Wealthy Tide Pools

Intertidal Species Richness and Ecology Program for 6th - 8th Grades

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BLM

Yaquina Head Outstanding Natural Area

Acknowledgements

Wealthy Tide Pools was collaboratively developed by student interns under the direction of the Education Program Coordinator, Roy Simpson, from 2010 through 2012. Since that time, thousands of students have participated in what has become Yaquina Head's most popular program. It would not have been possible without input from the following interns who put so much time and effort into developing piloting and improving this program.

- To Chelsea Rider for co-creating and piloting the initial program outline and activities.
- To Christopher Dunham and Jenna Halsey for improving the program, reformatting the written elements, and further developing pre- and post-visit activities.
- To Meagan Campbell, Amanda Collier, Colby Davidson, Ashley Jamison, Paul Odomirok, Megan Pros, Hanna Sarver, Meghan Suba, Samantha Starns, and Tara Whalen.

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Wealthy Tide Pools

Objectives:

- Recall and discuss tide pool rules and explain their importance
- Identify 10 to 20 tide pool organisms (invertebrates and algae)
- Define and discuss "species richness."
- Apply mathematics with real-life activities through collecting, compiling and graphing data.
- Conduct scientific monitoring to determine species richness in three different tide pool zones.
- Create and test a hypothesis: Which tide pool zone is the most species rich?
- After quietly observing a natural system, recall personal observations and/or appreciation.
- Identify strategies to "steward" the tide pool ecosystem.

On-Site Activities:

- Review "Rules of the Pools"
- Define and discuss "Species Richness" (Observe and define zonation)
- Tide Pool Scavenger Hunt
- Monitoring Instructions and Hypothesis: Which Zone is the most "Species Rich?"
- Monitor for "Species Richness"
- Compare, Contrast and Graph Monitoring Data
- Individual Quiet-Reflection Time

Pre-Visit Activities:

- Define and discuss species richness.
- Review tide pool rules by playing "*Shout Out*." *Refer to page 6 of* ***Wealthy Tide Pools*** *outline.*
- Identify and/or review tide pool organisms using ***Discovering the Intertidal*** activity.
- Review procedures and set up a quadrat to monitor for species richness, using the ***Finding Species Richness*** activity.

Evaluative Activities:

- Manipulate data collected on the field trip by comparing and contrasting results from the entire class. Data and graph sheet are included in the WTP packet.
- Review tide pool species observed with ***Intertidal Animal Scramble*** and ***Critter-cal Thinking*** activities.
- Summarize a field trip experience, through writing, artwork, or poetry.
- Propose three ways to help preserve and protect our tide pool ecosystems.

Wealthy Tide Pools

Oregon Educational Standards

Grade 6:

6.2 Interaction and Change: *The related parts within a system interact and change.*

6.2L.2 Explain how individual organisms and populations in an ecosystem interact and how changes in populations are related to resources.

6.3 Scientific Inquiry: *Scientific inquiry is the investigation of the natural world based on observations and science principles that includes proposing questions or hypotheses, and developing procedures for questioning, collecting, analyzing, and interpreting accurate and relevant data to produce justifiable evidence-based explanations.*

6.3S.1 Based on observations and science principles, propose questions or hypotheses that can be examined through scientific investigation.

6.3S.2 Organize and display relevant data, construct an evidence-based explanation of the results of an investigation, and communicate the conclusions.

6.3S.3 Explain why if more than one variable changes at the same time in an investigation, the outcome of the investigation may not be clearly attributable to any one variable.

Grade 7:

7.3 Scientific Inquiry: *Scientific inquiry is the investigation of the natural world based on observations and science principles that includes proposing questions or hypotheses, designing procedures for questioning, collecting, analyzing, and interpreting multiple forms of accurate and relevant data to produce justifiable evidence-based explanations.*

7.*3S.1* Based on observations and science principles, propose questions or hypotheses that can be examined through scientific investigation. Design and conduct a scientific investigation that uses appropriate tools and techniques to collect relevant data.

Grade 8:

8.2 Interaction and Change: *Systems interact with other systems.*

8.*2L.1* Explain how species change through the process of natural selection. Describe evidence for evolution.

8.3 Scientific Inquiry: *Scientific inquiry is the investigation of the natural world based on observations and science principles that includes proposing questions or hypotheses and designing procedures for questioning, collecting, analyzing, and interpreting multiple forms of accurate and relevant data to produce justifiable evidence-based explanations and new expl`orations.*

8.3S.1 Based on observations and science principles, propose questions or hypotheses that can be examined through scientific investigation. Design and conduct a scientific investigation that uses appropriate tools, techniques, independent and dependent variables, and controls to collect relevant data.

OCEAN LITERACY: The Essential Principles of Ocean Sciences

 # 5 The ocean supports a great diversity of life and ecosystems.

d. Ocean biology provides many unique examples of life cycles, adaptations and important relationships amoung organisms that do not occur on land.

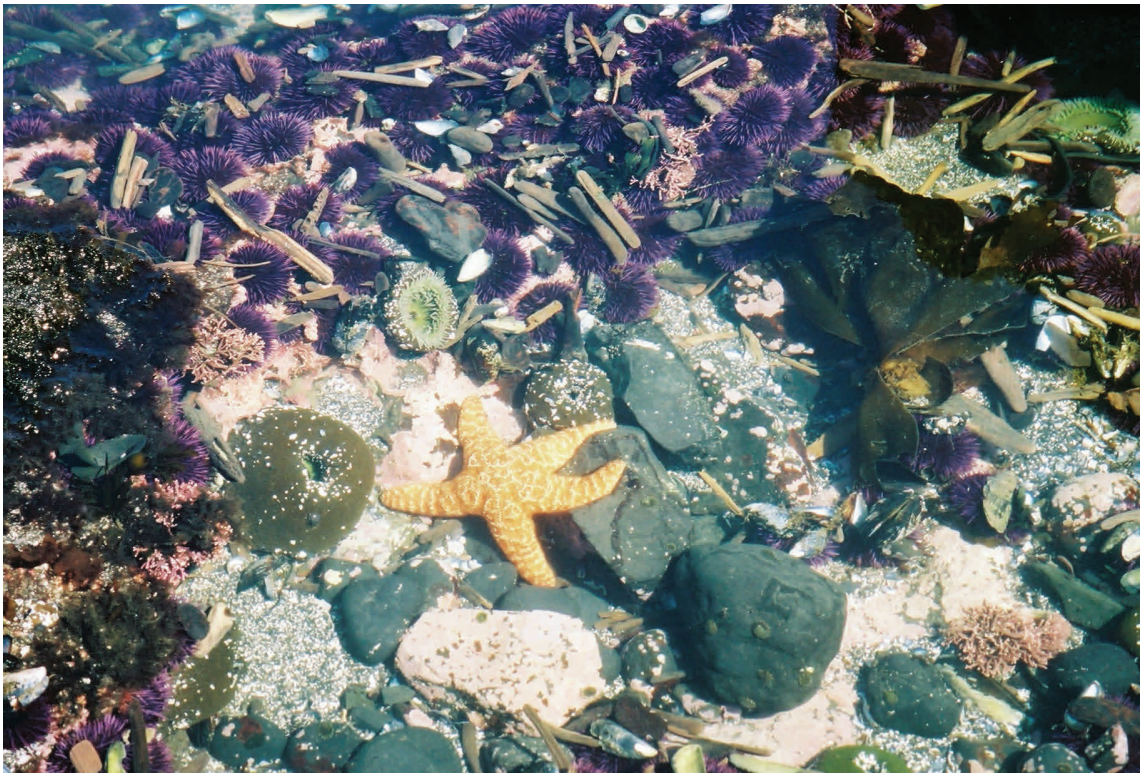
h. Tides, waves and predation cause vertical zonation patterns along the shore, influencing the distribution and diversity of organisms.

 # 6 The ocean and humans are inextricably interconnected.

c. The ocean is a source of inspiration, recreation, rejuvenation and discovery.

e. Humans affect the ocean in a variety of ways.

Wealthy Tide Pools



Instructions

Wealthy Tide Pools

The "Wealthy Tide Pools" program at Yaquina Head ONA is designed to give 6th-8th grade students the opportunity to interact with the Cobble Beach tide pool area as ecologists, monitoring relative species richness. The program provides the students with the chance to learn about the scientific method, ecology, and biology in a safe and engaging physical environment. It aims to engage the students' hands, minds, and hearts, as well as to encourage lifelong stewardship of this unique ecological resource.

Introductions and Rules of the Pools

After a short bus orientation, students proceed to the **Lighthouse Garden** for a large-group, tutorial presentation about the "**Tide Pool Rules**" (tide pool etiquette and safety), entitled "Good Ranger - Bad Ranger." In this short skit, some of the rangers will exemplify bad tide pool behaviors, and then be corrected by the "good ranger" who will instruct the entire group on the associated correct behavior. Teachers and chaperones, who play an integral part in the program, are asked to be present during this presentation where they will also receive a short orientation. Students need not be standing in their assigned chaperone-groups for this activity.

RULES OF THE POOLS - SHOUT OUT		
Rule	**Ranger Shouts**	**Student Shout Reply**
Walk on Bare Rocks	*Walk on*	**BARE ROCK**
Don't pick up alive critters	*Alive or attached*	**DON'T PICK IT UP**
OK to touch gently	*Touch*	**GENTLY**
No Collecting	*Collect only*	**TRASH**
Leave sticks and stones	*Sticks and Stones*	**LEAVE EM ALONE**

Defining Species Richness

Once the tide pool rules are clearly defined, the students will engage in a hands-on demonstration of monitoring for species richness by making a human quadrat. Students, already standing in a circle, will turn their circle into a square or "quadrat."

Rangers instruct students to enter the quadrat and become tide pool animals, explaining what quadrats are and how they are used in scientific monitoring. A discussion of how biodiversity is measured by monitoring for *species richness* and *species abundance*, and the difference between each.

By discussing the difference between species richness and species abundance, students will begin to understand how biodiversity is measured and why it is measured over time. The "Human Quadrat" is a hands-on approach to clarifying how scientific monitoring is done and why it is important.

At this point in the program, the students will split into their chaperone-groups (three chaperones per group; pre-arranged by the teacher), and assigned to work with a ranger for the remainder of the program. Ranger-led groups will depart from the Lighthouse Garden area and head down the stairs towards Cobble Beach.

Monitoring the Tide Pools

Rangers next introduce concepts and give instructions for how to complete the monitoring activity. In small groups, students will clarify the instructions and create a testable hypothesis that answers the following question "Which intertidal zone has the most species richness?" Students will hypothesize and record their names on their team's "*Tide Pool Richness Data Collection Sheet*"

At this point in the program the ranger may stop to clarify the directions for the next activity, and lead the group in a discussion of why each team chose their hypothesis. This allows the students to hear the reasoning behind other teams' hypotheses, and gives them an opportunity to share their thinking.

The Tide Pool Richness Monitoring activity is approximately 30-40 minutes in duration. During this time each of the three student groups will have approximately 10-15 minutes to spend monitoring each of three, two-meters square, quadrats (sample areas).

Each sample will be located in major intertidal zones: high tide, mid tide, and tide pool. Upon completion of the monitoring activity, groups will compare and analyze their data. Students will be asked to verbally report their data from each zone, and the data from all three teams will be averaged to come up with a mean species richness figure for each sample area. Students will then graph the data, and discuss which hypotheses were correct, which were incorrect, and why.

Tide Pool Scavenger Hunt

On the stairway platforms, rangers will sub-divide their groups into even smaller, chaperone-led teams (one chaperone per five students). Each team will be responsible for completing a tide pool scavenger hunt, explained in the context of a "cursory sample of species richness;" Students will determine whether each species is present or absent in their assigned tide pool area. The scavenger hunt will last approximately 20-30 minutes before the students are called together to **discuss their scavenger hunt findings**. Any questions or observations about specific creatures can be discussed at this point, including the following:

Did you see everything on your scavenger hunt card? Why or why not?

Did you see a species you have never seen before? If so, what did it look like?

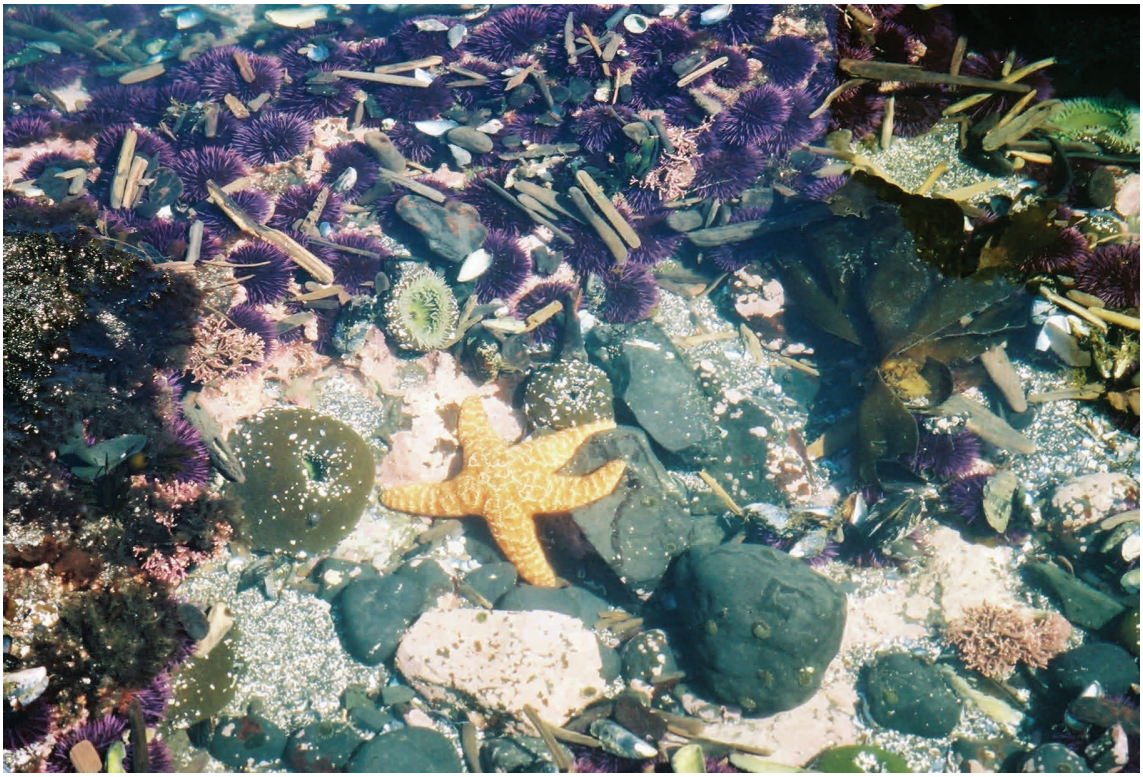
How many species do you think exist in the entire tide pool area?

Were some areas more diverse than others? Why or why not?

Conclusion

The program concludes with a reflective activity, to be decided upon by the ranger. Because so many different groups respond to different types of activities uniquely, your group's ranger may chose to play a game, do a quiet solo activity, or use a talking-stick to discuss the day's events from a thoughtful and meaningful point of view, allowing the students to connect with rocky shore ecology on a deeper level.

Wealthy Tide Pools



Master Pages

Measuring Biodiversity

Species Richness

The number of different species present in a given area.

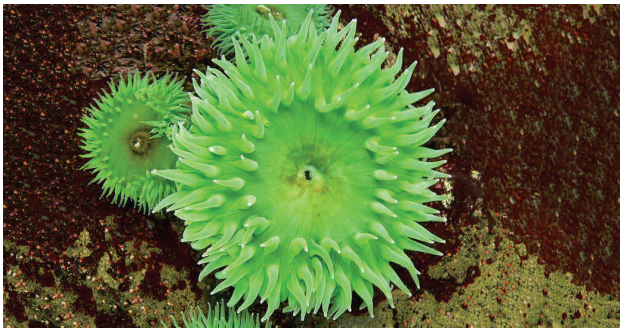
(Count each species only once)

Species Abundance

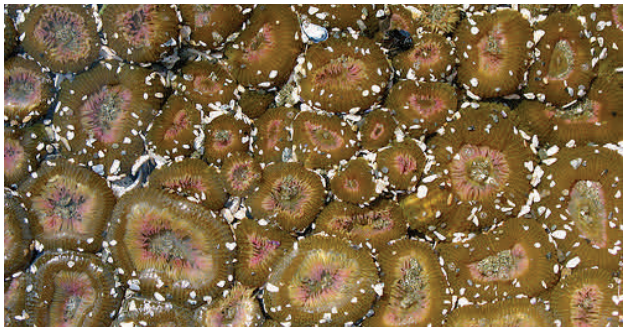
The total number of individuals of a species measured in a given area.

(Count everything)

Wealthy Tide Pools - Scavenger Hunt # 1



GIANT GREEN ANEMONE, *Anthopleura xanthogrammi-*



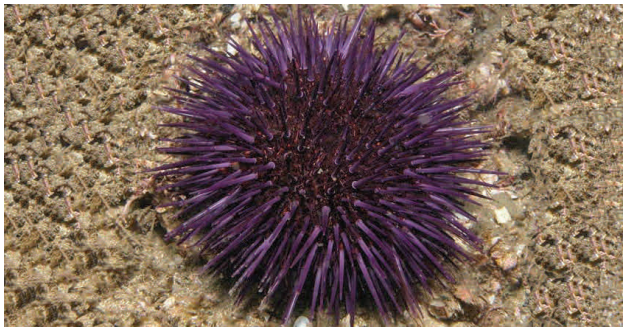
AGGREGATING ANEMONE,*Anthopleura elegantissi-*

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

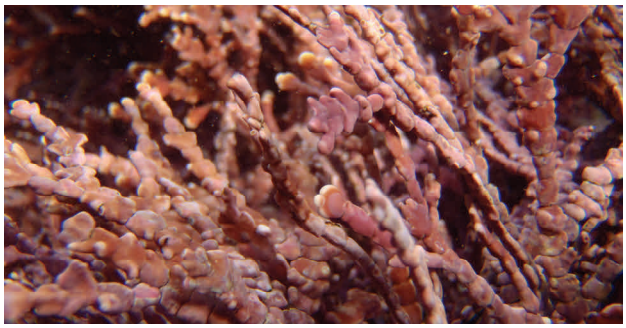
HERMIT CRAB, *Pagurus spp.*

TURBAN SNAIL, *Chlorostoma funebralis*

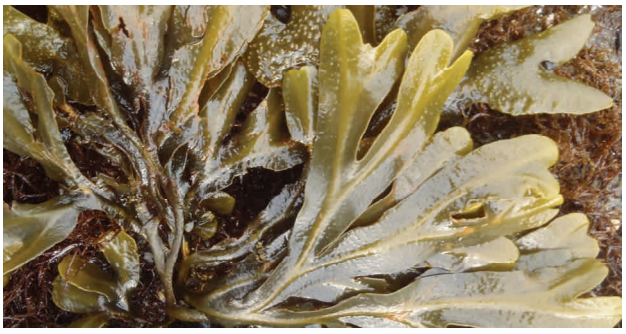
LIMPET, *Lottia spp.*

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*

Monitoring for Tide Pool Richness

Instruction Sheet

1. **Create a quadrat in each zone:**
   - Select a random area representative of each zone to place the pre-made *quadrats**. **On-site programs** - *the ranger will give instructions on how and where to set them up*. **Off-site programs** – *teachers will need to create and place their own quadrats.* (Call the education coordinator for assistance.)

1. **Survey your quadrat:**
   - Slowly and carefully walk along the perimeter of the cuadrat. Record the presence of any and all species located within the plot. Make sure to count both the listed (*pictured*) species, as well as ones you are unable to identify, or "*Other Species*."
   - Count each species only once. Do not count individual populations!
   - Get down on your hands and knees to explore in the water, under sea weed, etc.

3. **Rotate to the next zone:** After approximately 10 minutes, the ranger/adult will signal for you and your group to move to the next quadrat (in the next intertidal zone). Switch zones safely and swiftly, so as to make sure you and your team have adequate time to sample each zone.

4. **Repeat:** Repeat step 2 and 3 until your team have sampled and recorded data from each zone.

5. **Record and compile your data:** As you survey each sample plot, your team should be recording data on the presence or absence of species in that area. When you have finished surveying the quadrats, compile data by totaling the number of different species in each zone. Don't forget to add data from "*Other Invertebrates*" and "*Other Algae*." This data will be used to graph the relative species richness of each intertidal zone.

Tide Pool Organism Common Name, *Scientific Name*		Tide Pool	Mid Tide	High Tide
Turban Snail, *Tegula funebralis*		✓	✓	✓
Whelk, *Buccinum undatum*			✓	✓
Total number of species present in this zone including "Other species."		2 (1+1)	4 (2+2)	5 (2+3)

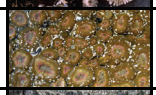
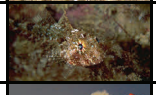
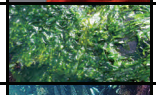
Other Species Invertebrates		
TP	Mid	High
✓	✓	✓
	✓	✓
		✓
1	2	3

When you have finished compiling your data, your chart should look something like this

6. **Return to your team/group:** Analyze and discuss the data you have collected. Verbally report your team's data, and compare it to the data from other teams in your group. Graph the data.

7. **With the entire class:** Once you and your classmates return to school, you will have another opportunity to analyze and discuss your data. Expand the data to include samples from each team. Analyze and graph the data.

Tide Pool Richness Data Collection Sheet

Tide Pool Organism Common name, *Scientific name*		Tide Pool	Mid-Tide	High-Tide
Thatched Barnacle, *Semibalanus cariosus*				
Aggregating Anemone, *Anthopleura elegantissima*				
Black Pine, *Neorhodomela larix*				
California Mussel, *Mytilus californianus*				
Coralline Algae, *Calliarthron spp.*				
Giant Green Anemone, *Anthopleura xanthogrammi-*				
Gooseneck Barnacle, *Pollicipes polymerus*				
Gumboot Chiton, *Cryptochiton stelleri*				
Hermit Crab, *Pagurus spp.*				
Iridescent Algae, *Mazzaella splendens*				
Limpet, *Lottia spp.*				
Ochre Star, *Pisaster ochraceus*				
Purple Sea Urchin, *Strongylocentrotus purpuratus*				
Sculpin, *Oligocottus maculosus*				
Sea Lemon Nudibranch, *Anisdoris Nobilis*				
Sea Lettuce, *Ulva lactuca*				
Sunflower Star, *Pycnopodia helianthoides*				
Rockweed, *Fucus gardneri*				
Turban Snail, *Chlorostoma funebralis*				
Whelk, *Nucella spp.*				
TOTAL SPECIES COUNT (*including "Other Species"*)				

Other Species (*Invertebrates*)		
TP	Mid	High

Other Species (*Algae*)		
TP	Mid	High

Student Name:

Ranger Name:

Chaperone Name:

Hypothesis

Which zone will have the most Species Richness?

Circle One: Tidepool Mid-Tide High Tide

HOW WEALTHY IS YOUR TIDEPOOL?

Group Totals and Averages for Chaperone-led Groups

Ranger Name:
Student Names:

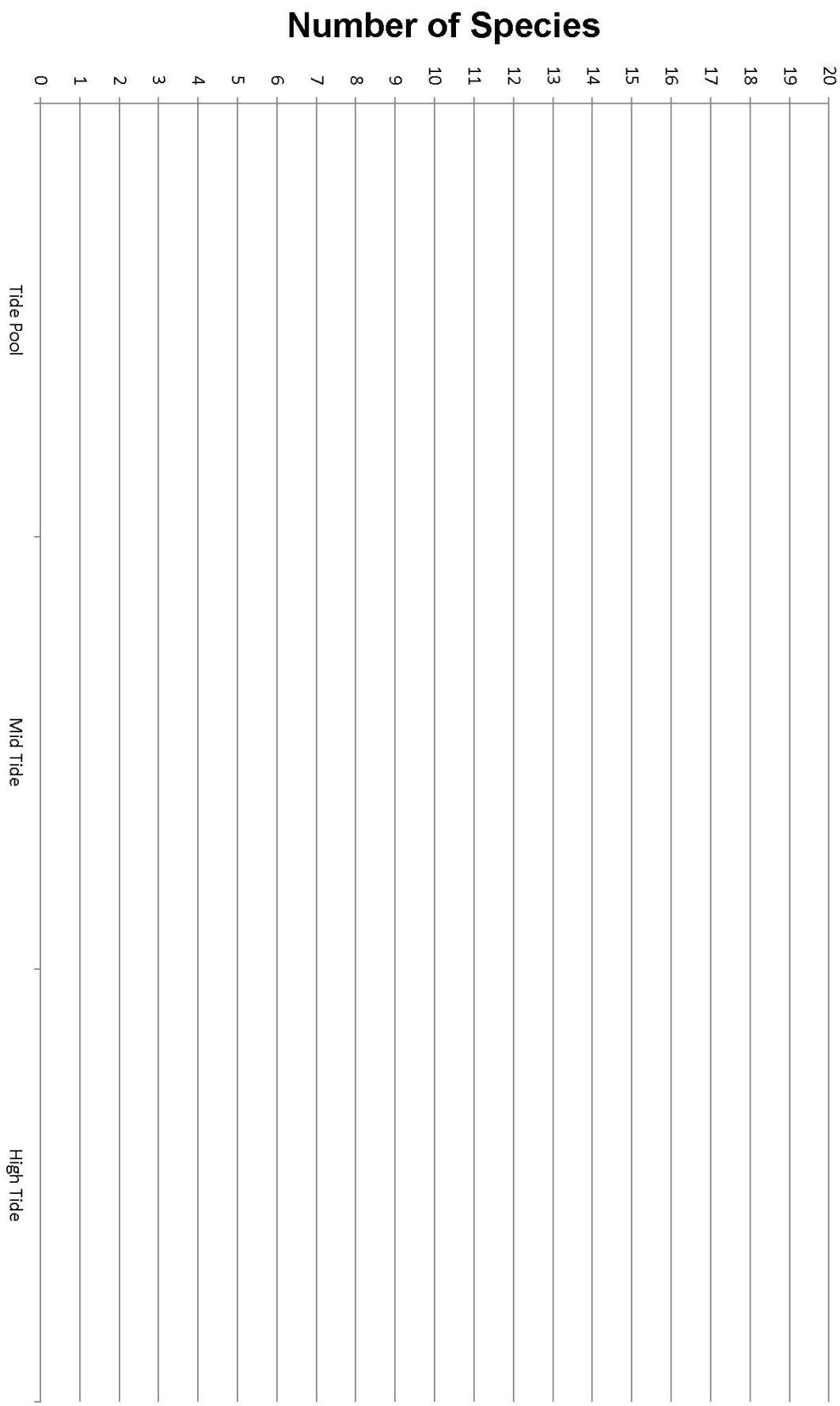
Hypothesis: Which is the most "Species Rich" zone?

Circle one: Tide Pool Mid Tide High Tide

	Tide Pool	Mid Tide	High Tide
Chaperone Team 1			
Chaperone Team 2			
Chaperone Team 3			
Total			
Average (total ÷ 3)			

HOW WEALTHY IS YOUR TIDEPOOL?

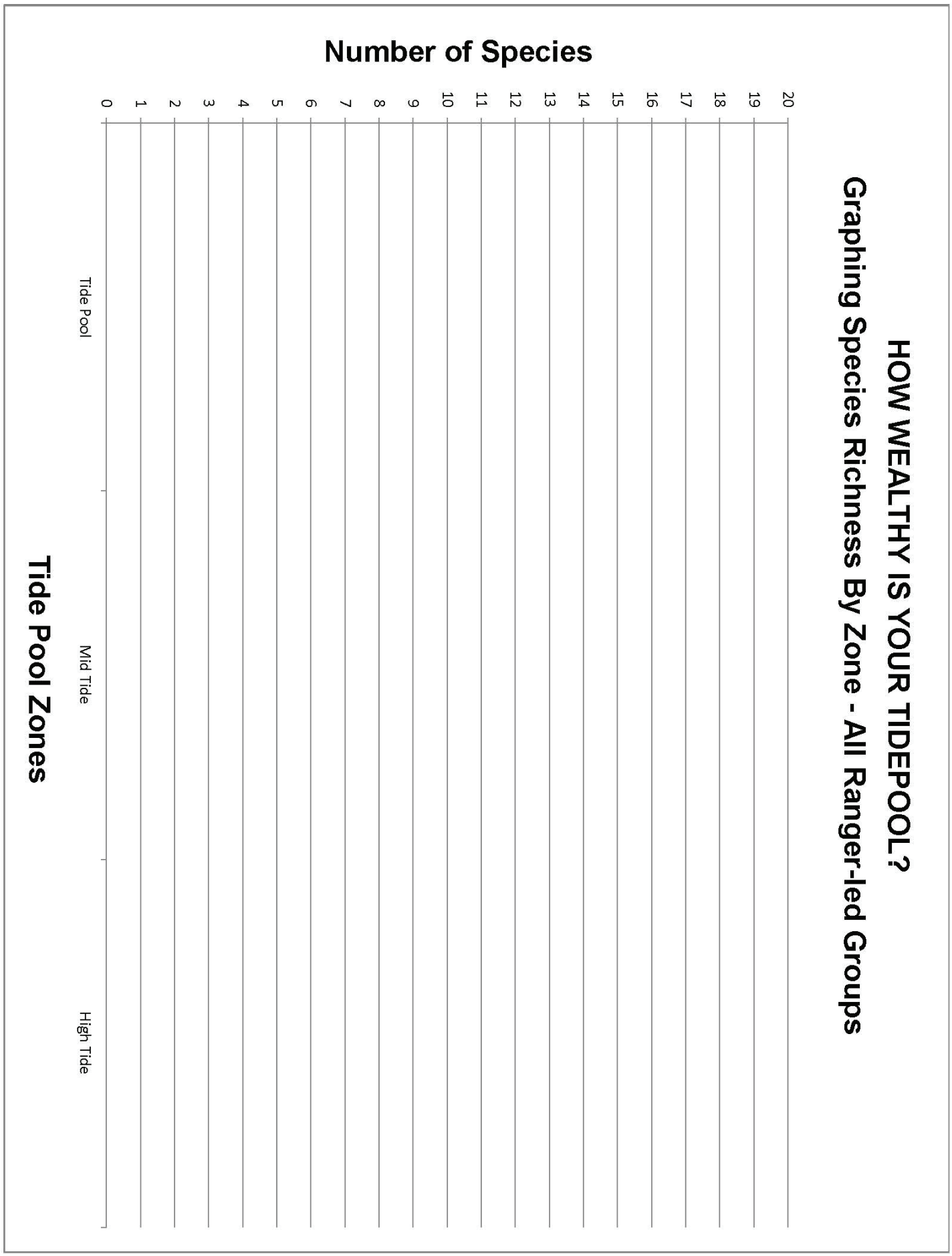
Graphing Species Richness By Zone - Chaperone-Led Groups



Tide Pool Zones

HOW WEALTHY IS YOUR TIDEPOOL?
Class Totals and Averages – Ranger-led Groups

	Tide Pool	Mid Tide	High Tide
Ranger Team 1			
Ranger Team 2			
Ranger Team 3			
Ranger Team 4			
Ranger Team 5			
Total			
Average (total ÷ 5)			


HOW WEALTHY IS YOUR TIDEPOOL?
Graphing Species Richness By Zone - All Ranger-led Groups
Number of Species
20
19
18
17
16
15
14
13
12
11
10
9
8
7
6
5
4
3
2
1
0
Tide Pool
Mid Tide
High Tide
Tide Pool Zones