Cabrillo Marine Aquarium
Lesson Plan

Grade Level: Second Grade

Title: Eggs along the Shore

Objective: Students will be able to identify the different stages of the grunion life cycle. They will understand that grunion reproduce differently than most other types of fish but that all grunion reproduce in the same manner. Students will be able to note similarities and differences between grunion and other types of fish.

California Science Standards: **2nd:** 2a, 2b, 2c

Time to Complete: 50 minutes

Materials Provided by CMA: ***Worksheet: California Grunion Life Cycle Coloring Sheet, Graphic: California Grunion Life Cycle,*** (the following items only provided with CMA's Ocean Discovery Kit: ***Photo***, Grunion Life Cycle Magnets, Grunion Life Cycle Banner, Preserved Grunion and Other Fish, Preserved Grunion Eggs)

Materials Provided by Teacher: Crayons, scissors, glue/tape, magnetic white board

Vocabulary: Grunion, juvenile, larva, life cycle, plankton, spawn, tides

Teacher Preparation:

- Make a copy of the Grunion Life Cycle coloring sheet for each student.

Background Information:

California grunion are small silvery fish found only on the coast of southern California and northern Baja California. They have bluish-green backs with the rest of the body a shiny-silver color. Their average length is between 127 and 152 mm (5 - 6 inches). This fish belongs to the family Atherinidae, commonly known as silversides. Other common atherinids found in California are the jacksmelt, *Atherinopsis californiensis* and the topsmelt, *Atherinops affinis*.

Along southern California's sandy beaches, from February through September, one of the most remarkable life cycles in the ocean is completed; the California grunion comes ashore to spawn. The spawning is tied very closely to the tides. Along the Pacific coast of North America the two daily high tides vary in height, and the higher of the two occurs at night during spring and summer months. Grunion spawn only on these higher tides, about an hour after the tide has started to recede. Since waves tend to erode sand from the beach as the tide rises and deposit sand as the tide falls, spawning at this time helps keep the eggs from getting washed out of the sand. The most ideal conditions occur on the 3rd, 4th and 5th

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nights after the highest tide, which occur on the nights of the full and new moon. The eggs develop and are ready to hatch in about 10 days, which is the length of time it takes for the tides and waves to erode enough sand to free the eggs.

Spawning runs typically begin with one or two fish swimming in with a wave and occasionally stranding themselves on the beach. Gradually, more and more fish come in with the waves and by swimming against the out-flowing wave strand themselves until often the beach is covered by a blanket of grunion. In the presence of males, a female will twist and turn and bury herself about half her body length (51-76 mm/2-3 inches) into the sand, tail first. One or two males will curl around her exposed head and pectoral fins. At this time, she will discharge 2,000 – 3, 000 eggs. The male then emits his milt, which runs down the sand and fertilizes the eggs. The female then frees herself from the sand and both return to the ocean with the next wave. Should they not be washed back to the water immediately, the grunion can stay out of the water for about 30 minutes.

Larger females are capable of producing up to 3,000 eggs every 2 weeks. As the mature eggs are deposited in the sand, another group of eggs are developing that will be spawned during the next series of runs. This cycle continues throughout the season. During the early part of the season only older fish spawn, but as the season progresses fish hatched the previous year come into spawning condition and join the runs. Fish of all ages will spawn by April and May.

Spawning normally starts about 20 minutes after the first fish appear on the beach. Typically a run lasts 1 to 3 hours, but the number of fish on the beach at any given moment can vary from none, to thousands. Peak activity is reached about an hour after the start of the run and lasts from 30 to 60 minutes. Finally, when the tide has dropped a foot or more, the run slackens and then stops as suddenly as it started. No more fish will be seen that night, and they will not appear again until the next night or the next series of runs.

Egg Development and Hatching
While the eggs are initially deposited 51-76 mm (2-3 inches) below the surface of the sand, the outgoing tide and waves deposit sand onto the beach, covering the eggs to a depth of 203 – 406 mm (8-16 inches). The eggs are initially a bright orange in color, but slowly change as the embryo develops and uses the up yolk. By 4 days, you can see the eyes, and the baby is fully developed by day 10. At this point the egg is ready to hatch, but it needs the agitation of waves to complete the hatching cycle. Once the eggs are washed out of the sand, the babies hatch in about 2-3 minutes and swim away with the currents.

At this point, they become part of the ocean's plankton population. Many of them are consumed by other fish and plankton eaters, but some always escape their predators and grow to adulthood. They are adults by the time they are 1 year old, ready to come back on shore and reproduce. Adult grunion will live to be about 4 years old.

Lesson Outline:

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1. As an introduction to the topic, ask the students if they know where fish come from. Discuss that many fish come from eggs laid by their mother. Tell the students that these fish go from egg to larva to juvenile and finally to adult. This is called a Life Cycle.
2. Introduce the students to the grunion. Discuss some of its life history (from Teacher Background) and life cycle using the banner and preserved grunion specimens.
3. Share the following information about some of the characteristics of the different stages.
    - Eggs(embryo): In this stage, the grunion develop their brain, eyes, heart and other major internal organs. The bright orange yolk sac slowly shrinks as the embryo grows over the 10 days of development in the egg stage.
    - Larva: Larval (baby) grunion are very well developed and large (6.5 – 7 mm) compared to other fish larvae. They are very active with eyes and jaws fully functional. They are capable of feeding immediately, but usually won't feed until the second day, and can live off their remaining yolk sac for several days before needing to feed. They spend about 40 days at this stage, drifting with the currents as part of the ocean's plankton.
    - Juvenile: Juvenile grunion are strong enough swimmers to no longer be considered plankton, but are now free swimming fish. They continue to feed on the small creatures in the plankton and grow to about 130 mm(5 inches) in their first year.
    - Adult: Grunions are adults at 1 year of age. This is when they will come back to the beach, mate, and start the whole cycle over again!
4. Pick some students to put the life cycle magnets on the white board (including the arrows).

Lesson Wrap-up:

Pass out the Grunion Life Cycle coloring sheets and have the students color them in and fill in the names of each step in the cycle.

Further Student Exploration:

- Plan a field trip to Cabrillo Marine Aquarium during Grunion Season (March-June) to actually hatch larval grunion.

References:

- Cabrillo Marine Aquarium Grunion Page
  http://www.cabrillomarineaquarium.org/exhibits/marine-life.asp?id=4
- Introduction to Grunion Biology
  http://grunion.pepperdine.edu/IntroductionToGrunionBiology.pdf
- California Grunion Facts and Runs
  http://www.dfg.ca.gov/marine/grunionschedule.asp

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