



Lesson Overview:

By completing a mock monitoring experiment simulating a tide pool environment, students will define and discuss the principle of species richness, become familiar with data collection procedures paralleling on-site field trip monitoring activities, collect and compile data, identify tide pool invertebrate and algae species, and make a scientific hypothesis.

Finding Species Richness

Subjects:

Species Identification, Critical Thinking, Ecology

Preparation:

1. Photocopy pages 3–5, *Tide Pool Diversity Cards* #one, two and three; Cut out squares (20/page) from each card - Do not mix images between the three cards.
2. Photocopy page 6, *Tide Pool Richness Data Collection Sheet*, and *Wealthy Tide Pools Scavenger Hunt*, page 7 - 8, (one for each workgroup).

Materials:

- Copies of pages 3-8, as instructed above.
- Ample classroom space to set up three stations or "Mock Tide Pools."

Time:

30 - 60 minutes

State of Oregon - Education Standards

- 6.2 *Interaction and Change*
 - 6.2L.2
- 6.3 *Scientific Inquiry*
 - 6.3S.1
 - 6.3S.2
 - 6.3S.3
- 7.3 *Scientific Inquiry*
 - 7.3S.1
- 8.2 *Interaction and Change*
 - 8.1L.1
- 8.3 *Scientific Inquiry*
 - 8.3S.1

Ocean Literacy Standards

- 5a *Some major groups are found exclusively in the ocean.*
- 5h *Tides, waves and predation cause vertical zonation patterns*

Set up (prior to class)

1. Make photocopies and preparation as instructed in the sidebar.
2. Set up three mock tide pools in different parts of the classroom or other appropriate area. Use the cut out squares from each Tide Pool Diversity Card to create your mock tide pool.

The object of the mock tide pools is to teach students monitoring protocols while defining species richness and zonation. It is intentionally designed to not accurately find species specific to each zone until students explore the intertidal zone.

3. Keep sets separate in different areas of the room, in an area approximately one meter squared (representative of a quadrat).

Defining Species Richness

1. Ask all students wearing blue jeans to stand on one side of the room, (alternatively select another article of clothing shared by the majority of students)
2. Have all other students (not wearing blue jeans, etc.) to stand on the other side of the room.
3. Compare and contrast the two groups. Which has more diverse clothing? Are there other characteristics that make one group more diverse? Use the discussion in #3 as a lead to talk about biodiversity.
4. Discuss the two ways scientists measure biodiversity: abundance and species richness (For the purpose of this program, we will be measuring biodiversity using species richness).
5. Individually or in workgroups, ask students to create an experiment/ monitoring protocol to test for Species Richness.

Measuring Biodiversity Species Richness

The number of different species present in a given area.
(Count each species only once)

Species Abundance

The total number of individuals of a species measured in a given area.
(Count everything)

| Tide Pool Richness Data Collection Sheet | | | | | |
|--|--------------------------------------|-----------------|----|----|----|
| Tide Pool Organism | Common name | Scientific name | #1 | #2 | #3 |
| corn Barnacles | <i>Balanus glandula</i> | | | | |
| greggating Anemone | <i>Anthopleura elegantissima</i> | | | | |
| Jack Pine | <i>Neorhodomela larina</i> | | | | |
| California Mussel | <i>Mytilus californianus</i> | | | | |
| coralline Algae | <i>Acropora</i> spp. | | | | |
| Leaf Green Anemone | <i>Anthopleura xanthogramma</i> | | | | |
| roseate Barnacles | <i>Pilayella littorata</i> | | | | |
| limbbed Chiton | <i>Cryptochiton stelleri</i> | | | | |
| ermine Crab | <i>Pagurus berhardus</i> | | | | |
| Redstart Algae | <i>Maczella comucopiae</i> | | | | |
| limpet | <i>Acmaea mitra</i> | | | | |
| chryse Star | <i>Platier ochraceus</i> | | | | |
| purple Sea Urchin | <i>Strongylocentrotus purpuratus</i> | | | | |

Finding Species Richness

Tide Pool Monitoring Step by Step

1. **Survey your quadrat** slowly and carefully while observing and recording the presence of any and all species. Count both the listed (pictured) species, as well the “Other Species.” you are unable to identify. Count each species only once.
2. **Rotate to the next station** approximately every 5-10 minutes, or as directed.
3. **Repeat step 1** until your team records data from each station.
4. **Record and compile your data:** compile data by totaling the number of different species in each of the other three samples. Don't forget to add data from “Other Invertebrates” and “Other Algae.”
5. **Analyze and discuss** the data you have collected. *Which tide pool area had more species? What does this tell you as a scientist? If you had to manage a tide pool area, how could you use this data?*

6. Divide the class into smaller workgroups of approximately 5 students/group (you may have to duplicate the set up to accommodate larger class sizes).

7. Hand out copies of the *Tide Pool Richness Data Collection* sheet, both pages of the *Wealthy Tide Pools—Scavenger Hunt*, one to each work group. Option: copy and distribute *Monitoring for Tide Pool Richness - Instructions*.

8. Briefly review student's ideas for how to test for species richness. Explain the importance of scientific monitoring.

9. Instruct students on how to collect data and assign each workgroup to a mock monitoring site.

10. Allow approximately 5- 10 minutes for each group to collect data from mock tide pools, designating when to rotate between stations.

11. Compile and review data. Which mock tide pool was the most species rich? What implications might this information have for scientists or park managers?

12. Lead students in deducing tidal zonation: tide pool, mid-tide, and high-tide. Define and discuss the different tidal zones.

13. Ask each student, individually or in workgroups, to make a hypothesis as indicated on the Richness Data Worksheet.

14. Students will have the opportunity to test their hypothesis at the time of their visit.

Hypothesis

In which zone will you find the most Species Richness?

Circle One: Low-Tide Middle-Tide Tidepool

- Extensions:**
- ◆ Define and discuss tidal zones and their differences.
 - ◆ Ask each student to research and report on an assigned species.
 - ◆ Critter-cal Thinking, lesson plan from Yaquina Head Outstanding Natural Area





Tide Pool Richness Data Collection Sheet

| Tide Pool Organism <small>Common name, <i>Scientific name</i></small> | | Tide Pool | Mid-Tide | High-Tide | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
|---|---|-----------|----------|-----------|---|--|--|----|-----|------|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|
| Thatched Barnacle, <i>Semibalanus cariosus</i> |  | | | | Other Species (Invertebrates) <table border="1" style="width: 100%; border-collapse: collapse; margin-top: 5px;"> <thead> <tr> <th style="width: 33%;">TP</th> <th style="width: 33%;">Mid</th> <th style="width: 33%;">High</th> </tr> </thead> <tbody> <tr><td style="height: 30px;"></td><td></td><td></td></tr> <tr> <td style="background-color: #e0e0e0;"></td> <td style="background-color: #e0e0e0;"></td> <td style="background-color: #e0e0e0;"></td> </tr> </tbody> </table> | | | TP | Mid | High | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
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| Aggregating Anemone, <i>Anthopleura elegantissima</i> |  | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Black Pine, <i>Neorhodomela larix</i> |  | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| California Mussel, <i>Mytilus californianus</i> |  | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Coralline Algae, <i>Calliarthron spp.</i> |  | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Giant Green Anemone, <i>Anthopleura xanthogrammi</i> |  | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Gooseneck Barnacle, <i>Pollicipes polymerus</i> |  | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Gumboot Chiton, <i>Cryptochiton stelleri</i> |  | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Hermit Crab, <i>Pagurus spp.</i> |  | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Iridescent Algae, <i>Mazzaella splendens</i> |  | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Limpet, <i>Lottia spp.</i> |  | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Ochre Star, <i>Pisaster ochraceus</i> |  | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Purple Sea Urchin, <i>Strongylocentrotus purpuratus</i> |  | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Sculpin, <i>Oligocottus maculosus</i> |  | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Sea Lemon Nudibranch, <i>Anisdoris Nobilis</i> |  | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Sea Lettuce, <i>Ulva lactuca</i> |  | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Sunflower Star, <i>Pycnopodia helianthoides</i> |  | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Rockweed, <i>Fucus gardneri</i> |  | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Turban Snail, <i>Chlorostoma funebris</i> |  | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Whelk, <i>Nucella spp.</i> |  | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| TOTAL SPECIES COUNT (<i>including "Other Species"</i>) | | | | | Other Species (Algae) <table border="1" style="width: 100%; border-collapse: collapse; margin-top: 5px;"> <thead> <tr> <th style="width: 33%;">TP</th> <th style="width: 33%;">Mid</th> <th style="width: 33%;">High</th> </tr> </thead> <tbody> <tr><td style="height: 30px;"></td><td></td><td></td></tr> <tr> <td style="background-color: #e0e0e0;"></td> <td style="background-color: #e0e0e0;"></td> <td style="background-color: #e0e0e0;"></td> </tr> </tbody> </table> | | | TP | Mid | High | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
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|---|---|
| Student Name: Ranger Name: Chaperone Name: | <p><u>Hypothesis</u></p> <p><i>Which zone will have the most Species Richness?</i></p> <p>Circle One: <u>Tidepool</u> <u>Mid-Tide</u> <u>High Tide</u></p> |
|---|---|

Wealthy Tide Pools - Scavenger Hunt # 1



GIANT GREEN ANEMONE, *Anthopleura xanthogrammi*



AGGREGATING ANEMONE, *Anthopleura elegantissimi*



THATCHED BARNACLE, *Semibalanus cariosus*



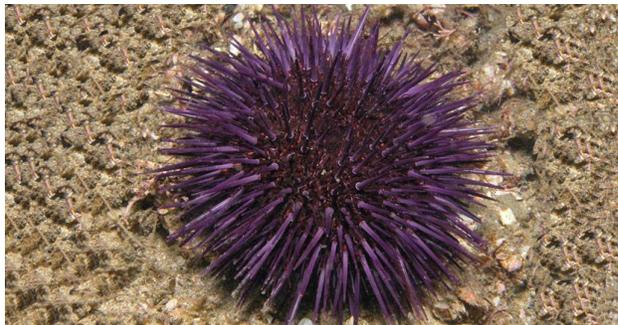
GOOSENECK BARNACLE, *Pollicipes polymerus*



OCHRE STAR, *Pisaster ochraceus*



SUNFLOWER STAR, *Pycnopodia helianthoides*



PURPLE SEA URCHIN, *Strongylocentrotus purpuratus*



SCULPIN, *Oligocottus maculosus*



GUMBOOT CHITON, *Cryptochiton stelleri*



SEA LEMON NUDIBRANCH, *Anisdoris nobilis*

Wealthy Tide Pools - Scavenger Hunt # 2



HERMIT CRAB, *Pagurus* spp.



TURBAN SNAIL, *Chlorostoma funebris*



LIMPET, *Lottia* spp.



WHELK, *Nucella* spp.



CALIFORNIA MUSSEL, *Mytilus californianus*



CORALLINE ALGAE, *Calliarthron* spp.



ROCKWEED, *Fucus gardneri*



IRIDESCENT ALGAE, *Mazzaella splendens*



SEA LETTUCE, *Ulva lactuca*



BLACK PINE, *Neorhodomela larix*