simulation in which they assume roles of individuals who, like us all, use and have an impact on our watershed. The students take actions appropriate to their roles, which alter the water quality in various local waterbodies, such as creeks and rivers or the bay itself. The smaller waterbodies are represented by water-filled cups placed in the appropriate locations on a large map of southern California and a 10-gallon aquarium filled with water represents Santa Monica Bay. Over the course of the game, the water quality will inevitably change, clearly illustrating the impact each of us has on our water resources.

KEY CONCEPTS

1. Each person constantly makes decisions that affect the condition of our watershed.
2. Sometimes our decisions have consequences that we can't foresee when we make them. Often an innocent person and the environment suffers the consequences.
3. Our economy frequently rewards actions that bring short-term gain instead of rewarding behaviors that are in everyone's best interest over the long-term.

CALIFORNIA SCIENCE CONTENT STANDARDS MET

Grade 3:, 1 a,b; 3a,b,c,d; I&E 5a,d,e

Grade 4: 2a,b,c; 3a,b; 5a,c; I&E 6 a,c,f

Grade 5: 3a,d,e; I& E 6 b,c,d

Grade 6: 6a,b; 7a,d,e,g,h; 5a,b,c; 2d, 2a,b; I&E 7a,d,e,h

High School Biological Sciences: 6a,b,c,d,e,g; 7a,b,c,d; 8a,b,e; I&E 1 c,d,f,g

OCEAN LITERACY PRINCIPLES MET

4. The ocean makes Earth habitable.
5. The ocean supports a great diversity of life and ecosystems.
6. The ocean and humans are inextricably linked.

PLAYING THE GAME

During the course of the game, “contaminants” will be introduced into “Santa Monica Bay” and its tributaries. Contaminants will include food coloring, dirt (siltation), confetti (trash), a solution of ammonia and water (an invisible contaminant that changes the water’s pH), and Tootsie Rolls (fecal waste).

At several points in the game students must test the water quality in Santa Monica Bay. Three different water quality tests will be used in the game:

- Compare a water sample to a pre-mixed color standard. When the water sample is darker than the standard, the sample is considered to be contaminated.
- Lower a Secchi disk from the surface and record the depth at which it is no longer visible. (A Secchi disk is a standard piece of water quality equipment used for measuring the turbidity or cloudiness of the water. Directions on how to make a Secchi disk will be given later.)
- Test the pH of the water with litmus paper. As the ammonia solution is added, the pH will rise in Santa Monica Bay. For the purposes of the game it is not necessary that students understand the meaning of pH. This test is used strictly as a convenient way to sample an invisible contaminant.

Some students will have the opportunity to try catching fish. They will find that, as Santa Monica Bay’s water becomes darker, catching fish on the bottom becomes much more difficult.

The game includes cards describing 33 different roles. The game can be played in one of two ways:

- 1) By the entire class, in which each student is responsible for 1 role card. You may create additional roles if you have more than 33 students playing the game together.
- 2) In cooperative learning groups of 4-6 in which students divide up the role cards among themselves.

The Santa Monica Bay Game is both whimsical and serious. Do not worry if your students take the game lightly as it is played. Its message will be clear no matter what choices are made, and regardless of the spirit in which it is played!

After playing the Santa Monica Bay Game, students may want to use the same format of role playing to create another game that highlights water quality issues in their local area.

MATERIALS

For each group of students (either 1 set for the whole class to play together or 1 set for each group of 4 to 6 students):

- 1 [SM Bay Map](#) **
- 11 Clear plastic cup labeled San Gabriel River, L.A. River, Verdugo Wash, Sepulveda Basin, Whittier Narrows Basin, Big Dalton Creek, Rio Hondo, San Jose Creek, Arroyo Seco, Ballona Creek, and Malibu Creek
- 1 5-10 gallon container (represents Santa Monica Bay)
- 10 Plastic fish **
- 1 Dropper bottle of food coloring (or use small container with eye dropper for dispensing) – “colored contaminant” **
- 1 Cup labeled “Water Quality Standard” that is filled with water and contains 1 drop of food coloring
- 1 Cup labeled “Water Sample” (this should be the same kind of cup as used for “Water Quality Standard” to be filled and used during game play)
- 1 Dropper bottle (or use small container with eye dropper for dispensing) of “clear contaminant” (5% solution of ammonia) **
- 1 Container filled with dirt
- 1 Container filled with confetti **
- 1 [Secchi Disk](#) **
- 1 Fishing Pole **
- 1 set of [role playing cards](#)
- **Amount Varies (10 pieces per student)** - Bags of candy “money”
- **Amount Varies (1 per student or answer questions in a class discussion format)** - [Santa Monica Bay Game Student Handout \(secondary only\)](#)
- **Amount Varies (one per student)** - Lined Sheet of Paper titled “Issues”
- 1 Package modeling clay (to make plastic fish)
- 1 Measuring spoon (teaspoon size)
- 1 Towel (for spills and drips)
- 1 Package of small Tootsie Rolls (represents dog poop)

Kept by teacher:

- 1 Container labeled “Bank”
- 1 Litmus Paper Dispenser (pH range 6-10)
- 1 bottle household Ammonia

** **Note:** directions on how to make these items are in the “SetUp” section.

SETUP

Class OR Group (4-6 Players) Format:

- 1) **SM Bay Map** 1 [map of the Santa Monica Bay](#) for the class **OR** 1 map for each group.
Use one of the following methods:
 - 1) Have students draw the map on the floor with chalk or masking tape.
 - 2) Copy the image on the cover page onto a transparency. Tape a tarp onto the wall and project the image onto the tarp. Trace the image onto the tarp.
 - 3) Paste an enlarged image of the Santa Monica Bay Map onto a poster board. This can be done by printing the 4 pictures at the end of this packet onto separate pages, cutting them out, and pasting them together onto a poster board.

The tarp or poster board method is best because the map can be re-used.
- 2) **11 Clear Plastic Cups** (1 set of 11 cups for the class **OR** 1 set per group):
Label 11 clear plastic cups as “San Gabriel River”, “L.A. River”, “Verdugo Wash”, “Sepulveda Basin”, “Whittier Narrows Basin”, “Big Dalton Creek”, “Rio Hondo”, “San Jose Creek”, “Arroyo Seco”, “Ballona Creek”, “Malibu Creek”.
Fill each cup with water and set each cup on its corresponding label on the map.
- 3) **5-10 gallon clear container** (1 for the class **OR** 1 for each group):
Label an aquarium (or 5-10 gallon clear container) “Santa Monica Bay” and place it near the map. Fill it with water.
If you don’t have an aquarium, Big Lots/Target sells clear plastic containers at a relatively low cost. (Many teachers like to put the aquarium on a rolling cart so it can be easily moved aside if the game needs to be continued another day.)
- 4) **10 Plastic Fish** (1 set of 10 fish for the class **OR** 1 set per group):
Cut fish shapes from a coffee can lid or other piece of flexible plastic such as tops of yogurt containers, and slot them to fit into modeling clay bases so that they stand upright. Punch a hole in each fish so that it can be caught from above with the hook. Weight each fish with a paper clip if it floats so that it will sit on the bottom of the tank. Arrange 6 fish on the bottom of Santa Monica Bay.
- 5) **Colored Contaminant** (1 bottle for the class **OR** 1 bottle for each group):
Mix blue and red food coloring to make a muddy brown color. Keep in a small container with an eye dropper **OR** keep in small dropper bottles (works better). Label the container “Colored Contaminant”
- 6) **Water Quality Standard** (1 cup for the class **OR** 1 cup for each group):
Fill a clear plastic cup (approx. 8 fluid ounces) with water and add 1 drop of “colored contaminant.”
- 7) **Water Quality Sample** (1 cup for the class **OR** 1 cup for each group):
Use a clear plastic cup identical to the cup for the “Water Quality Standard”. Label this cup “Water Quality Sample.” Students will fill the cup with a sample from the aquarium and compare it to the “Water Quality Standard.”

- 8) **Clear Contaminant** (5% solution of Ammonia)
(1 bottle for the class **OR** 1 bottle for each group)
For example, mix 5mL of Ammonia with 95mL water. You may need more depending on how many groups will play. Keep in a small container with an eye dropper **OR** keep in small dropper bottles (works better). Label the container “clear contaminant.”
- 9) **Dirt** (1 container for the class **OR** 1 container per group):
Fill a container or ziplock bag with fine dirt.
- 10) **Confetti** (1 bag for class **OR** 1 bag per group):
Fill a ziplock bag with confetti. This can be made with scrap paper and a hole- puncher. Smart & Final also sells confetti for approximately \$2 per bag.
- 11) **Secchi Disk** (1 for class **OR** 1 per group):
Make a miniature [Secchi disk](#) for measuring water turbidity. Run a sheet of [transparency film](#) through a photocopier to print a simple pattern or small printed message faintly onto the film. A copy of this pattern can be found at the end of this packet.
Cut a 2” circle containing the printed pattern out of the film and use a [thumbtack](#) to attach it to the zero-end of a wooden [ruler](#). It can also be attached to a [pencil](#) with 6 centimeters marked from the end where the circle is attached.
- 12) **Fishing Pole** (1 for class **OR** 1 per group):
Make poles from a [stick](#), a [piece of string](#), and a [paper clip](#) bent to form a “hook.” Tie a piece of string onto a wood stick. Tape the string to the wooden stick to make sure it stays. Tie a bent paper clip onto the other end of the string. Test the fishing pole yourself before the game to make sure the hook hangs at an angle with which you can catch a fish.
- 13) **Playing Cards (Role Cards)** (1 set for class **OR** 1 set per group):
Duplicate [role cards](#) on card stock and cut them out. Teachers can copy role cards on one color of color paper and have students divide up the cards **OR** teachers can copy sets of role cards on separate colors, dividing up the cards before students arrive.
- 14) **Money** (1 container of 10 pieces per student):
Put 10 pieces of [candy](#) “money” per student in paper cups, envelopes, or zip lock bags. (Smart & Final sells inexpensive hard/chewy wrapped candies – 250 pieces for approximately \$3).
- 15) **SM Bay Student Handout** (Secondary only): for class format, 1 per student **OR** 1 per group):
Copy “[Santa Monica Bay Student Handout](#)”
- 16) **SM Bay Game Materials/Playing Rules Card** (1 for class or 1 per group):
On card stock make a copy of the [SM Bay Game Materials/Playing Rules](#) Card
- 17) **Bank** (1 for teacher station):
Label a [container](#) “Resources Savings Bank” or some other appropriate title. You will use the bank when collecting the students’ payments.
- 18) **Litmus Paper** (1 for teacher station):
Order litmus paper (pH range 6-10) from a science supply company. **Students will come up to get litmus paper as they need it.**
Recommendation: Monitor how much paper students take. They have a tendency to use a lot more than needed.

**** Recommendation:** Keep all materials in 5-10 gallon container with lid for easy storage of materials, easy setup, and cleanup. Laminating role playing cards and materials/playing rules card will prolong the life of these materials and ensure repeated use.

LESSON PROCEDURE

- 1) Ask your students if they have ever been to beach before. If they have, ask them if they like to play in the ocean.
- 2) Introduce your students to Santa Monica Bay. Santa Monica Bay is a beautiful marine bay known for its excellent fishing, and spectacular scenery. Tell them that over the years, its small towns have become cities, many new businesses have moved into the area, and people are buying property along its shorelines. They, the students, will play the roles of many of the people who live, work and play in the watersheds that drain into Santa Monica Bay.
- 3) Point out each part of the setting and equipment for the Santa Monica Bay game. If you are using the small-group format, have each group check their materials against the list on the Santa Monica Bay Game Materials/Rules Card.
- 4) Have students fill the 5-10 gallon container(s) (SM Bay) with water (about $\frac{3}{4}$ full to avoid spilling). Have them place this near a SM Bay Map.
- 5) Have students fill the 11 plastic cups representing the different tributaries with water. These should be placed on the corresponding labels on the SM Bay Map.
- 6) Have students make the "Water Quality Standard" by filling the "Water Quality Standard" cup with water and adding 1 drop of "colored contaminant."
- 7) Review the game rules as a class making sure that each student understands them.
- 8) Explain and model each of the 3 water quality tests, noting the condition of Santa Monica Bay's water before the game begins:
 - a. Take a water sample from the aquarium in the clear "Water Sample" cup. Compare it to the "Water Quality Standard." Explain that if the sample is darker than the Standard it is considered to be contaminated.
 - b. Lower the Secchi disk into the water and see if you can see the disk 6 inches below the surface when you look down from above. Explain to the students that not being able to see the Secchi disk will result in certain consequences.
 - c. Place a few drops of water from the aquarium on a piece of litmus paper and compare it to the color key that came with the paper.
- 9) Teacher - Read card #1 to the class to show students how the cards should be read and acted upon. Explain that each student will do the same, following the order of numbers on the cards.
- 10) Distribute role cards among students. In the class format each student receives at least one card. In the group format, a set of all 33 cards is dealt out among the 4-6 students in each group. Have students note the number on the corner of each card. The playing order of the game follows the numbers. Have students read their cards silently and consider the decisions and/or actions they will take.
- 11) Distribute containers with 10 pieces of candy "money" to each student.
- 12) To play the game, each student, in turn, reads his/her role aloud to the class. Some cards will offer choices of action while others will not. If the card offers a set of choices

the student should only read the top part of the card out loud. The consequences should **NOT** be read before the group makes a decision. Once the card is read the student performs the action called for on the role card: polluting the water, paying money, sampling water, catching fish, calling for a class vote, etc.

- 13) Many issues will be raised as the cards are read. Have each student write these issues down on a piece of paper titled "Issues." These issues will be discussed after the game has been completed. Some issues may be familiar to students, but others might require explanation. (Walk around and answer any questions students may have.)
- 14) **Middle/High Classes:** After playing the game, have students discuss as a class the questions on the Santa Monica Bay student page.
- 15) Discuss the factors that affected their decision making processes. Discuss things students can do that will have a positive affect on the environment.
- 16) **Elementary Classes:** Heal the Bay has a "Coastal Cleanup Up" booklet with fun activities surrounding the issues brought up in this game. Free copies, including a teacher resource guide, can be ordered for your students from Heal the Bay (www.healthebay.org/).

Note: The Santa Monica Bay Game takes approximately 90 minutes to complete. If your class periods are shorter, you will need to interrupt the game and save all props for the next day. Students' cards and money can be saved in labeled envelopes; river cups and other materials can be stored on a cart, along with the aquarium. If you plan to do this activity with more than one class a day in the periods of less than 90 minutes, you will need an aquarium and river cups for each class.

SANTA MONICA BAY GAME: MATERIALS / PLAYING RULES

Objective: To see how our actions affect our local marine environment.

Each Lab Station should have (if something is missing, raise your hand):

- 1 Ziplock bag filled with dirt
- 1 Bottle of food coloring – “color contaminant”
- 1 Bottle of “clear contaminant”
- 1 Bag per student of candy money (10 pieces each)
- 1 Ziplock bag filled with confetti
- 6 Plastic fishes
- 1 Fishing Pole
- 11 Labeled cups filled with water (represent San Gabriel River, L.A. River, Verdugo Wash, Sepulveda Basin, Whittier Narrows Basin, Big Dalton Creek, Rio Hondo, San Jose Creek, Arroyo Seco, Ballona Creek, Malibu Creek).
- 2 Labeled cups (Water Sample and Water Quality Standard): Water Quality Standard should be filled with water and 1 drop of food coloring.
- 1 5-10 gallon container (represents the Santa Monica Bay)
- 1 Santa Monica Bay Student Handout (Middle/High School Only)
- 1 Santa Monica Bay Map
- 1 Tablespoon
- 1 Ziplock bag containing playing cards
- 1 Secchi Disk (transparency with faint writing attached to ruler)
- 1 Lined Sheet of Paper titled “Issues”
- 1 Towel

At the teacher lab station you will find:

- Litmus Paper (range 6-10)
- Money Jar

Game Rules:

- 1) If playing the game in groups, each lab station should have 4 to 6 players. Each player should have at least 5 role cards. Divide the remaining cards among yourselves.
- 2) Players should **not** show other players what their cards say.
- 3) Each player will read his/her card to the other players in your group. Read the story first. Some cards will give the other players a choice of actions. Have the other players make a choice **before** you read the consequences at the bottom of your card. After they have made their choice then tell them the consequences of their choice and what they need to do.
- 4) Use the cards in order, starting with number 1. The numbers are located in the upper left hand corner of each card.
- 5) On the “Issues” paper write down questions and concerns as they come up during the decision making process.
- 6) **Middle/High School Only:** Answer the questions on the “Santa Monica Bay Game” Handout.
- 7) If you are playing in a group, raise your hand when your group is done.

4. Non-point source is the term for sources of contamination that are hard to locate because they come from many places. Often they are caused by the behaviors of individuals. Backyard gardens are an example of a non-point source in this game.

a. What is another example of a non-point source of pollution used in the Santa Monica Bay Game?

b. What is an example of a non-point source of pollution in your own neighborhood?

5. In your opinion, what is the point, or message, of the Santa Monica Bay Game?

6. What is something you or your family could do to improve the water quality where you live?

ROLE PLAYING CARDS

1. I am a careless tourist from Newport Beach. I am driving through the Verdugo Wash area. I throw a burning cigarette out my car window. It starts a forest fire in the forest. Many trees are destroyed. With the trees gone, erosion is increased. Ashes and mud pollute the Los Angeles River. Mud also washes into the Santa Monica Bay.



Add 1 teaspoon of dirt to the Verdugo Wash.

Also add 1 teaspoon of dirt to Santa Monica Bay

2. I live near Bull Creek. My septic tank is old. It has been leaking into the river. This isn't a problem for me. The well I use for my water supply still has plenty of clean water. It's too bad, but people downstream have to live with my septic waste. It would cost me \$500 to repair my septic system. I could use this money for a vacation I'm planning to Acapulco. I must choose. Should I pay to have my system fixed? Or should I save my money and let it continue polluting the creek? **Make decision first as group before reading consequences.**



Either pay 1 piece of "money" OR
add 2 drops of color to the Sepulveda Basin and 4 drops to Santa Monica Bay.

3. I own a container ship. It is carrying products made in Japan to Europe where they will be sold. I need to refuel the ship in Santa Monica Bay. I can call a fuel barge to meet the ship just outside the bay or I can have the ship travel the extra distance to a fuel dock in Redondo Beach. It will cost my company \$10,000 more to take the ship all the way to Redondo Beach. In Redondo Beach, there is equipment to catch any fuel we spill. On the other hand, we could save money by using the barge. If we do, we might spill a little fuel near the bay. **Make decision first as group before reading consequences.**



If you choose to refuel at a fuel dock pay 5 pieces of "money." OR

If you decide to risk spilling some oil into Santa Monica Bay,
add 3 teaspoons of clear contaminant into Santa Monica Bay

4. I live in Marina del Rey and I work in Inglewood. I have a sailboat at a nearby marina and I take my boat out whenever I can take the time off from my job. At the marina there is a sanitary pumpout station where I could empty the holding tank from the toilet on my boat, but I don't want to bother making a special trip to empty the tank. I just wait to flush it when I get out on the water. It saves me lots of time.



Add 3 drops of color into Santa Monica Bay.

5. I live near Venice. When I change the oil in my truck I just let it run onto the ground. It probably seeps through the soil and pollutes the water in the bay. I know that waste oil can be recycled at a service bay nearby, but I'm too lazy to do it.



Add 4 drops of color to Santa Monica Bay.

6. I like to keep my town looking nice. I use lots of fertilizer, weed killer and pesticides. I can't imagine what my world would be like if I ever had to stop using these chemicals. I suppose it's all washing into Ballona Creek and out into the bay.



Add ½ teaspoon of clear contaminant into Ballona Creek.

Also add 1 teaspoon of clear contaminant to Santa Monica Bay.

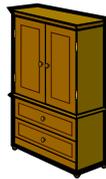
7. I have a dairy farm 'way north of Santa Clarita. The creeks nearby run into the lake behind Hansen Dam. I know I really shouldn't let my cows walk through the creek. Their manure gets into the water. Their feet cause the banks to erode. But it's easier and cheaper for me to let the cows get their water from the creek than to pump water to the pasture. If I decide to protect the creek it will cost me \$1,500 for fencing and watering systems. That's a lot of money! **Make decision first as group before reading consequences.**



Pay 2 pieces of "money" OR

add 2 drops of color to the Los Angeles River and 6 drops of color to Santa Monica Bay

8. I own a small business repairing furniture in Reseda. I use a lot of chemicals like epoxy and paint strippers. They are very toxic to people. They must be hazardous to the environment too. It is illegal to dump them into the ground. On the other hand it will cost me \$200 each month to have them taken away to a hazardous waste disposal site. **Make decision first as group before reading consequences.**



If you decide to have these chemicals disposed of properly, pay 2 pieces of "money," OR

if you just dump them on the ground, add 2 drops of color to the Los Angeles River and 2 drops to the Bay.

9. I have a beach house in Hermosa Beach. My friends and I hang out at the beach all summer long. We have parties with lots of food and drinks. Sometimes we are careless with our trash. Lately I've started seeing chunks of styrofoam and plastic everywhere. Doesn't this stuff ever break down?



Add a pinch of confetti to Santa Monica Bay.

10. I am a developer. I make money by building and selling condominiums. People like to live by the water. I am interested in filling in some of the wetlands at the mouth of Ballona Creek so I can build some more condos there. If I do this it will take away habitat for birds and other wildlife. **Make decision first as group before reading consequences.**



If you choose to build, reach into the Bay and remove 1 fish, OR
if you decide to protect the wildlife, pay the bank 3 pieces of “money.”

11. I work for an agricultural company. The company owns land all along the west side of Santa Monica. We often use herbicides to keep unwanted growth from competing with what we want to grow. If we stop using these we would have fewer crops to harvest and we would make less money. But herbicides wash into the water and pollute the bay. We must decide. Should we continue using herbicides or give up some profits? **Make decision first as group before reading consequences.**



If you choose to stop using herbicides, pay 5 pieces of “money,” OR
if you decide to continue to use herbicides, add 1 teaspoon of clear contaminant to the Los Angeles River and 1 teaspoon to the San Gabriel River, AND add 3 teaspoons of clear contaminant to Santa Monica Bay.

12. I'm a commercial fisherman. The engine on my boat leaks oil into the bilge. Sometimes water collects in there too. To stay afloat I have to pump out this oily mess every so often. If the Coast Guard spotted my boat making an oil slick, I could be fined \$5,000. Before I start the bilge pump, I sometimes pour detergent into the oily bilge water. This hides the oil so you can't see it but of course it is still there. It's against the law to do this, but I sure don't want the Coast Guard catching me with an oil slick behind my boat!



Add 2 teaspoons of clear contaminant to Santa Monica Bay.

13. I work in the city of Torrance. I help operate the sewage treatment plant. A new secondary treatment plant would pollute the water less than our plant does now. We wonder if the citizens in our town would be willing to pay extra money to build a secondary treatment plant. **Make decision first as group before reading consequences.**



Many communities around Santa Monica Bay face this problem, so take a group vote. Will these citizens agree to tax themselves 1 piece of “money” *each* to build better sewage treatments plants around the Bay?

If the majority votes “yes,” each person in the group must pay the bank 1 piece of “money.” If the group votes “no,” add 10 drops of color to Santa Monica Bay.

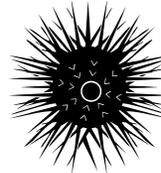
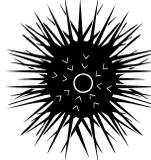
14. I raise fruits and vegetables on my small farm near Puddingstone Reservoir. I use commercial fertilizers and pesticides on my crops. Some of these chemicals wash into the river. I know some farmers have switched to organic farming methods. I wonder if they make as much money as I do by using these chemicals? **Make decision first as group before reading consequences.**



If you decide to farm organically, pay 2 pieces of “money” for losses.

If you decide against it, add ½ teaspoon of clear contaminant to the Whittier Narrows Basin and 2 teaspoons to Santa Monica Bay.

15. I live close to the Palos Verdes Peninsula. I like to go to the tidepools below the cliffs and look for sea urchins in the tidepools. If the water becomes too polluted, the urchins and other animals in the pools may die and it won't be fun to visit the tidepools any more.



Take a water sample from the aquarium. Use litmus paper to test the water.

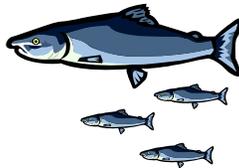
If it tests 8 or higher on the color scale, the water is contaminated. You may not harvest urchins.

16. I live near Chicago, Illinois. I love to scuba dive. I come to dive in Santa Monica Bay because it has such interesting underwater life. If the places where I like to dive become too polluted I won't see as many interesting creatures.



Use the Secchi disk to test the water. Lower it into the aquarium and look down at it. If you can't see the edge of the circle when it is 6 inches below the water surface, you won't come back to dive in the Bay.

17. I am the chief biologist for a fish hatchery on Malibu Creek. We hatch fish and raise them in water from the creek. The fish are released into the creek when they are big enough to live on their own. If the water is too polluted the young fish won't survive. Fewer fish will make it to the Bay.



Take a water sample from the creek. Compare it with the water quality standard. If it is darker than the standard, the fish will not survive. Pay 3 pieces of "money" and look for another job.

If it is lighter, keep your job and add 2 fish to the Bay.

18. I work for a power company. We want to put a dam on the Los Angeles River. Right now all that water is just going to waste. It could be generating cheap power. People and business would move into the Santa Monica Bay area. A few kinds of animals might be hurt, but wouldn't we rather have a strong economy? **Make decision first as group before reading consequences.**



Have the group vote on whether to dam the river.

If the group votes yes, remove half of the water from the river. Pour the water out into a sink or waste bucket. Reach into the Bay and remove 2 fish.

If the group votes not to dam the river, turn off 1 light in the classroom.

19. I work for a logging company. We harvest timber outside of Angeles Crest. The rainy season has started. We have been cutting down trees on steep slopes. Sometimes we work too close to the creeks and streams. Erosion and mudslides are carrying large amounts of silt into the streams. **Make decision first as group before reading consequences.**



Put 1 teaspoon of dirt into the Big Dalton, Rio Hondo and San José Creeks.
Put 4 teaspoons of dirt into the Bay and stir gently.

20. I just bought a nice little place to live in the hills. It's close to the Thompson Creek Dam. I've decided to test the water in my well. I want to make sure it's safe for my family.



The water behind the dam and your well are connected. Water can move slowly through the ground between them. Take a sample from the water behind the dam (San Jose Creek). Compare it with the water quality standard. If it is darker than the standard your water is polluted. It will cost you \$1,000 to connect with a city water supply.

Pay 3 pieces of "money."

21. I manage a marina in Redondo. I want to dredge the channels, but the mud on the bottom is contaminated. It would cost \$1,000,000 to ship the mud to a toxic waste disposal site. I would have to charge more money for boats to stay in the marina. I want permission to dump the mud out in Santa Monica Bay. Then more ships can use the harbor, I won't have to spend a lot of money, and I will create more jobs.

Ask the group to vote on whether you will be allowed to dump the mud into the Bay. If the group votes "Yes," add 8 drops of color to the Bay. Choose 5 classmates to receive high paying jobs in the marina. These people each receive 1 piece of "money" from the bank. **(Don't tell them before they vote!)**



If the group votes "No," pay 5 pieces of "money" to dispose of the mud safely.

22. I just bought a sailboat. I need to have it hauled out so I can repaint the bottom. I will have to scrape all the old paint off. The paint has copper and other toxic chemicals in it to keep barnacles from growing on the bottom of the boat. When I scrape the old paint off, it falls on the ground. From the ground it washes right back into the water. I could decide to catch all the old paint and dispose of it properly. **Make decision first as group before reading consequences.**



Pay 1 piece of “money” for a tarp to go under your boat OR add 1 teaspoon of clear contaminant to the Bay.)

23. I run a resort in Malibu. People come from all over the country to spend their vacations here. They sail, fish, and have a good time in the water. If the water is polluted, people will stop coming here. I’ll go out of business.



Use the Secchi disk to test the water. Lower it into the water.

If you can’t see it 6 inches from the surface, turn in all your “money.” You are out of business.

24. I manage a chemical plant near San Pedro. Our refining process pollutes the air and water of the bay. To clean up our factory would cost us \$1,000,000. If we have to pay that much, we will have to cut back our business. Two hundred and fifty people will lose their jobs. I have to choose! Should I stop polluting but put workers out of a job? Or should I continue to operate the way we always have? **Make decision first as group before reading consequences.**



Pay 5 pieces of “money” OR add 3 teaspoons of clear contaminant to the Bay.

25. I am a commercial fisherman. I catch halibut near San Pedro. I'm worried that the fish I catch may contain toxic materials at concentrations higher than the federal standards for safety. If they do, I cannot sell them to the public. I will not be able to make my boat payments. I will have to go out of business.



Take a water sample from the Bay. Compare it with the standard color.

If it is darker than the standard, the fish are contaminated. Turn in all your "money" and go out of business.

If the water is lighter than the standard, take 1 minute to try to catch some fish.

26. I am an executive for a shipping company. We ship a lot of commercial items to the Orient, including oil. Some people say we should replace our old ships with new ones. The new ships would have double hulls, with two layers of steel. They say this could prevent oil from leaking out of the ship in case of an accident. It would cost us millions of dollars. We are not required to do this by law but it would protect the plants and animals in the ocean. Of course we would have to pass the cost onto our customers! **Make decision first as group before reading consequences.**



Take a group vote. Would the people be willing to pay more to reduce the chance of oil spills? If a majority agrees, each person pays 1 piece of "money."

If they vote "No", add 15 drops of color to the Bay.

27. I raise crabs at the end of Palos Verdes. I sell my crabs to restaurants all around the Bay. If the water in the bay becomes too polluted, the Health Department will close the area to crab harvesting. If I cannot sell my crabs, I will go out of business.



Take a water sample from the Bay. Use litmus paper to test the water. If it tests higher than 8, your crabs are contaminated. Turn in all your "money" and go out of business.

28. I represent a manufacturing company located on the Los Angeles River. We use 400,000 gallons of clean water from the river every day. After we use the water we return it to the river, but now this water is polluted with chemicals. We could clean up our process so that we don't pollute the river, but it would cost \$1,000,000. **Make decision first as group before reading consequences.**



If you decide to continue polluting the river, add 2 drops of color to the Los Angeles River and 8 drops to the Bay.

If you decide instead to clean it up, pay 5 pieces of "money."

29. I live in Colorado and I come to Santa Monica for my vacations. I pay for a charter boat to take me fishing in the Bay. I also spend money to stay in hotels and I eat in restaurants while I'm in town. If the water is polluted I can't catch fish and I will go somewhere else when I have time off.



Try to catch fish. One minute will be allowed for fishing.
If a fish is caught, every student receives one piece of "money."

30. I live in Burbank. I can't afford a car, so every weekend I take the bus to the beach to go fishing. I fish for croaker off the piers. I always take the fish I catch home to eat. Is the water so polluted that the fish I'm eating are contaminated?



Take a water sample from the Bay. Use litmus paper to test the water.
If the water tests less than 8 you are still healthy.

If it tests higher than 8 you will get cancer from eating contaminated fish.
Pay 10 pieces of "money" for your medical expenses and die.

31. I am a pollution control agent. We have laws to protect the environment. Sometimes they are violated. It takes people like me to enforce the law and take violators to court. It takes money to pay my salary so I can do this work. Many people complain about taxes. Would you tax yourself so that there will be money to hire people like me to enforce our clean water laws?



Take a vote.

If the group votes to tax themselves and hire you, everybody pays one piece of "money".

You may issue a fine to as many as 3 people who have polluted during the game. Charge these violators 1 piece of "money" each.

(Naturally you won't tell them this before they vote!)

32. I live in an apartment near the Arroyo Seco in Pasadena. I like to take my dog Sparky for walks on trails in the Arroyo. I know that I should clean up after Sparky when he goes to the bathroom. If I don't, bacteria in his poop can wash through the Arroyo to the Los Angeles River and end up in the ocean. People and animals swimming in the ocean could get sick from those bacteria. But I don't *want* to pick up his poop – it's icky!



Drop 2 Tootsie Rolls into the Arroyo Seco and 1 Tootsie Roll into Santa Monica Bay.

33. I am a sea bass living in Santa Monica Bay. I share this watershed with you. If my habitat is polluted or destroyed, animals like me are in big trouble. Will I be able to survive? Will you?



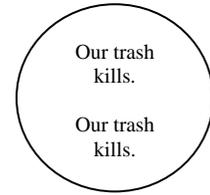
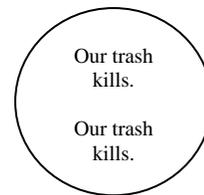
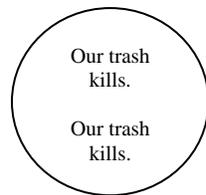
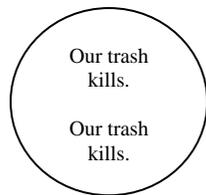
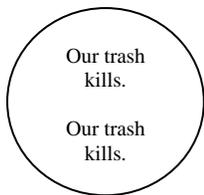
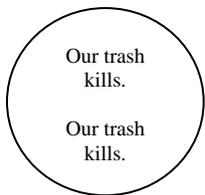
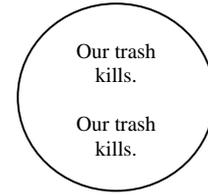
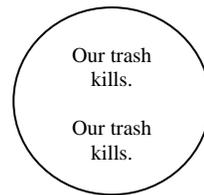
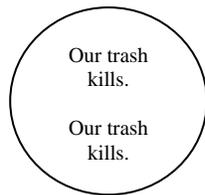
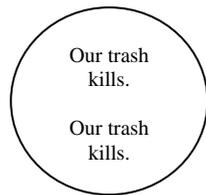
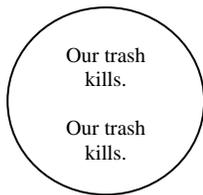
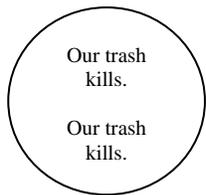
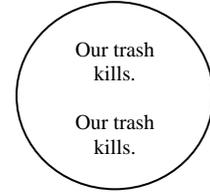
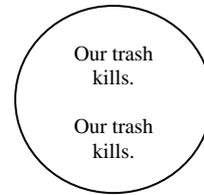
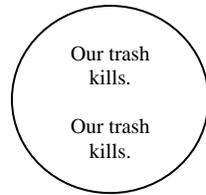
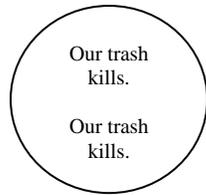
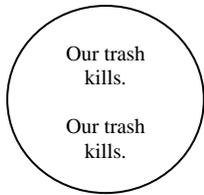
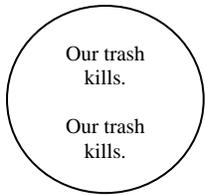
Take a water sample from the Bay. If it is darker than the standard, remove 2 fish from the Bay.

If it is lighter, add 2 fish.

There were 6 fish at the beginning of the game. How many are left?



SECCHI DISK TEMPLATE



SANTA MONICA BAY GAME VOCABULARY BANK

Bilge Pump – a pump that removes bilge (the rounded part of a ship’s hull) water from a boat.

Concentration - The amount of a specified substance in a unit amount of another substance.

Contaminant – a substances that mixes with another substance making it unclean.

Erosion - The process by which water, ice, wind, or gravity moves fragments of rock and soil.

Fecal Waste – Poop.

Fertilizer – Any of a large number of natural and synthetic materials, including manure and nitrogen, phosphorus, and potassium compounds, spread on or worked into soil to increase its capacity to support plant growth.

Fuel Barge - A long, large, usually flat bottom boat for transporting fuel that is generally un-powered and towed or pushed by other craft.

Harvest - The act or process of gathering a crop.

Herbicide - A chemical substance used to destroy or inhibit the growth of plants, especially weeds.

Hull - The frame or body of a ship, exclusive of masts, engines, or superstructure.

Litmus - A water-soluble blue powder derived from certain lichens that changes to red with increasing acidity and to blue with increasing basicity.

Litmus Paper - An unsized white paper impregnated with litmus and used as a pH or acid-base indicator.

Non-Point Source Pollution - Sources of contamination that are hard to locate, because they come from many places.

Organic Farming – A farm that does not use pesticides, drugs, hormones, or synthetic chemicals to grow crop or raise animals.

Pesticides - A chemical used to kill pests, especially insects.

pH - A measure of the acidity or alkalinity of a solution, numerically equal to 7 for neutral solutions, increasing with increasing alkalinity and decreasing with increasing acidity. The pH scale commonly in use ranges from 0 to 14.

Point Source Pollution – Sources of contamination that come from a single place.

Pollution – Harmful materials that is added to the water, land, or air.

Refinery - An industrial plant for purifying a crude substance (raw or natural), such as petroleum or sugar.

Santa Monica Bay – The area of ocean between Point Vicente (Palos Verdes) and Point Dume (Malibu).

Secchi Disk – An instrument used to measure the visibility (how far someone can see) of the water.

Septic Tank – A tank that holds human waste.

Sewage - Liquid and solid waste carried off in sewers or drains.

Tidepool – A pool of water that collects in rocky hollows at low tide.

Toxin – A poisonous substance.

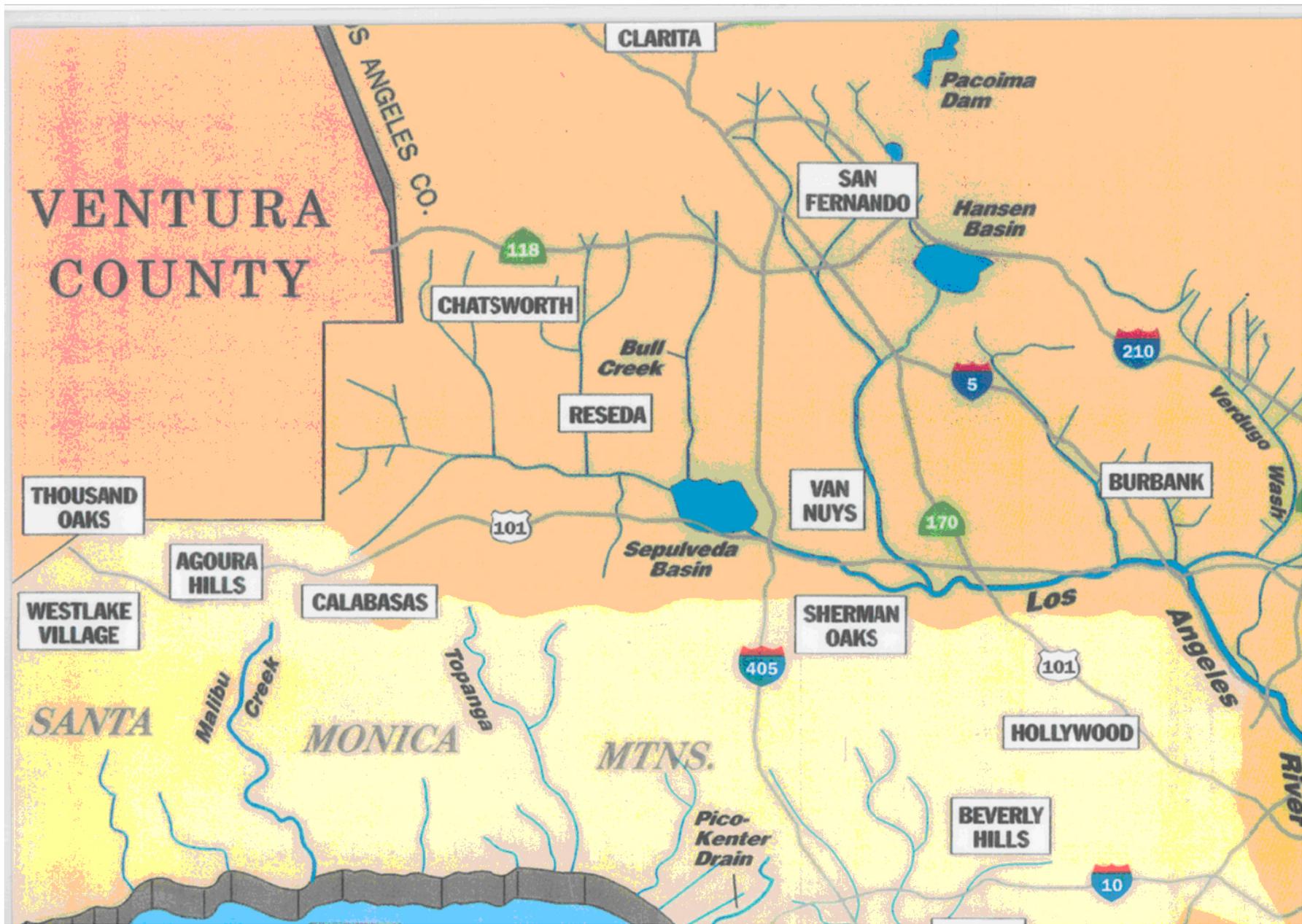
Violate - To break or disregard (a law or promise, for example).

Waste Disposal - The act or process of getting rid of waste.

Water Quality Standard – The normal characteristics of the water source.

Water Sample – A portion of the water taken to compare to the water quality standard.

Watershed - The region draining into a river, river system, or other body of water.



VENTURA COUNTY

LOS ANGELES CO.

CLARITA

SAN FERNANDO

Pacoima Dam

Hansen Basin

118

CHATSWORTH

Bull Creek

RESEDA

5

210

Verdugo Wash

BURBANK

170

VAN NUYS

Sepulveda Basin

101

THOUSAND OAKS

AGOURA HILLS

CALABASAS

SHERMAN OAKS

Los

Los Angeles River

WESTLAKE VILLAGE

SANTA

Malibu Creek

MONICA

Topanga

MTNS.

Pico-Kenter Drain

405

HOLLYWOOD

101

BEVERLY HILLS

10





