OREGON COAST AQUARIUM

A Living Classroom

In 2018…

- **411,000** people visited the Aquarium
- **Outreach Education Programs** presented to **24,280** students and 970 teachers in 101 schools in OR, WA, ID, CA and NV
- **406** Oregon teachers attended Aquarium trainings, including 245 who attended **Oregon Coastal Learning Symposium**
- **50,329** people (teachers, teens, pre-teens) were virtual users of our distance learning network ***www.oceanscape.aquarium.org***
- **10,828 field trip students** from schools in OR and WA counties
- **3,067** children and their parents **stayed overnight** amid tunnels of fish, sharks and rays
- **725** preschoolers attended our ***Aquatots*** early education program
- **390 volunteer** interpreters, divers, educators and animal care providers keep the Aquarium open 364 days a year
- **9 interns** work with animal curators
- **39 youth volunteers** explore careers in marine science

REQUEST: The Oregon Coast Aquarium is asking the State of Oregon for **$10Million to support the Aquarium's capital campaign,** projected to be $18M-$20M. Capital projects defined for the campaign are: 1) Remodel the Entryway/Café, 2) Improve Three Galleries, 3) Recreate a NaturePlay Area themed on forestry, 4) Construct and furnish a Marine Wildlife Rehabilitation/Education Center for assessment, urgent care, surgery, research, veterinary practicums and marine science education; and 5) Sustainable education program support during the campaign and beyond.

Every year, the Oregon Coast Aquarium's onsite and outreach programs educate more than 500,000 people about the coastal environment and marine science. More than a tourist destination; it is a vital STEM education and ocean literacy resource for the State of Oregon. Children and adults alike learn about Oregon ecosystems, the interdependence of all species, as well as the significance of their decisions on the environment, their food sources, climate and ultimately their future.

EDUCATION PROGRAMS The Aquarium plays a significant role in both scientific inquiry and marine life exploration in the following programs:

Aquatots - a free, monthly on-site early childhood education program designed to engage children and their families on a voyage of discovery. Parents with their children rotate through NaturePlay stations, and learn ways to teach skills in observing, listening, discerning and exploring.

On-Site Programs - in addition to educational tours for field trips and overnight stays, the Aquarium facilitates lab experiences for more than 2000 K-12 students and interns interested in marine science.

School Outreach - taking the Aquarium on the road to elementary schools and home-school communities in 29 Oregon counties. Scholarships are provided to Title 1 and rural schools where distance and limited budgets preclude field trips or limit ocean science curriculum. The Aquarium has expanded outreach to remote schools in five states.

Volunteer Program trains a legion of interpreters, divers, educators and animal care providers who keep the Aquarium open 364 days a year.

Youth Volunteers engage in conservation-focused projects and compete in national ocean science bowls.

Coastal Learning Symposium is an annual professional development conference organized by the Aquarium for K-12 educators. It provides activities, resources and best-practices in STEM and interdisciplinary ocean education that aid teachers in designing curriculum and making science curriculum more relevant to students.

Oceanscape Network - a web-based distance-learning program connecting students and educators to science, nature and outdoor experiences using technology as the catalyst. Oceanscape.aquarium.org offers resources and links to grade-specific content, youth correspondent blogs and virtual field explorations.

EXPENSES	On-site & Public Edu	School Liaison	Curriculum Develop	Volunteer Progam	School Outreach	Oceanscape Network	Totals
Full-time payroll	$43,155	$41,896	$30,375	$100,738	$31,081	$56,460	$303,705
Part-time payroll	$82,000	$0	$9,550	$0	$2,600	$0	$94,150
Payroll taxes	$11,904	$3,936	$3,213	$9,444	$3,156	$4,992	$36,645
Employee Benefits	$8,716	$7,516	$7,476	$22,157	$7,384	$7,708	$60,957
Books/Exhibit Supplies	$0	$600	$1,500	$2,400	$2,550	$0	$7,050
Printing	$0	$0	$0	$0	$0	$500	$500
Uniforms	$300	$0	$100	$4,600	$100	$50	$5,150
Other Supplies	$4,800	$80	$2,400	$9,600	$1,260	$700	$18,840
Transportation	$1,500	$1,750	$1,100	$3,000	$0	$2,400	$9,750
Lodging	$0	$600	$200	$0	$15,000	$1,500	$17,300
Meals	$0	$140	$200	$0	$4,150	$650	$5,140
Postage	$0	$0	$50	$150	$0	$0	$200
Service Contracts	$22,700	$3,600	$9,000	$2,900	$0	$6,000	$44,200
Professional Development	$570	$650	$250	$2,500	$1,000	$700	$5,670
Total Education Program Ext.	**$175,645**	**$60,768**	**$65,414**	**$157,489**	**$68,281**	**$81,660**	**$609,257**

Financial support for Ocean Literacy Education will make a difference!

The Oregon State Board of Education adopted the Next Generation Science Standards in 2014, which includes marine science concepts. The Aquarium offers professional development workshops, teacher guides and curriculum with pedagogical strategies and marine science content for teachers, schools and districts that meet Next Generation Science Standards and national Ocean Literacy Principles. Financial support from the State of Oregon will enable the Aquarium to maintain and expand education program service delivery.

The State can be assured the Oregon Coast Aquarium's operations are sustainable. The non-profit is in the best financial position it has ever been, and is ahead of schedule to pay down a 2005 Series A Revenue bond loan, now less than $8.5M, obtained to finance original construction of the Aquarium.

FOR MORE INFO:

Molly Dumas, Director of Development, molly.dumas@aquarium.org 541.867.3474 x.5216
Carrie E. Lewis, President/CEO carrie.lewis@aquarium.org 541.867.3474.

Thank you for your thoughtful consideration!

OREGON COAST AQUARIUM

www.aquarium.org

Field Trip Planning Guide for Teachers

Call 541-867-3474 x5301 or email education@aquarium.org to book your group today!

The mission of the Oregon Coast Aquarium is to create unique experiences that connect you to the Oregon coast and inspire ocean conservation. The Aquarium is a living classroom, a place where people of all ages can explore and discover the wonders of the Oregon coast. This Planning Guide will help you prepare yourself, your students, and your chaperones for your visit.

TABLE OF CONTENTS

PLANNING CHECKLIST AT-A-GLANCE

Check off this list to ensure that you are fully prepared for your field trip to Oregon Coast Aquarium. Be sure to read this entire guide for more information, tips, and details.

6 weeks before Aquarium Visit (or earlier)

- ☐ Thoroughly review this entire Planning Guide
- ☐ Decide what your students' learning goals will be at the Aquarium, and how they will meet them (pg. 3-6)
- ☐ Develop a plan for how you will connect the Aquarium visit to classroom curriculum, before and/or after their field trip (pg. 3-6, 16)
- ☐ Plan a Preview Trip for yourself, if possible (pg. 4, 18)

4 weeks before Aquarium Visit

- ☐ Decide if you wish your students to participate in a classroom education program while at the Aquarium, and browse our options (pg. 3) NOTE: if you're planning to visit during our busy season in April-May, plan to book your program as far in advance as possible!
- ☐ Provide all the information needed to our Groups Coordinator to get your field trip booked (pg. 3)
- ☐ Begin recruiting Chaperones (see Chaperone Policies on pg. 9)

2 weeks before Aquarium Visit

- ☐ Develop a plan for same-day nearby activities such as tidepooling, if desired (pg. 16)
- ☐ Provide Purchase Order or other form of payment to our Groups Coordinator
- ☐ Communicate field trip information to parents by sending home the Student Contract (pg. 7-8)

1 week before Aquarium Visit

- ☐ Be sure you have the Group Leader Contract and other day-of materials completed and compiled (pg. 4, 17)
- ☐ Prepare your students by going over their learning goals and behavior expectations for their Field Trip (pg. 6-7)
- ☐ Prepare your Chaperones by clearly communicating their role, the day's schedule, learning goals, and any pertinent information about their students (pg. 9)
- ☐ Fill out and distribute to each Chaperone a copy of the Chaperone Guide (pg. 10-13)
- ☐ Know what to expect when you arrive at the Aquarium (pg. 14-15)

PREPARING FOR YOUR VISIT

Booking your field trip

Thank you for choosing the Oregon Coast Aquarium for your class field trip! If you have not already done so, the first step is to contact our Groups Coordinator, Carie Evans at carie.evans@aquarium.org or call 541-867-3474 ext. 5301. Our Coordinator will start the process of scheduling your group and work with you to ensure that you and we have all the necessary information.

Before reaching out to us, please try to have an idea of your ideal date(s), time(s), and estimated numbers of students and chaperones. We recommend (and admit free of charge) one chaperone for every five students. At the minimum, one chaperone per ten students is required for all self-guided visits.

If you wish to schedule a classroom education program, review our current options at aquarium.org/education/on-site-school-programs. If you have questions or would like more information about these programs, contact education@aquarium.org. One chaperone per five students is required for classroom programs.

Please note that teachers are not counted as chaperones, and all chaperones must be at least 21 years of age. Other children outside your class, such as siblings, are not allowed.

Preparing yourself

Consider your goals

Why do you want to take your students on a field trip to Oregon Coast Aquarium? Is it to introduce them to local marine life and ecosystems? Or to provide hands-on investigation of an issue you've been addressing in class? Perhaps you just want to get them out of the school for a day. Which of these three goals is the most impactful in the long run?

Research and our experiences have shown that field trips are much more memorable, impactful, and useful when deliberately connected to classroom curriculum. Consider what you've already been working on in class, or what you'd like students to learn in their next unit, and find a way to connect this to their field trip. Giving students something to look for or a driving question to answer during their field trip will help keep them focused and make their experience at Oregon Coast Aquarium more meaningful. Be sure to clearly communicate these goals to both students and chaperones *before* their field trip. You will find some printable tools to help you do so in the following pages.

Use the Teacher Planning Page to record your goals for your field trip and how this will connect to your classroom curriculum. More ideas for how to connect a field trip at Oregon Coast Aquarium to classroom activities may be found on page 16.

To make the Learning Goals even more meaningful, consider asking the students what they want to learn at the Aquarium! Spend some time asking students to generate questions they'd like to answer, and make these your Learning Goals for their field trip. **If you're not sure how to connect your field trip to classroom curriculum, we can help.** Contact our Teacher Programs Manager at sara.shawroberts@aquarium.org, call 541-867-3474 (ext. 5317), or visit our Teacher Resources page.

Consider a planning trip to the Aquarium

Oregon Coast Aquarium offers a Preview Pass to provide free admission to teachers wanting to scope out the Aquarium before their field trip. If you've never been to the Aquarium, or even if you have, this can be a valuable opportunity for you to familiarize yourself with our campus, identify the most relevant exhibits for your learning goals, and find important landmarks – i.e. restrooms!

A copy of the Preview Pass may be found at the end of this document on Page 17.

Review the Behavior Expectations and generate consequences for poor behavior

Oregon Coast Aquarium has specific expectations for student behavior on our campus. Before your field trip, review these rules on Page 6 and be sure you are familiar with them so you can help enforce rules during your visit.

You should also consider some consequences for students who do not follow these rules and become a danger or distraction to themselves or others. Whether students have to sit out of activities, will have their gift shop privileges revoked, or some other penalty on-site or back at school, both students and chaperones should be aware of the rules and the consequences for not following them. Tools for communicating this information can be found in the next two sections of this Planning Guide.

Know what to expect

When planning your day, check the current schedule of animal feedings, demonstrations, and other special events you might want your students to see at the Aquarium. Go to www.aquarium.org for our daily schedule. Remember, some special activities including Animal Encounters and Behind-the-Scenes Tours must be reserved in advance, can only accommodate small groups, and have minimum age limits. Call 541-867-3474 ext. 5301 for more information or to book these activities.

Checklist of paperwork to bring to your field trip

- ☐ Group Leader Contract (page 15): Teachers/Group Leaders must review, sign, and present this when they check in for their field trip.
- ☐ Confirmation Email from Oregon Coast Aquarium
- ☐ Purchase Order or preferred form of payment, if not already provided (cash, school check, or card)
- ☐ Copies of Chaperone Information Sheet for each chaperone in the appropriate language (pages 10-13)
- ☐ Self-guided tours for your grade level (if desired and relevant to your learning goals)
- ☐ Student materials (worksheets or other tools they will use)

You don't need to print copies of the map or Aquarium schedules beforehand; these will be available for you and your Chaperones at the Front Desk.

TEACHER PLANNING PAGE FOR OREGON COAST AQUARIUM FIELD TRIP

Learning goal(s) for field trip (these can be behavior skills, such as working in groups, and/or academic, such as recognizing fish adaptations):

1.

2.

3.

How will students demonstrate achievement of these learning goals? (using a worksheet you create, a self-guided tour workbook, recordings in their notebooks, etc.)

What have we done or will we do in class that connects?

How will I communicate this connection to students? To parents/chaperones?

Education standards being addressed or worked towards:

Preparing your students

Your field trip to Oregon Coast Aquarium will be more fun and more educational for everyone if students are properly prepared beforehand. The following are some suggestions we strongly encourage you to follow:

1. **Share the field trip plan with your students.** Students who are aware of the day's plan, schedule, and expectations are much more likely to focus on the Learning Goals.
2. **Orient students to the Aquarium before you leave school.** Use our Virtual Field Trip Video to introduce students to the campus, our animals, exhibits, and behavior expectations. This is very important especially if students have never been to the Aquarium before – it can help reduce the sensory overload and confusion resulting from the novelty of visiting a new place.
3. **Give them purpose.** Share with students the Learning Goals you developed on your Teacher Planning Page, and how they will achieve them. Be very clear about what they should be doing or looking for at the Aquarium, and how this will tie back to what they're doing in school. This will give students an authentic context for their field trip rather than making it "just a fun day away from class".
4. **Be clear about behavior expectations and consequences.** Using the Student Contract (pages 7-8), review the rules and your own expectations for students. Tell students very clearly and specifically what the consequences will be if they do not follow these rules. Fill out the empty fields on the Student Contract, print a copy for each student, then have them sign it and bring it home to share with their parents.

A NOTE ON WORKSHEETS

If you plan on creating a worksheet for your field trip, use these proven best practices to make it more engaging and effective:

-**Give students choice** in the species or exhibits they examine to answer a question

-**Use open-ended questions** to encourage critical thinking & discussion

-**Tie everything back to your Learning Goals!**

For more guidance, visit our Teacher Resources page

Behavior Expectations for Oregon Coast Aquarium Field Trips

- No climbing on the rocks or running in the exhibits or paths.
- Do not tap or lean on the exhibits.
- Do not handle any live animals unless an Oregon Coast Aquarium volunteer or staff member says it's okay, and follow their instructions carefully.
- Keep the Aquarium clean by not littering or dropping anything in the water. No food or drinks outside the Café.
- Keep voices quiet and respectful of other students, Aquarium staff and Volunteers, and other visitors.
- Students should always stay with their assigned group and Chaperone.
- If you are participating in a Classroom education program, please be respectful and listen quietly when the Instructor is talking. The use of electronic devices such as cell phones and tablets is not allowed during education programs.

Clearly communicate with parents

Even if a parent is not going to chaperone the field trip, they should still know the expectations for their child's behavior and the consequences if they do not follow these rules. Use the following *Student Contract and Parent Information* page to review expectations with students, then send this home with them to share with their parents.

STUDENT CONTRACT AND PARENT INFORMATION FOR OREGON COAST AQUARIUM FIELD TRIP

Your child is going to have an exciting day at Oregon Coast Aquarium on _____!
To help everyone have a great time and learn a lot, we expect that all students will obey the following Behavior Expectations during their field trip. Please review these with your child at home, and be aware of the consequences if your child does not follow these guidelines.

1. I will not climb on the rocks or run in the exhibits or paths.
2. I will not tap on the exhibits.
3. I will not try to handle any live animals unless an Oregon Coast Aquarium volunteer or staff member says it's okay, and I will follow their instructions carefully.
4. I will keep the Aquarium clean by not littering or dropping anything in the water.
5. I will keep my voice quiet and respectful of my fellow students, chaperones, Aquarium staff, and other visitors.
6. I will always stay with my assigned group and Chaperone.
7. If I can't find the answer to my question, I will ask!

Additional expectations from the teacher:

The consequences for not following these Expectations are:

Strike 1:

Strike 2:

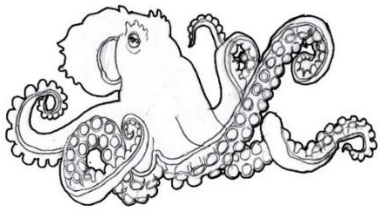
Strike 3:

Our Learning Goal(s) for our field trip:

We will learn this by using/doing:

Student signature: _____

Parent signature: _____



CONTRATO ESTUDIANTIL E INFORMACION PARA LOS PADRES CON RESPECTO AL DIA DE CAMPO/EXCURSIÓN EN EL ACUARIO DE LA COSTA DE OREGON

¡El día _____ su hijo(a) va a tener un día emocionante en el Acuario de la Costa de Oregon! Para ayudar a que todos se la pasen bien y aprendan mucho, nosotros esperamos que todos los estudiantes obedecerán las siguientes Expectativas de Comportamiento durante el día de campo/excursión. Favor de revisar esto con su hijo(a) en casa, y tengan en cuenta las consecuencias si su hijo(a) no sigue estos parámetros.

1. Yo no treparé las rocas o correré en los pasillos (caminos) o salas de exhibiciones.

2. Yo no voy a golpear las exhibiciones.

3. Yo no trataré de tocar o agarrar a cualquiera de los animales vivos a menos que algún voluntario o empleado diga que esta bien, y trataré de seguir las instrucciones cuidadosamente.

4. Trataré de mantener el Acuario limpio al no ensuciar o tirar nada dentro del agua.

5. Mantendré mi voz baja y respetaré a mis compañeros, chaperones, empleados del Acuario, y a los demás visitantes.

6. Permaneceré dentro de mi grupo asignado y con mi chaperón.

7. ¡Si no encuentro la respuesta a mi pregunta, yo preguntaré!

Expectativas adicionales por parte del maestro(a):

Las consecuencia por no seguir estas expectativas son:

1ª. Ocurrencia:

2ª. Ocurrencia:

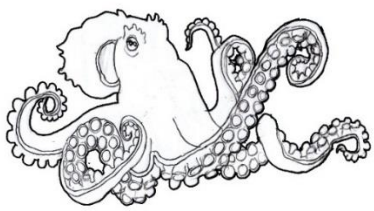
3ª. Ocurrencia:

Las metas de aprendizaje de nuestro día de campo/excursión:

Aprenderemos esto utilizando/haciendo:

Firma del alumno: _____

Firma de los padres: _____



Preparing your Chaperones

Not only are Chaperones responsible for the safety and behavior of your students, they can also have a huge impact on your students' experience at the Aquarium. If your Chaperones are anxious, confused, or frustrated, your students will sense it and their experience will be negatively impacted. That's why it's important to prepare your Chaperones for their field trip just as deliberately as you prepare your students.

You should prepare your Chaperones well in advance of your field trip. We have provided a Chaperone Information Sheet for field trips on the next page that you should use to communicate important information with your Chaperones. *Fill out a separate sheet for each chaperone* so you can list the students each is assigned to and any special notes for that group. Please fill out the empty fields for EACH Chaperone and distribute these ahead of time if possible. Be sure to include important items like lunch, meeting, departure, and any planned group activities in the Schedule table on the second page of the Chaperone Information Sheet.

Some other things you may wish to discuss with your Chaperones include:

- Chaperones must stay with their assigned group at all times, and should periodically take a head count to ensure they're not missing anyone.
- Remind Chaperones that their attitude during the field trip will translate to their students, so they should try to have fun and stay positive – they are very important members of the "field trip team"!
- Explain the schedule for the day and how you will communicate with one another once you've arrived at the Aquarium.
- Be sure your Chaperones know the times and places to meet for lunch, to leave for the buses, and any other scheduled activities.
- Let Chaperones know whether or not students are allowed to visit the Gift Shop, and when they should do so.
- If your Chaperones are driving, provide them with the map and arrival information on Pages 14-15. Come up with a plan of where and when everyone will gather. Remember, the entire group must enter together for scheduled Classroom programs.
- Using the Chaperone Information Sheet, inform them of your Learning Goals and encourage them to ask open-ended questions to help students stay engaged and focused.
- If you are participating in a Classroom Education Program, let Chaperones know that they will be actively helping to facilitate the program. They should not use any electronic devices during the program, and should follow the directions of the Instructors to help guide students through the activities.

Chaperone Policies

- We recommend (and admit free of charge) one chaperone for every five students. At the minimum, 1 chaperone per 10 students is required for all self-guided visits.
- 1 chaperone per 5 students is required for Classroom programs.
- Teachers are not counted as chaperones. All chaperones must be at least 21 years of age.
- Other children outside your class, such as siblings, are not allowed.
- Chaperones are expected to be aware of and enforce all Aquarium Behavior Expectations.

CHAPERONE INFORMATION FOR OREGON COAST AQUARIUM FIELD TRIP (PG. 1)

Thank you for volunteering to be a Chaperone for your child's field trip to Oregon Coast Aquarium! Chaperones play an important role in shaping students' experiences, enforcing behavior expectations, and keeping everyone safe and on-task. Please review the following information and ask your teacher if you have any questions. Most importantly – have fun!

Chaperone Name:

Field Trip Date and Times:

Behavior Expectations

1. No climbing on the rocks or running in the exhibits or paths.

2. Do not tap or lean on the exhibits.

3. Do not handle any live animals unless an Oregon Coast Aquarium volunteer or staff member says it's okay, and follow their instructions carefully.

4. Keep the Aquarium clean by not littering or dropping anything in the water. No food or drinks are allowed outside the Café.

5. Keep voices quiet and respectful of other students, Aquarium staff and Volunteers, and other visitors.

6. Students should always stay with their assigned group and Chaperone.

Additional expectations from the teacher:

The consequences for not following these Expectations are:

Strike 1:

Strike 2:

Strike 3:

Our Learning Goal(s) for this field trip:

We will learn this by using/doing:

CHAPERONE INFORMATION FOR OREGON COAST AQUARIUM FIELD TRIP (PG. 2)

Field Trip Schedule:

Time	Activity	Location

Some strategies to help your students have fun and learn more:

- Constantly re-direct student investigations to their Learning Goal(s), but don't ignore other questions – encourage curiosity!
- Use open-ended questions relating to the Learning Goal(s) to keep students engaged, such as:
    - *What do you notice about this exhibit?*
    - *What do you wonder about this?*
    - *Why do you think this animal is behaving this way?*
- Encourage students to read the informational signs and talk to Aquarium Staff and Volunteers. We love interacting with students and answering their questions!

Teacher's name and cell phone number:

Number of students in my group:

Names of students in my group:

If a student gets lost or injured: First, go to the Front Desk located in the Main Lobby, or alert any nearby Aquarium Volunteer or Staff Member. Then notify your Teacher. If you need any assistance, you can always find a Volunteer in the Aviary or at the Touch Pool.

Other notes from the teacher:

INFORMACIÓN DEL CHAPERÓN PARA EL DIA DE CAMPO/EXCURSIÓN AL ACUARIO DE LA COSTA DE OREGON (1A. PAG.)

¡Gracias por ser un chaperón voluntario para el día de campo/excursión al Acuario de la Costa de Oregon de su hijo(a)! Los chaperones juegan un papel muy importante en la formación de experiencias de los alumnos, reforzando las expectativas de comportamiento, y manteniendo a todos seguros y enfocados en las actividades. Favor de revisar la siguiente información y pregunten a su maestro si tienen alguna duda. ¡Lo mas importante – es que se diviertan!

Nombre del Chaperón:

Fecha y Horario del día de campo/excursión:

Expectativas de Comportamiento:

1. No se suban o trepen a las rocas o corran durante en las salas de exhibiciones o en los pasillos (caminos).

2. No golpeen o se recarguen en las exhibiciones o pasillos (caminos)

3. No agarren a ninguno de los animales vivos a menos que alguno de los voluntarios o empleados del Acuario de la Costa de Oregon diga que esta bien, y siga las instrucciones cuidadosamente.

4. Mantengan el Acuario limpio al no ensuciar o tirar nada dentro del agua. La comida y las bebidas nos on permitidas fuera del Café.

5. Mantengan la voz baja y respeten a sus compañeros, a los empleados del Acuario y los voluntarios, al igual que los demás visitantes.

6. Los alumnos siempre tienen que mantenerse con sus grupos asignados y su Chaperón.

Expectativas adicionales del maestro:

Las consecuencia por no seguir estas Expectativas son:

1a. Ocurrencia:

2a. Ocurrencia:

3a. Ocurrencia:

Las metas de aprendizaje de nuestro día de campo/excursión:

Aprenderemos esto utilizando/haciendo:

INFORMACIÓN DEL CHAPERÓN PARA EL DIA DE CAMPO/EXCURSIÓN AL ACUARIO DE LA COSTA DE OREGON (2ª. PAG.)

Horario del Día de Campo/excursión:

Hora	Actividad	Lugar

Algunas de las estrategias para ayudar a que sus alumnos se diviertan y aprendan más:

• Canalicen constantemente las investigaciones de sus alumnos hacia sus Metas de Aprendizaje, pero no ignoren las otras preguntas – ¡Queremos fomentar la curiosidad!

• Utilicen preguntas abiertas que tengan que ver con las Metas de Aprendizaje para mantener a los alumnus involucrados, tales como:

- *¿Qué es lo que notan en esta exhibición?*
- *¿Qué es lo que se preguntan de esto?*
- *¿Por qué creen que este animal se esta comportando de esta manera?*

• Animen a que sus alumnos lean las señales de información y que hablen con los empleados del Acuario y los voluntarios. ¡Nos encanta interactuar con los alumnos y contestar sus preguntas!

Nombre del maestro y su numero de teléfono celular:

Numero de alumnos en mi grupo:

Nombre de los alumnos en mi grupo:

Si uno de los alumnos se pierde o se lesiona: Primero, vayan a la Recepción localizada en el Vestíbulo Principal, o avísenle a cualquiera de los Voluntarios o empleados del Acuario. Después avísenle al maestro. Si necesitan de asistencia alguna, ustedes siempre podrán encontrar a un Voluntario en la Pajarera o por donde está el Piscina Táctil.

Otras notas del maestro:

AT THE AQUARIUM

You've worked hard to prepare yourself, your students, and your Chaperones for your field trip – now what?! Use the follow information to easily navigate your field trip.

Arrival Information

Parking

Buses may drop off students along the sidewalk in the Green Zone by our Front Entrance, then they should park in the Bus/RV parking lot OR in the Sea Lion Lot If you are arriving in carpools, drivers may park in any available spaces. Make sure Chaperones and students use caution and look both ways when crossing the parking lots or the main road.

Where to check in

Upon arrival, proceed directly to the Member's Desk to check in. As the teacher, you should enter first and keep your group on the buses or outside while you check in. Be sure you have your Confirmation Letter, Group Leader Contract (pg. 15), and PO or form of payment ready.

Before exploring the Aquarium

Before releasing your Chaperone groups to explore, be sure everyone has the following:

- Each Chaperone has their copy of the Chaperone Information Sheet (Pages 10-13)
- Each Chaperone has an Aquarium map and schedule (available at the Front Desk)
- Each student has a name tag
- Each student knows who their Chaperone is and who else is in their group
- Each student has the tools they need to achieve their Learning Goal(s) (worksheet, self-guided tour, notebook, etc.)

If you're scheduled for a Classroom Program

You should plan to arrive at least 15 minutes before your scheduled program time. Allow even more time if your students will need a restroom stop before they begin. If your group arrives later than 5 minutes after the scheduled check-in time, your program may be subject to cancellation.

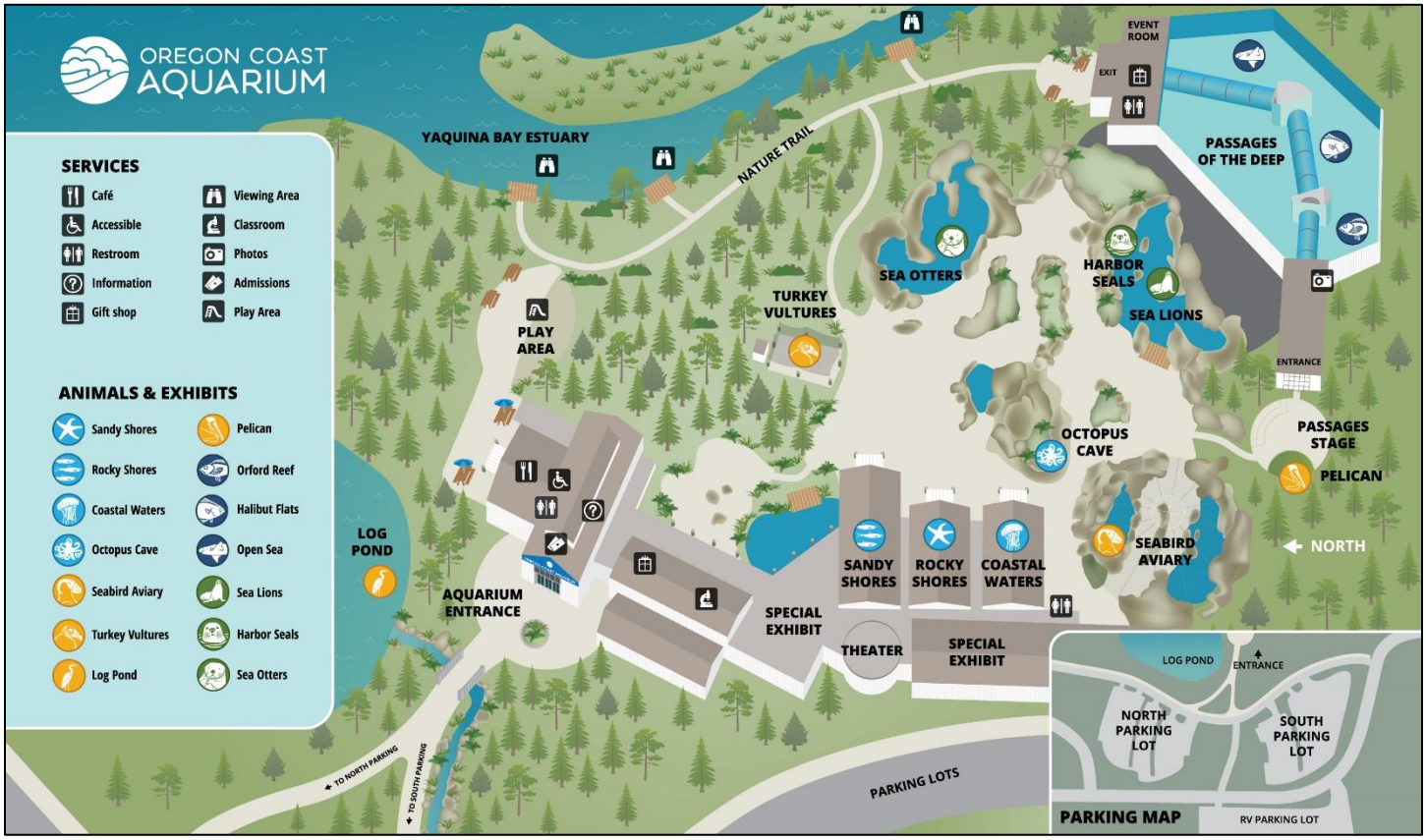
If you have a large group which will be split in half, one half will begin with the Classroom program while the other half explores the Aquarium, then you will switch. Be sure that the designated times and locations for these activities are noted on the Chaperone Information Sheets.

Lunch Procedures

We do not allow food or drinks to be brought inside the Aquarium, however, we do have a Lunch Pavilion in the Tufted Puffin lot (capacity: 60-80 people) that you may use free of charge. We are unable to make reservations for this space so be aware that it is first-come, first-serve and plan alternatives accordingly. Lunches should be stored in buses or vehicles.

Our Café is able to provide catering for groups that have booked meals in advance (Tuesday-Sunday only). Contact the Groups Coordinator at carie.evans@aquarium.org or 541-867-3474 ext. 5301 at least 2 weeks in advance to arrange pre-ordered lunches.

Aquarium Map



Gallery Highlights

Sandy Shores: Here, much of the life is hidden beneath the sand. Species you may find here include Bay Pipefish, Dungeness Crab, Sand Dollars, Sardines and Anchovies.

Rocky Shores: Oregon's rocky tidepools are havens for a variety of organisms. Meet species hands-on including urchins, crabs, anemones, sea stars, and more at the Touch Pool.

Coastal Waters: Discover some of the many ecosystems just offshore. This gallery includes a 5,000-gallon kelp forest, a coastal reef exhibit, several species of jellies, and more.

Big Bites: This new gallery, opened in May 2017, showcases creatures with unique feeding adaptations. View the fascinating teeth and jaws of pufferfish, piranhas, parrotfish, and more.

Marine Mammals: The outdoor enclosures housing our Sea Otters, Harbor Seals, and Sea Lions provide a rare opportunity to observe these playful, intelligent animals up close.

Seabird Aviary: Our open-air, walk-through aviary is one of the largest of its kind in North America. Puffins, Oystercatchers, Murres, and more will fly and squawk all around you.

Passages of the Deep: A series of underwater tunnels leads the visitor from the dark canyons of Orford Reef, through the teeming waters of Halibut Flats, and finally into the vast blue expanse of the Open Sea. View several species of sharks, plus sturgeon, rockfish, and more.

EXTENDING THE EXPERIENCE

Tidepooling

The Central Oregon Coast has a number of great tidepooling sites. Near Oregon Coast Aquarium, check out Seal Rock State Recreation Area or Yaquina Head Outstanding Natural Area. Both sites have restrooms and picnic facilities. Otter Rock is also a great spot. Check out our Oceanscape Network tidepooling page for tidepooling tips, a map of tidepooling sites across Oregon, tide schedules, and a field guide to common tidepool creatures. Oregontidepools.org also has many additional great resources. Be sure to check a tide table beforehand to ensure you're visiting as close to low tide as possible!

Tidepooling etiquette to review with your students:

- Watch where you put your feet! Try not to walk on animals and plants that live on the rocks and in the pools.
- When touching tidepool animals, be very gentle – do not poke or prod.
- Moving animals to new surroundings can injure or kill them. Remember, these organisms are alive and adapted to a very specific environment. Taking them home with you will kill them.
- Leave natural habitats cleaner than you found them. Pick up any debris you find, if you can safely do so, and dispose of it properly.

Other Nearby Field Trip Opportunities

Hatfield Marine Science Center: hands-on exhibits and education programs

Marine Discovery Tours: boat cruises for school groups on the ocean and in Yaquina Bay

OMSI Coastal Discovery Center: over-night environmental programs

Oregon State Parks: beaches, picnic areas and other natural sites along the coast (near the Aquarium, Brian Booth, South Beach, and Beverly Beach are great state parks to visit)

Yaquina Head Outstanding Natural Area: tidepooling, historic lighthouse, interpretive center

Pacific Maritime Heritage Center: exhibits feature local fisheries, artifacts, and cultural stories

Back in the Classroom

There are a number of ways you can connect what students saw and learned at the Aquarium back to classroom activities. If you completed your Teacher Planning Page on page 5, you should have a good idea of how classroom curriculum connects to your Aquarium field trip.

Some general ideas include:

- Have students select an animal to observe closely at the Aquarium, then write a story or research report about it.
- Ask students to invent a new species of animal based on adaptations they saw at the Aquarium, and build a model or draw a picture of it.
- Challenge students to research a conservation issue facing Oregon coast animals, and ask them to come up with ways to prevent or mitigate this issue.

For a more thorough guide to connecting classroom curriculum to field trips, visit our Teacher Resources page at aquarium.org/education/teacher-resources.

GROUP LEADER CONTRACT

Dear School Group Leaders,

We're so glad you chose to visit the Oregon Coast Aquarium with your students! To ensure your group has a fun and educational experience, the Aquarium has developed the following contract.

PLEASE BRING A SIGNED COPY OF THIS CONTRACT WITH YOU THE DAY OF YOUR VISIT!
It's not necessary to send via Email or Fax ahead of time.

Review and share the following information with your students and chaperones before your visit:

For students

- No climbing on the rocks or running in the exhibits or paths.
- Do not tap or lean on the exhibits.
- Do not handle any live animals unless an Oregon Coast Aquarium volunteer or staff member says it's okay, and follow their instructions carefully.
- Keep the Aquarium clean by not littering. No food or drinks are allowed outside the Café.
- Keep voices quiet and respectful of other students, staff and Volunteers, and other visitors.
- Students should always stay with their assigned group and Chaperone.
- If you are participating in an education program, please be respectful and listen quietly when the Instructor is talking.

For Chaperones

- Provide each Chaperone with their own copy of the Chaperone Information Pages. These materials can be found on Pages 9-13 of this Teacher's Guide.
- Chaperones must stay with their assigned group at all times, and should periodically take a head count to ensure they're not missing anyone.
- Be sure your Chaperones know the times and places to meet for lunch, to leave for the buses, the gift shop, and any other scheduled activities.
- If your group is participating in a Classroom Education Program, Chaperones will be actively helping to facilitate the program. They should not use any electronic devices during the program, and should follow the directions of the Instructors to help guide students through the activities.
- 1 chaperone per 10 students is required for self-guided visits and 1 chaperone per 5 students is required for our Classroom Education Programs. Chaperones must be 21 or older.

Classroom Education Programs

- Meet the Education staff in the Lobby at least 10 minutes before the start of your scheduled program. If your group is late, you may not be admitted to the program.
- The Aquarium reserves the right to cancel a program without notice in the case of an emergency.

Food & Drink

- We do not allow any outside food or drinks into the Aquarium. Lunches should be stored in a vehicle and eaten off-site, or outside in our Pavilion.

I have read the above guidelines, discussed them with my students and chaperones, and we agree to abide by them during our visit to the Oregon Coast Aquarium.

_____ _____

Group Leader Name | Group Leader Signature

_____ _____

School/Group Name | Date

Thank you for helping us make your visit a quality learning experience for your students!

OREGON COAST AQUARIUM TEACHER PREVIEW PASS

Please print this form, fill out completely and bring it to the Oregon Coast Aquarium to preview our facility at no cost. Appropriate school identification must be presented at the time of admission. This pass allows entry for the educator only, no guests.
Pass is not valid for any special events, including Creatures of the Night, Sea of Lights, etc.

Date of Visit:

First Name:

Last Name:

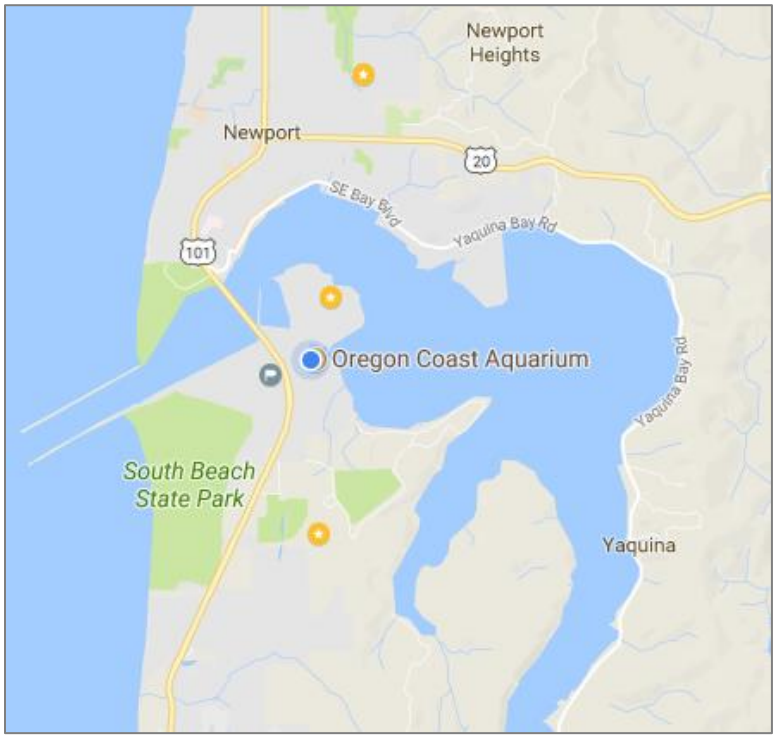
School / Organization:

Address:

City, State and ZIP:

Business Email:

Business Phone:



OREGON COAST AQUARIUM

2820 SE Ferry Slip Rd., Newport, OR

Phone: (541) 867-3474

www.aquarium.org

Winter Hours

The day after Labor Day through Memorial Day

10:00 am - 5:00 pm daily

Summer Hours

Start of Memorial Day weekend (Saturday) through Labor Day

10:00 am - 6:00 pm daily

Be sure to ask if there is a Volunteer available for a guided tour when you arrive!

OUR OCEAN LITERACY PARTNERSHIP

Helping teachers connect their students to our coast's science, history, habitats, and communities

Lincoln County is fortunate to have a number of marine industries, scientists, natural resources and expert marine educators. In 2010, Oregon Coast Aquarium and Lincoln County School District entered a formal partnership to integrate the oceans and coast into the curriculum. With the support of other community partners, we seek to connect teachers and their students to the vibrant natural and cultural resources that define our region.

Our Mission

The mission of the Ocean Literacy Partnership is to make local coastal environments and communities the integrating context for learning across all grades and subjects.

We aim to accomplish this by:

- Connecting students to the ocean through curriculum related to their natural and human community
- Giving educators and administrators the support, resources, and professional development necessary to provide high-quality instruction in natural resources content
- Sustaining partnerships with community partners that represent the science, tourism, fishing, forestry, and other industries in our area

What is Ocean Literacy?

Understanding the ocean's influence on you, and your influence on the ocean

The ocean covers most of our planet, is the source of most life on Earth, regulates our weather and climate, provides most of our oxygen, and feeds much of the human population. Our coastal ecosystems - and our way of life - are under threat from human activities. Better public understanding of the ocean and coastal communities is an important part of resolving these complex and critical issues. This understanding begins with our youth.

An ocean-literate person:

- understands fundamental concepts about our oceans and coasts
- can communicate about the ocean in a meaningful way
- makes informed and responsible decisions regarding coastal resources

Resources we offer

- Monthly Newsletter
- Online Resources Library
- Curriculum and field trip support
- Teacher and administrator training
- Annual Coastal Learning Symposium and other workshops

Learn more

Visit our website at www.tinyurl.com/LCOLP
Or contact the Teacher Programs Manager at:
sara.shawroberts@aquarium.org / 541-867-3474 ext. 5317.

CONNECTING FIELD TRIPS TO CLASSROOM CURRICULUM

Research and common sense show that field trips are much more memorable, impactful, and effective when deliberately connected to classroom curriculum. Having clear ties to what you're working on in class helps build student knowledge, while also making the entire curriculum more relevant. Use these tips to create a cohesive learning experience.

Identify your learning goals

Before planning your field trip or any of the supporting curriculum, ask yourself: *What do I want students to gain from this experience?* Do you have specific topics or concepts you'd like to address? Skills you would like students to practice? It's important to identify these at the very beginning so that you can incorporate them into both field trip and classroom activities.

Identify 1-3 specific concepts or skills you would like students to become proficient in by the end of the unit. Think about how students will demonstrate achievement of these Learning Goals, and what education standards they meet. Then, identify which Learning Goal(s) *each* planned activity – both in the classroom and during your field trip – will support. See Pages 3-4 of this document for planning templates and pages 5-10 for an example fieldtrip-driven unit plan.

Before your field trip

Classroom activities done prior to your field trip can serve several purposes:

- **Build knowledge** of the concepts or topics they will explore during their field trip
- **Practice skills** or use tools they will use during their field trip
- **Meet experts** who can introduce the topics students are exploring
- **Introduce expectations** and rules you wish students to follow during the field trip
- **Orient students** to what they will see and do

During your field trip

Some ways you can actively support classroom work during the field trip:

- **Prepare an effective worksheet** that incorporates Learning Goals and provides guidance for students about what to focus on (see our Teacher Resources page for our *Guide to Designing a Great Field Trip Worksheet*)
- **Sign up for an education program** that relates to your Learning Goals, if available
- **Enlist experts at the site** to guide students, answer questions, or provide special opportunities such as career interviews or a private tour

NOTE: Not sure what learning opportunities your field trip site can provide? JUST ASK! Many sites welcome teachers who wish to work with them on special programs, and developing these relationships can help spark authentic student projects long into the future.

After your field trip

It's important not to let the opportunity to continue learning slip away once you get back to class!

- **Review and reinforce** what they learned during the field trip
- **Investigate questions** that came up during the field trip
- **Build on the experience** with related projects and experiments
- **Use it as a segue** into the next learning unit!

SIMPLE IDEAS FOR PRE- AND POST-FIELD TRIP PROJECTS

Before the Field Trip

- Have students draw a picture of what they think the field trip site will be like and what they'll see there. Use the drawing as an assessment tool by having students adjust their picture after the field trip.
- Ask students to research the history of the field trip site and explain its significance in the local community.
- Have students practice visual observation skills in the classroom or on school grounds by asking them to imagine themselves as alien visitors to Earth, then describe ordinary objects (such as a hairbrush, clothespin, blade of grass, etc.) in detail.

After the Field Trip

- Have students select an animal or object to observe closely at the field trip site, then write a story or research report about it.
- Ask students to invent a new species of animal, or a new version of an object or artifact they saw during their field trip. Have them build a model and give a presentation sharing why they think their invention is an improvement on the original.
- Challenge students to research an age-appropriate conservation or social issue related to their field trip site, and ask them to come up with ways to prevent or mitigate this issue.

ADDITIONAL RESOURCES

Visit our Teacher Resources page for more tools and field trip information.

Visit our Ocean Literacy Partnership Resources Library for activities, curriculum, and background information on a number of ocean topics.

See our Map of Lincoln County Field Trip Sites and Community Partners.

Contact Oregon Coast Aquarium's Teacher Programs Manager for curriculum planning, field trip support, and help connecting to community partners.

TEACHER PLANNING PAGE FOR FIELDTRIP-CONNECTED CURRICULUM

Learning goal(s) for *overall unit*:

1. Specific topics?

2. Broad concepts?

3. Skills or behaviors?

How will the field trip support these learning goals?

How will classroom curriculum support these learning goals?

BEFORE field trip:

AFTER field trip:

What questions will students investigate and answer throughout this unit? (*NOTE:* Make sure these directly support your Learning Goals!)

Education standard(s) being addressed or worked towards:

FIELD TRIP UNIT PLANNING CALENDAR

UNIT NAME/THEME:	Field Trip Site:	Time Frame:
Learning Goals – Student will:	Questions students will investigate and answer:	

WEEK__*

DAY 1	DAY 2	DAY 3	DAY 4	DAY 5
Question to investigate: Objective(s): Activity: Connection to Field Trip:	Question to investigate: Objective(s): Activity: Connection to Field Trip:	Question to investigate: Objective(s): Activity: Connection to Field Trip:	Question to investigate: Objective(s): Activity: Connection to Field Trip:	Question to investigate: Objective(s): Activity: Connection to Field Trip:

NOTES:

*make copies of this page as needed for multiple weeks

TEACHER PLANNING PAGE FOR FIELDTRIP-CONNECTED CURRICULUM

Learning goal(s) for *overall unit*:

1. Specific topics?

Students will identify adaptations as features that ocean organisms have which help them to get food, find mates, grow, and survive in their unique habitat.

2. Broad concepts?

Students will understand that all living things have internal and external structures that help them to survive where they live.

3. Skills or behaviors?

Students will practice scientific observation skills and using evidence to support their statements.

How will the field trip support these learning goals?

At Oregon Coast Aquarium, students will observe a diversity of ocean species and identify visible adaptations they have for survival in their specific habitats.

How will classroom curriculum support these learning goals?

BEFORE field trip: Activities will support students in defining the term *adaptation*; practicing scientific observation skills they will use at Oregon Coast Aquarium; and becoming familiar with species and ecosystems they will see at Oregon Coast Aquarium.

AFTER field trip: Activities will support students in identifying patterns of *external* adaptations in a diversity of living things; investigating *internal* features that help with survival; and exercising scientific skills to gather evidence about new species and habitats

What questions will students investigate and answer throughout this unit? (*NOTE:* Make sure these directly support your Learning Goals!)

- What are adaptations and how do they help living things survive?
- How do ocean organisms use their adaptations to survive in their unique habitats?
- How do scientists learn about species and their habitats?

Education standard(s) being addressed or worked towards:

NEXT GENERATION SCIENCE STANDARDS (NGSS):

Performance Expectation 4-LS1-1: Construct an argument that plants and animals have internal and external structures that function to support survival, growth, behavior, and reproduction

- *Science & Engineering Practices*: Construct an argument with evidence, data, and/or a model.
- *Disciplinary Core Ideas*: Plants and animals have both internal and external structures that serve various functions in growth, survival, behavior, and reproduction.
- *Crosscutting Concepts*: A system can be described in terms of its components and their interactions.

FIELD TRIP UNIT PLANNING CALENDAR

UNIT NAME/THEME: Ocean Adaptations (4th Grade)	Field Trip Site: Oregon Coast Aquarium	Time Frame: 2 weeks (Ten 45-minute instructional periods)

Learning Goals – Student will:

- identify adaptations as features that ocean organisms have which help them to get food, find mates, grow, and survive in their unique habitat
- understand that all living things have internal and external structures that help them to survive where they live
- practice scientific observation skills and using evidence to support their statements

Questions students will investigate and answer:

- What are adaptations and how do they help living things survive?
- How do ocean organisms use their adaptations to survive in their unique habitats?
- How do scientists learn about species and their habitats?

WEEK 1

DAY 1

Question to investigate:

How do scientists learn about species and their habitats?

Objective(s):

- Identify skills that scientists use to study the world
- Introduce field trip

Activity:

- Pre-unit KWL exercise
- "What Do Scientists Do?" reading round robin
- Review Student Contract and Parent Info page found in the OCAq Field Trip Planning Guide; send home for parents to sign

Connection to Field Trip:

Students will use these skills to make observations at OCAq.

DAY 2

Question to investigate:

How do scientists learn about species and their habitats?

Objective(s):

Practice skills that scientists use to study the world

Activity:

Schoolyard Safari

Connection to Field Trip:

Students will use these skills to make observations at OCAq.

DAY 3

Question to investigate:

What are adaptations and how do they help living things survive?

Objective(s):

Understand what an adaptation is and how it functions

Activity:

Adaptation Stations

Connection to Field Trip:

Understanding the basics of what adaptations are and why living things have them will help students explain what they see at OCAq.

DAY 4

Question to investigate:

How do ocean organisms use their adaptations to survive in their unique habitats?

Objective(s):

- Investigate common Oregon Coast species and habitats
- Prepare for field trip

Activity:

- Ecosystem Exploration
- Tidal animals exploration
- OCAq Virtual Field Trip video

Connection to Field Trip:

Students will build familiarity and knowledge of organisms and habitats they'll encounter at OCAq. They will also learn about field trip expectations.

DAY 5

Question to investigate:

How do ocean organisms use their adaptations to survive in their unique habitats?

Objective(s):

Identify and explain adaptations for coastal species

Activity:

Field trip to OCAq!

- Student Guide Book
- "It's A Rough Life" lab program
- Encourage students to use their scientist skills to closely observe species and their adaptations

Connection to Field Trip:

N/A

NOTES: Review Oregon Coast Aquarium's Field Trip Planning Guide for Teachers thoroughly before beginning this unit. As soon as possible, recruit chaperones for your field trip. Fill out the "Chaperone Information for Oregon Coast Aquarium Field Trip" pages (available in Spanish) and distribute ASAP so Chaperones have time to review and ask questions.

FIELD TRIP UNIT PLANNING CALENDAR

UNIT NAME/THEME: Ocean Adaptations (4th Grade)	Field Trip Site: Oregon Coast Aquarium	Time Frame: 2 weeks (Ten 45-minute instructional periods)

Learning Goals – Student will:

- identify adaptations as features that ocean organisms have which help them to get food, find mates, grow, and survive in their unique habitat
- understand that all living things have internal and external structures that help them to survive where they live
- practice scientific observation skills and using evidence to support their statements

Questions students will investigate and answer:

- What are adaptations and how do they help living things survive?
- How do ocean organisms use their adaptations to survive in their unique habitats?
- How do scientists learn about species and their habitats?

WEEK 2

DAY 6	DAY 7	DAY 8	DAY 9	DAY 10
Question to investigate: How do ocean organisms use their adaptations to survive in their unique habitats? Objective(s): Explore how animal adaptations reflect their natural habitats Activity: The Perfect Home Connection to Field Trip: Students can recall exhibits they saw at the Aquarium for inspiration and ideas.	Question to investigate: What are adaptations and how do they help living things survive? Objective(s): Identify patterns of adaptations in unrelated species around the world Activity: Adaptations Around the World Connection to Field Trip: Students should recall the animals they saw at OCAq.	Question to investigate: What are adaptations and how do they help living things survive? Objective(s): Investigate common internal adaptations of ocean animals Activity: In the Belly of the Beast Connection to Field Trip: Ask students to imagine what internal adaptations some of the species they saw at the Aquarium might have to help them survive in the ocean.	Question to investigate: How do scientists learn about species and their habitats? Objective(s): Practice scientific observation skills and apply understanding of adaptations Activity: Mystery Species Connection to Field Trip: Students call recall Aquarium species for inspiration, and apply the same observation skills they used there.	Question to investigate: *What do I know now that I didn't know before?* Objective(s): Reinforce knowledge gained by reflecting on the whole unit Activity: • Complete KWL from Day 1 • Identify what else they would still like to learn! Connection to Field Trip: Students should describe how their experience at Oregon Coast Aquarium contributed to their knowledge.

NOTES: Additional resource: "Blue Whales and Buttercups" book from the *Seeds of Science* reading series – all about variation and adaptation

The comprehensive collection of various types of adaptations at this BBC Nature page is a great general resource!

EXPLANATION OF "OCEAN ADAPTATIONS" EXAMPLE UNIT ACTIVITIES

Day 1

Pre-unit KWL exercise – On a large white board or sheet of chart paper, create a 3-column KWL chart with the first column labeled "Know", the second column labeled "Want to learn", and the third labeled "Learned". As an introduction to this unit, ask students: *What do you already know about how ocean animals survive?* Record answers in the first column. Then ask, *What do you want to learn about how ocean animals survive?* Record answers in the second column. Tell students that using classroom activities and a field trip to Oregon Coast Aquarium, we are going to answer the following questions: *What are adaptations and how do they help living things survive? How do ocean organisms use their adaptations to survive in their unique habitats? How do scientists learn about species and their habitats?*

"What Do Scientists Do?" **reading round robin** – give students copies of the linked Big Book about how scientists do their job: investigating the world around us. Going around the classroom, have students take turns reading one paragraph at a time.

Day 2

Schoolyard Safari – students practice skills that scientists use to study the world in the familiar habitat of their school grounds. Take students outside into a safe, quiet area in the schoolyard (or a nearby park or natural space if possible). Ask students to share questions they have about what they see around them. (Student curiosity will vary but may include questions such as *what animals live here?* Or *why is there so much grass and no trees?* Tell students that they will use several important tools that scientists use to answer the questions they have about the world: their eyes, their ears, and their hands. Direct students to spread out in the designated area and choose a one-square-foot area to closely study in as much detail as possible. They should use their *eyes* to observe the colors, shapes, sizes, and patterns they see in their study site; their *ears* to observe sounds nearby and caused by them touching or tapping things in their site; and their *hands* to observe the texture and temperature of how things feel in their site. They should write all these observations down in a field journal and include drawings if they wish.

- Materials needed: Field journals, pencils, rulers (to estimate their one-square-foot area), hand lenses (optional)

Day 3

Adaptation Stations – Before class, print out the prompts for each station (see below) in large print and place each on a table with that station's materials. Place students into four groups. If you haven't already, define *adaptations* as *features that all living things have which help them survive where they live.* Tell students that they are going to rotate between four different stations representing four different types of adaptations: moving, eating, hiding, and mating. Send each group to start at a different station and allow them to explore the materials for a designated amount of time (at least 8-10 minutes) before asking them to rotate to the next station.

1. *Moving Adaptations Station:* Have students act out descriptions of how specific animals move (examples: a seal galumphing, a lion stalking, a bird hopping between branches, etc.)
   - Materials: pictures of several animals with short descriptions of how they move
   - Prompt: "Read the descriptions of how these animals move. Then take turns acting them out!"
2. *Eating Adaptations Station*: Students will use everyday materials that represent mouth and jaw adaptations to attempt to hunt different types of food.
   - Materials: For mouths: clothespins, chopsticks, tweezers, spoons; for foods: pennies, beads, toothpicks; two small rubs (one for mouth items and one for food items)
   - Prompt: "Choose a mouth and experiment with what type of 'food' you can most easily capture!"
3. *Hiding Adaptations Station*: Students will match cut-out images of different animals to the habitat they think it lives in based on each animal's camouflage.
   - Materials: cut-out pictures of various animals; fabric (or magazine) swatches that are similar to each animal's coloration
   - Prompt: "Match the animal to its 'habitat' based on the colors and textures you see."

4. *Mating Adaptations Station*: Students will observe both extreme and more subtle features that animals have to attract mates.
   - Materials: Pictures of animals with striking mate-attracting features (peacocks, cuttlefish, narwhals, etc.)
   - Prompt: "Check out these crazy critters! What features do you see that might help them to attract a mate?"

NOTE: The BBC Nature Adaptations site lists numerous species with different types of adaptations. You can find pictures and more resources for each station at the linked site.

Day 4

Ecosystem Exploration – Using the Oregon Coast Aquarium's Oceanscape Network, explore the ocean and coastal ecosystem pages with students. There is a plethora of information on this site, so base your explorations on the time available and student interest (ask: *what do you want to learn more about?*). The goal of this activity is to familiarize students with some of the habitats they'll encounter at Oregon Coast Aquarium, so focus on the Sunlit Zone (in the Open Sea section), Beaches and Estuaries (in the Coastal Areas section), and Reefs and Kelp Forests (in the Coastal Waters section).

Tidal animals exploration – Similar to the exploration above, use the interactive illustration of common Oregon tidal animals found on the Oceanscape Network to investigate some of the species that students will see at the Aquarium. Click each organism's name for information and pictures.

OCAq Virtual Field Trip video – Play the 7-minute video located on the Aquarium's Teacher Resources Page. This will introduce students to what they will see on their field trip, rules they should follow, and your expectations for what they will learn at the Aquarium.

Day 5 - Field trip to OCAq!

Student Guide Book – Use the self-guided workbooks for Grades 3-5 available at the Aquarium Front Desk to direct student learning and give them a space to record observations while walking around the Aquarium.

"It's A Rough Life" lab program - The rocky shore is a tough neighborhood. In this on-site lab program, students will learn about the remarkable ways tidepool residents are adapted to weather the extremes of life on the rocks.

Throughout the field trip, encourage students to think about our main driving question: *How do ocean animals survive?*

Day 6

The Perfect Home – In this activity, students will design an aquarium exhibit for an Oregon Coast species to explore how animals' adaptations reflect their natural habitats. Ask each student to choose an animal that they saw at Oregon Coast Aquarium (if they can't recall an exact species, use our Explore Our Exhibits pages to find and learn more about it). Then have students sketch out the perfect exhibit space for that species based on its needs. Exhibits should reflect that animal's unique adaptations and be as close to its natural habitat as possible. Encourage students to recall the different components they observed in the Aquarium exhibits (places to hide, lighting, sand or rocks, etc.). When designs are complete, ask students to share their exhibit proposals and share feedback with each other.

Extension Opportunity: If time and resources allow, have students build a small scale model of their exhibit!

Day 7

Adaptations Around the World – Students will hypothesis the functions of various adaptations, then organize these adaptations into categories to identify patterns found in animals around the world. Prepare for this activity by accessing the BBC Nature Adaptations page and printing large pictures of the following 3 organisms in each of the following categories:

- *Camouflage:* Arctic Fox, Leafy Sea Dragon, Praying Mantis
- *Adapted to Gliding:* Flying Frog (featured at top of page), Great Grey Owl, Flying Fish
- *Courtship Display:* Peacock, Broadley's Flat Lizard, Giant Cuttlefish
- *Predation Defense:* Saguaros, Hedgehog, Thorny Devil

Challenge students to group the pictures into four different categories, based on what they can see in the pictures: *adaptations that help with hiding, adaptations that help with movement, adaptations that attract mates,* and *adaptations that fight predators.* After students feel they have organized all the pictures the best they can, ask them to hypothesize what specifically they believe the adaptations help the organisms do. (Answers should reflect the four BBC Nature categories listed above.)

Relate the animals pictured to ones they saw at the Aquarium. Can they think of any Aquarium animals with similar features?

Day 8

In the Belly of the Beast – Using the Common Squid as an example, students will investigate internal adaptations of an ocean species. There are a few ways you can do this activity:

- Real dissection! – The best option, of course, is to use real specimens. Buy several fresh, whole squid at the market and have students dissect them, identifying features they see. The next resource below will be very useful in guiding students through this.
- Virtual Squid Dissection – a step-by-step guide of squid anatomy with large pictures. Use the text as your guide for talking point to discuss with students as you go through the pictures.
- Interactive Squid Anatomy – use this site to explore internal and external anatomy of a colossal squid, including pictures and video (Flash Player required)

Whichever method you choose, use the following question guide to highlight key points with students:

- How many arms does the squid have? How many tentacles? Based on the structure of each, describe how their purposes differ.
- What is the function of the siphon? If water shoots out the siphon to propel the squid in the water, which direction does the squid swim?
- How does a squid breathe?
- What features do you see that are adaptations for the squid's predatory life? What adaptations help the squid avoid predators itself?
- What is the function of the pen (gladius)?

As a wrap-up activity, ask students to recall animals they saw at the Aquarium that may have similar anatomy and adaptations.

Day 9

Mystery Species – By the end of this unit, students have seen a huge variety of adaptations in many different types of plants and animals. Challenge students to invent their own species of organism inspired by all they have learned! Students should first ask themselves the following questions about their new species:

- Where does it live?
- What and how does it eat?
- Does it have any predators?
- How does it find mates?
- How does it move?

Then students can sketch (or build, if time and resources allow) their new species for the first half of the class period. Be sure they name their unique new species! In the second half of the period, have students exchange sketches only (with no other information written on them) and have students describe their classmates' species habitat and lifestyle based on the adaptations they can observe. Have the owner of each sketch confirm, deny, and explain their classmates' guesses.

Day 10

Complete KWL Chart from Day 1 – Return to the three-column chart you started at the beginning of this unit. Remind students of the questions they were investigating throughout this unit: *What are adaptations and how do they help living things survive? How do ocean organisms use their adaptations to survive in their unique habitats? How do scientists learn about species and their habitats?* For the blank third "Learned" column, ask students to share everything they learned about how ocean animals survive. Congratulate students on all of their new knowledge!

Identify what else they would still like to learn! - Review the "Want to learn" list on the KWL Chart with students. Did they learn everything they wished to? Check off the things they did learn, and circle what they did not. Topics they didn't cover can become student research projects or be integrated into future units!

EXPLORING OREGON'S ROCKY SHORES

A TEACHER'S GUIDE

OREGON COAST AQUARIUM

"THE SEA, ONCE IT CASTS ITS SPELL, HOLDS ONE IN ITS NET OF WONDER FOREVER."

-Renowned ocean scientist and explorer, Jacques Yves Cousteau

TABLE OF CONTENTS

ABOUT THIS GUIDE

This *Teacher's Guide to Exploring Oregon's Rocky Shores* was developed in conjunction with a workshop by the same name, held on August 5, 2017 at Oregon Coast Aquarium. This curriculum packet is designed for workshop attendees as well as other interested educators to support a Rocky Shores unit for Grades 3-5. The enclosed materials could also be adaptable for older or younger students.

This guide contains supporting information and resources to answer 4 Driving Questions, plus an Introductory Activity, Wrap-Up and Reflection Activities, and 2 field trips. You will find background information, step-by-step instructions for activities, tips for successful teaching, and more. We also provide resources to help you build your content knowledge and find additional activities and materials. This Guide is designed to be interactive, with embedded links you can easily access for more information throughout. A digital version of this document is available at aquarium.org/education/teacher-resources/.

We hope you find this Guide helpful and that you enjoy engaging your students in the science and wonder of the rocky shores! Please don't hesitate to contact our School Liaison (listed below) with questions or comments, or for additional support and resources.

Sara Roberts

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WHY TEACH ABOUT OREGON'S ROCKY SHORES?

Local connections

Rocky shores and intertidal habitats make up the majority of Oregon's shoreline – about 62%, according to the Oregon Parks and Recreation Department. This defining feature of our coast not only provides habitat for numerous unique species of seaweeds, fish, mammals, invertebrates, and birds, but is an important resource for humans as well. Rocky shores and their tidepools serve as nurseries for juvenile animals, some of which grow up to become important staples for the commercial fishing industry, such as Rockfish and Red Rock Crabs. In Oregon, the fishing industry is a significant part of our state economy, contributing around $150 million to the economy annually. Our state also has a number of Marine Reserves, protected areas where human use is limited and wildlife thrives, providing high biodiversity zones that then spread and help restore populations in surrounding waters. Oregon's wild shores are also an important part of our history and culture. Native peoples have been harvesting shellfish, salmon, and plants along the coast for at least 12,000 years. Before Oregon's highways were built, brave travelers used the beaches as roads for cars and horses to travel between coastal towns. Today, all people can freely access the coast thanks to the Oregon Beach Bill. Our beaches give us a place of sanctuary and peace, a space where we can connect with friends and loved ones, and inspire a sense of wonder. We encourage you to tap into these deeply personal, intrinsic connections to the coast with your students to make the science more meaningful.

Next Generation Science Standards

The Next Generation Science Standards (NGSS) emphasize hands-on, student-driven investigation, and a systems approach to learning that spans the bridge between nature, science, and people.

There are a number of Performance Expectations within the NGSS which can be supported or met by this curriculum. See the first page of each activity for a list of specific NGSS Performance Expectations aligned to that activity. Of course, depending on how you adapt these activities, you may be able to meet additional NGSS standards. Check out the NGSS website to browse the standards by topic, grade level, and more.

The Three Dimensions of the NGSS include Science and Engineering Practices, which real professionals in those fields must use in their work; Disciplinary Core Ideas, which are content knowledge benchmarks related to the various sciences; and Cross-Cutting Concepts, which are big ideas about how the world works. By following this curriculum, you can meet a number of standards across the Three Dimensions, including:

Science & Engineering Practices	Disciplinary Core Ideas	Cross-Cutting Concepts
Constructing explanations and designing solutions	Variation of traits	Cause and effect
Engaging in argument from evidence	Adaptation	Systems and system models
Developing and using models	Structure and function	Energy and matter
Obtaining, evaluating, and communicating information	Interdependent relationships in ecosystems	Patterns
	Human impacts on Earth systems	

Common Core for Math, Literacy, and Social Science

Common Core State Standards (CCSS) for multiple subjects can easily be incorporated into a rocky shores unit, even if your emphasis is on science. Adding exercises that involve reading, writing, math, history, and civics will give students a more meaningful understanding of our shorelines. This type of interdisciplinary teaching has also been proven to help information "stick" much more effectively. Throughout this Guide, we have included activities and exercises that help meet the CCSS for Grades 3-5. Just as with the NGSS, we encourage you to consult the Oregon Common Core Standards to check exactly which standards you may be addressing with your particular rocky shores unit.

Ocean Literacy

Ocean Literacy is *an understanding of the ocean's influence on you, and your influence on the oceans*. This includes knowledge of fundamental ocean concepts, the ability to communicate about the oceans in a meaningful way, and the power to make informed and responsible decisions regarding the ocean and its resources. In the early 2000's, stakeholder groups from across the country worked together to produce a Framework for Ocean Literacy for Grades K-12, identifying the most important concepts one should understand to be an ocean literate citizen. There are Seven Essential Principles of Ocean Literacy:

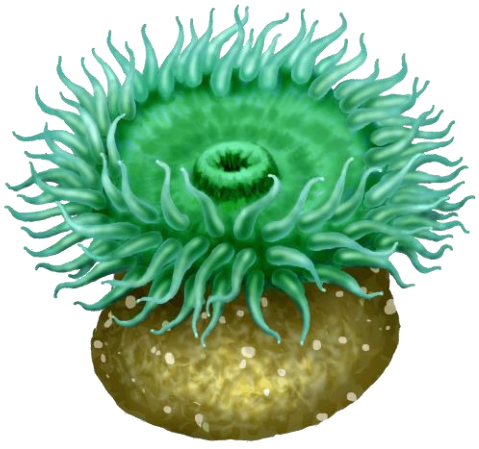
1. The Earth has one big ocean with many features.
2. The ocean and life in the ocean shape the features of Earth.
3. The ocean is a major influence on weather and climate.
4. The ocean makes Earth habitable.
5. The ocean supports a great diversity of life and ecosystems.
6. The ocean and humans are inextricably interconnected.
7. The ocean is largely unexplored.

Each Ocean Literacy Essential Principle has several Fundamental Concepts, which outline more specific learning goals. The Framework also includes a Scope and Sequence for Grades K-12, which shows how to most effectively address concepts at each grade band. Each activity in this curriculum is aligned with one or more Essential Principles and Fundamental Concepts of Ocean Literacy; see the "aligned standards" section of each activity for details.

Environmental Literacy

Oregon's environmental resources serve as a foundation of our state's economy and have created a dynamic heritage, one that we want to ensure and sustain for generations. Preparing Oregon's children to protect this valuable legacy and to understand their relationship to it is challenged by the fact that many of our youth are utterly disconnected from the natural environment. To create a sustainability-minded citizenry, we must instill an environmental ethic from a young age. In Oregon, environmental literacy is defined by the Oregon Environmental Literacy Plan (OELP). This plan was generated by a diverse task force created by the No Oregon Child Left Inside Act (HB 2544) in 2010. Environmental literacy is defined as *an individual's understanding, skills and motivation to make responsible decisions that considers his or her relationships to natural systems, communities, and future generations.* OELP goals addressed by this curriculum include:

- Treasure outdoor experiences
- Demonstrate love and respect for nature
- Participate as active, informed members of their local and global communities
- Strive to envision what a sustainable future looks like
- Understand the dynamics of systems and change
- Recognize the need for diversity in all systems
- Become applied, lifelong learners



STUDENT LEARNING GOALS AND DRIVING QUESTIONS

By the end of this unit, students will be able to:

- Explain how tides work and how they affect rocky shore animals
- Identify common rocky shore organisms
- Describe common intertidal adaptations and how they function
- Feel a greater sense of connection to the rocky shore
- Demonstrate awareness and respect for nature by following proper tidepooling etiquette
- Understand how humans impact rocky shore organisms, and what they can do to mitigate those impacts

These goals will be achieved through hands-on investigation of four Driving Questions:

1. *What are rocky shores?*
2. *How do tides work?*
3. *What lives at the rocky shore?*
4. *How can we care for rocky shores?*

This Teacher's Guide (and the workshop it accompanies) was designed to support the ideals of Project-Based Learning. Project-Based Learning, also known as PBL, is a teaching method in which students are engaged throughout a curriculum by a meaningful question to explore, a real-world problem to solve, or a challenge to design or create something. Students practice inquiry by developing their own questions and determining how to answer them. At the conclusion of a PBL unit, they demonstrate their learning through the creation of high-quality products and presentations of their work to others. While this curriculum is not a complete PBL unit, it could easily be extended into a longer project in which students investigate the Driving Questions as part of the bigger picture. To generate a true PBL unit, you can use the above Driving Questions to provide background and context within a larger, authentic question, such as *How do tide pool animals cope with changes to their environment?* or *What can we as students do to protect rocky shore life?* The key to a good authentic question is that it has local application, is open-ended, and can yield an impactful product or presentation at the end. This Resources Page is a great place to start, or contact the Oregon Coast Aquarium School Liaison Sara Roberts at sara.shawroberts@aquarium.org for PBL guidance and support.

SUGGESTED TIMING AND TEACHING SEQUENCE

Time requirements

This guide contains supporting background information and materials for 4 Driving Questions (D.Q.'s), an Introductory Activity, Wrap-Up and Reflection Activities, and 2 field trips. Each of these is designed to accommodate the typical class period, taking between 30-50 minutes. Assuming one day for a field trip to Oregon Coast Aquarium, and one day for a field trip to the tidepools (though these can also be done on the same day), you can expect this entire curriculum to take two school weeks, or between 6-8 class periods. If your time is limited, you may also choose to use only one or two of the enclosed activities. If you choose to use this curriculum as an accompaniment to a Project-Based Learning unit, it will require a longer time commitment – anywhere between two weeks and two months, with these investigations interspersed with your PBL work time.

Teaching sequence

In general, this guide was designed to be followed as written; that is, the investigations are provided chronologically. Of course, due to time and resource availability and field trip scheduling, you may also choose to "jump around" as appropriate. The activities were designed to be implemented in the classroom between field trips to the beach and to Oregon Coast Aquarium. Regardless of when your field trips occur, we encourage you to generally follow the 4 investigations in the order they are provided. This sequence was specifically designed to build student inquiry, from specific knowledge, to broader understanding, and finally to genuine care and concern for rocky shore ecosystems.

Suggested timeline

DAY 1: Introductory Activity

DAY 2: D.Q. 1: What are rocky shores? (Activity: *Moving with the Tides*)

DAY 3: D.Q. 2: How do tides work? (Activity: *The Sun, the Moon, and the Tides*)

DAY 4: Field trip to Oregon Coast Aquarium

Day 5: D.Q. 3: What lives at the rocky shore? (Activity: *Invent a Rocky Shore Creature*)

DAY 6: D.Q. 4: How can we care for rocky shores? (Activity: *Tidepool Obstacle Course*)

DAY 7: Field trip to the rocky shore

DAY 8: Wrap-up and Reflection Activities (may be done during rocky shore field trip)

INTRODUCTORY ACTIVITY

Time: 30-45 minutes | **Materials:** white board or paper; writing/drawing implements

What exactly are rocky shores? Chances are, if you've lived in Oregon for some time, both you and your students have visited at least one of our state's many rocky beaches. But it can be hard to explain what exactly makes rocky shores what they are – besides rocks!

Engage (5 mins): To introduce this unit and help students to recall their own experiences, ask students to show by a raise of hands who has been to a rocky shore. Ask them to describe their experience – *what did they see, hear, smell, and feel?* Write down these responses on the board. If you have a class of students who have largely never been to the beach, it will help to begin by showing this video and asking them to describe what they notice.

Explore (20 mins): Next, tell students that they are going to create a picture of what they think the rocky shore is – what it looks like, what lives there, anything they wish to include. This should be an open-ended challenge with very little guidance given, to encourage students to generate the drawing on their own. This serves as an excellent pre-unit assessment of their current knowledge. Give each student a piece of paper and writing implements with which to draw and allow them to do so uninterrupted.

Explain (5 mins): After sufficient time has been given for them to draw, ask them to describe what they created, pointing out the various features and explaining why they put them there. Do not correct or add to what they have drawn; again, the point of the exercise is to activate students' prior knowledge and to assess what they already know and understand (or don't) about rocky shores.

Evaluate: Can students clearly explain the features of their drawings?

NOTE: Make sure you collect and save the drawings. (They can also be displayed around the room!) This activity will be used again at the end of the unit to compare their baseline knowledge to what they learned.

Expand (15 mins): If time allows, read a related book. *Life in a Tidepool* by Allan Fowler, *In One Tidepool* by Anthony Fredericks, *Between the Tides* by Fran Hodgkins, and *Science Chapters: All About Tide Pools* by Monica Halpern are good options for elementary students.

Aligned Standards

Next Generation Science:

5-ESS2-1. Develop a model using an example to describe ways in which the geosphere, biosphere, hydrosphere, and/or atmosphere interact.

Common Core for English Language Arts:

College and Career Readiness for Reading – 7: Integrate and evaluate content presented in diverse media and formats, including visually and quantitatively, as well as in words.

Ocean Literacy:

Principle 5: f. Ocean ecosystems are defined by environmental factors and the community of organisms living there.

Principle 6: c. The ocean is a source of inspiration, recreation, rejuvenation, and discovery.

D.Q. 1: WHAT ARE ROCKY SHORES?

BACKGROUND INFORMATION

Life in the intertidal

"Rocky shore" is a broad term that encompasses a number of habitats, from the underwater subtidal zone to the nearly dry splash zone. Simply put, it is an area of the ocean shoreline where rocks, rather than sand, are the dominant substrate. It is a place where the tides are the driving force, changing the conditions from hour to hour and influencing all organisms which live there. Because of this, rocky shores are also known as the *intertidal zone.*

In Oregon, there are two low tides and two high tides every day. The changes which occur during and between these tides are drastic. Imagine a bucket of water left outside in the sun all day. What would happen to it? You could easily observe that the temperature increased, and you may be able to see that the water level lowered due to evaporation. With a little more investigation and some special tools, you would also find that oxygen levels decreased.

The spaces between the rocks in the intertidal zone, also known as *tide pools*, act just like this bucket. When the tide is in, cold, oxygen-rich seawater sweeps into the tidepools, restoring the temperature and bringing nutrients to the animals living there. But when the tide recedes, the temperature of the water begins to rise in the sunlight. Oxygen is used up by the animals and microorganisms living in the tide pools. Water evaporates, lowering the water levels and also raising salinity (the amount of salt in the water) – because the salt is left behind when the water evaporates. Rainfall can help lower the temperature, but also lowers salinity. The returning cycle of the high tide brings a return to more normal ocean conditions, but also risks: pounding waves can beat animals around and rip them from the rocks, and can also bring predators into the tidepools, such as octopus.

The organisms living in the tidepools must be adapted to withstand all of these extreme conditions: wet and dry, cold and warm, salty and fresh, and everything in between. Because of this, tidepool animals are some of the most resilient creatures on our planet.

Sea stars and anemones cluster towards the diminishing water in a tidepool.

LEARN MORE!

Visit NOAA Ocean Explorer's Virtual Tidepool

Intertidal Zones

The various zones at a rocky shore are determined by their location and their exposure to the air and water. From highest to lowest geographically, these are:

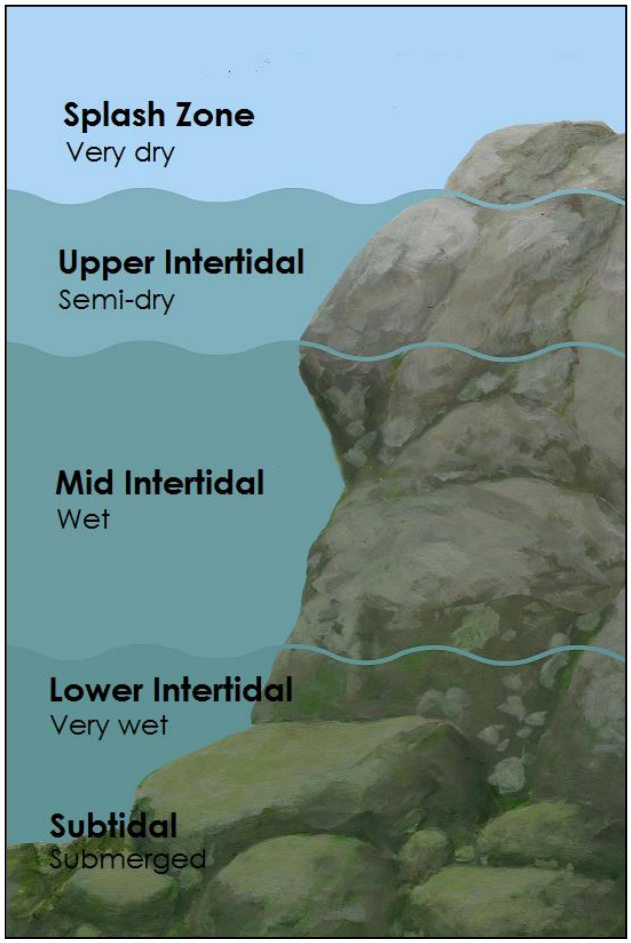
Splash Zone: The splash zone is above the surf line most of the time. It is reached by waves only during storms and the highest tides, but is splashed and sprayed occasionally by the waves below it.

Upper Intertidal Zone: The high tide zone is almost always exposed to the air, except during the highest high tides.

Mid Intertidal Zone: Extending from just below average sea level to the upper limit of the average low tides, this is the largest zone, and is covered and uncovered by water twice each day as the tides roll in and out.

Lower Intertidal Zone: This area is covered by water most of the time. It is exposed to air only during the lowest low tides.

Subtidal: The subtidal zone is covered with water almost all of the time. It may be exposed to air only during extreme low tides, known as *negative tides*.



The rocky shore also includes the beach itself, which can be made up of sand, shells, pebbles, or some combination of all those substrates. A number of animals from nearby habitats may visit this area of the rocky shore, even if they are not considered "marine" species. These may include turkey vultures, coyotes, raccoons, and more. Offshore, large marine mammals will often visit the edges of tidepools to hunt or rest, such as gray whales, dolphins, and sea lions.

LEARN MORE!
Visit Oregon Coast Aquarium's Oceanscape Network and Oregon Tide Pools

D.Q. 1: WHAT ARE ROCKY SHORES?

STUDENT ACTIVITY: MOVING WITH THE TIDES

Time: 15 minutes for prep, 45-50 minutes for activity | **Materials:** Sidewalk chalk (if doing activity outdoors) or masking tape (if doing indoors); "Critter Cards" (pg 16-17) printed and cut out

Conditions at the tidepools are always changing, and sometimes, the locations of the animals living there change with it! Some species are stuck to the rocks and don't move around, but others are mobile, and they follow the tides as the water moves up and down the rocks. In this activity, students will learn how rocky shore animals move into different tidal zones throughout the day during high tide, mid tide, and low tide.

Preparation (before students arrive) (15 mins): Set up the activity area, preferably outside on a paved area, or in a cleared space in a large classroom. You will need to create the five intertidal zones on the ground using sidewalk chalk or masking tape to designate each area, in the following order: *Subtidal, Lower Intertidal, Mid Intertidal, Upper Intertidal, Splash Zone.* Each area should be large enough for several students to stand in it a time. Label each zone with the chalk (or written labels). Next, print and cut out the "critter cards" provided on pages 16-17. Depending on your class size, you will have 2-5 students playing the role of each creature, so make sure you make enough copies for your class.

Engage (15 mins): Using the information provided on the previous pages, introduce students to the changing conditions found at the rocky shore throughout the day. Describe how temperature, salinity, and oxygen levels are different at high tide versus low tide. Ask students, *what would you do if you were standing outside and it started to rain? What if it got really hot? Would you stay where you are?* Of course not! Students would move somewhere to find shelter, and rocky shore organisms do the same thing: they move with the tides to where they can find more favorable conditions. Some animals prefer very wet conditions, while others prefer dry conditions, and still others can tolerate both dry and wet. Finally, describe the five intertidal zones found at the rocky shore, describing the wetness versus dryness typically found in each zone. Replicate the visual on the previous page on the board to provide students a visual aid of how the intertidal zones are arranged.

Aligned Standards

Next Generation Science:

3-LS4-3. Construct an argument with evidence that in a particular habitat some organisms can survive well, some survive less well, and some cannot survive at all.

4-LS1-1. Construct an argument that plants and animals have internal and external structures that function to support survival, growth, behavior, and reproduction.

5-ESS2-1. Develop a model using an example to describe ways in which the geosphere, hydrosphere, biosphere, and/or atmosphere interact.

Ocean Literacy:

Principle 5: f. Ocean life is not evenly distributed through time or space due to differences in abiotic factors such as oxygen, salinity, temperature, pH, light, etc.

Principle 5: h. Tides, waves, predation, substrate, and/or other factors cause vertical zonation patterns along the coast. These patterns influence distribution and diversity.

Explore (25-30 mins): Tell students they are each going to play the role of a different rocky shore animal. They will each get a "Critter Card" describing their animal, and how well they can cope with wet and dry conditions. It will also tell them what zones they can be found in throughout the day: at Low Tide, at Mid Tide (between high and low tides), at High Tide, and at extreme high and low tides. Hand out the Critter Cards. Depending on your class size, you will have 2-5 students playing the role of each creature. Give students a few moments to review the information on their Critter Card.

Next, show students the "intertidal zone" – the activity area you set up earlier. Tell students you will be announcing the tides as they change in your "intertidal zone". Point out the various intertidal zones, ensuring students know where each is and that the labels are clearly visible.

Begin the activity at "Mid Tide". Tell students it is now Mid Tide, and they should begin by finding their correct intertidal zone for that time of day. Then, tell students that the tide is rolling in. Use or adapt the following narrations: *The tide is coming in. Slowly, the water creeps up the rocks, filling empty tidepools, reaching higher and higher until – HIGH TIDE!* Once High Tide is announced, students should change zones based on where their animals would now be found. Then, the tide begins to recede again: *Water levels begin to fall. The upper rocks become uncovered as the tide goes out, washing down to pool in the Mid Intertidal Zone – MID TIDE!* Now students should move to the intertidal zone where they are found during Mid Tide, the time between High and Low Tide. Continue on to Low Tide: *The tide is going out more and more. Water is left behind in the tidepools to warm in the sun, as the sea washes out along the Lower Intertidal zone – LOW TIDE!* Once again, students should move to the zone their animal is most comfortable in during this tidal phase.

After this first round, students should have the hang of it, and you can introduce the Super Low and Super High tides. Tell students that unlike normal low and high tides, which happen twice daily, these extreme tides happen only rarely, when the Sun, Moon, and Earth are positioned just right. You don't need to elaborate on this now, but tell students they will learn more about how this works later. These extreme tides can move animals far beyond their normal range. At Super Low tides, the Subtidal can become exposed to the air, and at Super High tides, the Splash Zone can become quite wet. Go through the tide cycle again, this time including the Super Low and Super High tides. Encourage students to note where and how the organisms move during these extreme low and high tides.

Repeat the tide cycle as many times as you would like, perhaps speeding up your announcements to add an element of "racing" across the activity area (but remind them this process takes many hours in nature!).

The following chart shows the correct location of each Critter during each tidal phase:

	Super Low Tide	Low Tide	Mid Tide	High Tide	Super High Tide
Harbor Seal	Subtidal	Subtidal	Subtidal	Splash Zone	Lower Intertidal
Hairy Hermit Crab	Subtidal	Lower Intertidal	Mid Intertidal	Upper Intertidal	Splash Zone
Ochre Sea Star	Lower Intertidal	Mid Intertidal	Mid Intertidal	Upper Intertidal	Upper Intertidal
Purple Sea Urchin	Subtidal	Lower Intertidal	Mid Intertidal	Mid Intertidal	Upper Intertidal
Rockfish	Subtidal	Subtidal	Subtidal	Lower Intertidal	Mid Intertidal
Giant Pacific Octopus	Subtidal	Subtidal	Lower Intertidal	Mid Intertidal	Upper Intertidal

Explain (5 mins): Ask students to share their observations about how the "critters" moved as the tides changed. Were they able to observe any patterns? Students may be able to note that in general, animals moved down into the lower zones during low tides, and up into the upper zones at high tides. During most of the tide cycle, most of the organisms were somewhere between the Subtidal Zone and the Upper Intertidal. This is because most rocky shore organisms are adapted to some degree to living underwater and so cannot survive in the driest Splash Zone. One exception to this pattern is the Sea Lion, which basks on the rocks in the Splash Zone at High Tide, and is able to swim into the Lower Intertidal during Super High tides.

Expand (5 mins): Ask students to think about how rocky shore animals that cannot move – such as barnacles and mussels – cope with the changing tide conditions. What might they do to stay wet and cool during low tides? Spend a few minutes brainstorming, but acknowledge it's alright if they don't know the answer – they will learn more about these organisms' adaptations during a later activity.

Evaluate: Can students name the five intertidal zones found at the rocky shore? Are they able to describe the conditions found at each, and how these conditions change throughout the day as the tides go in and out?

"MOVING WITH THE TIDES" CRITTER CARDS

Print this page double-sided with the following page. Make enough copies so that each of these six "critters" has an even number of students playing it. Cut out along the dotted lines.

Harbor Seal

You are a marine mammal who likes to be in the water, except for when you're sunning yourself on the rocks.

Super Low Tide: Subtidal Zone
Low Tide: Subtidal Zone
Mid Tide: Subtidal Zone
High Tide: Splash Zone
Super High Tide: Lower Intertidal Zone

Purple Sea Urchin

With your spiny shell, you are safe from most predators, but must stay underwater for survival.

Super Low Tide: Subtidal Zone
Low Tide: Lower Intertidal Zone
Mid Tide: Mid Intertidal Zone
High Tide: Mid Intertidal Zone
Super High Tide: Upper Intertidal Zone

Ochre Sea Star

With your suction-cup "tube feet" you move along the rocks, following the tides and your favorite food – mussels!

Super Low Tide: Lower Intertidal Zone
Low Tide: Mid Intertidal Zone
Mid Tide: Mid Intertidal Zone
High Tide: Upper Intertidal Zone
Super High Tide: Upper Intertidal Zone

Hairy Hermit Crab

You borrow shells from snails for protection, but still need a lot of water so you don't dry out!

Super Low Tide: Subtidal Zone
Low Tide: Lower Intertidal Zone
Mid Tide: Mid Intertidal Zone
High Tide: Upper Intertidal Zone
Super High Tide: Splash Zone

Rockfish

Since you use your gills to breathe underwater, you need to stay submerged to survive!

Super Low Tide: Subtidal Zone
Low Tide: Subtidal Zone
Mid Tide: Subtidal Zone
High Tide: Lower Intertidal Zone
Super High Tide: Mid Intertidal Zone

Giant Pacific Octopus

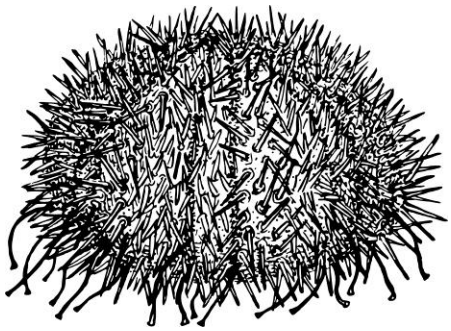
You need to stay wet, but you're able to crawl out of the sea and into the rocks hunting for crabs and fish.

Super Low Tide: Subtidal Zone
Low Tide: Subtidal Zone
Mid Tide: Lower Intertidal Zone
High Tide: Mid Intertidal Zone
Super High Tide: Upper Intertidal Zone

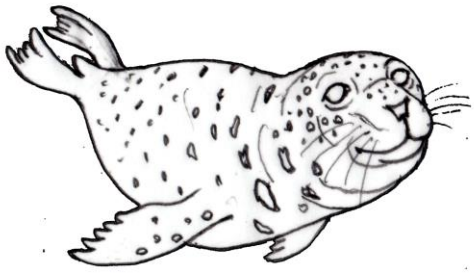
"MOVING WITH THE TIDES" CRITTER CARDS

Print this page double-sided with the previous page. Make enough copies so that each of these six "critters" has an even number of students playing it. Cut out along the dotted lines.

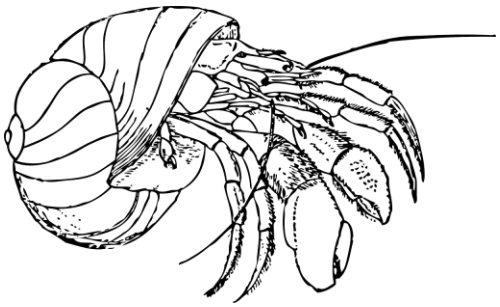
Purple Sea Urchin



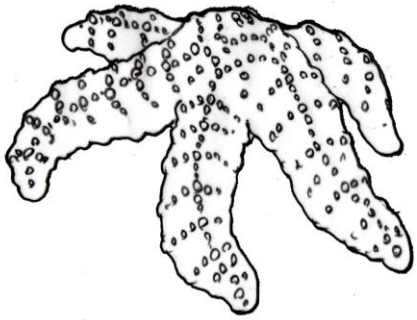
Harbor Seal



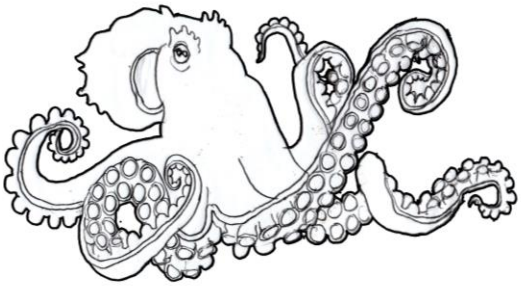
Hairy Hermit Crab



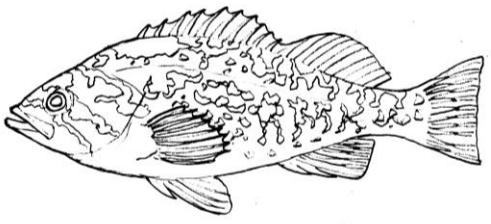
Ochre Sea Star



Giant Pacific Octopus



Rockfish



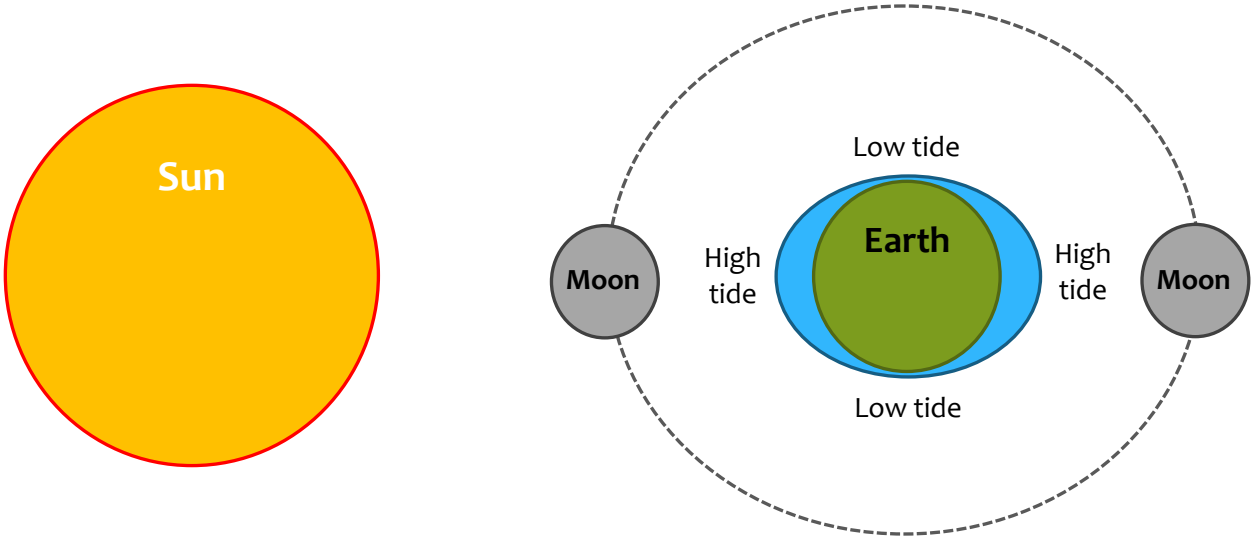
D.Q. 2: HOW DO TIDES WORK?

BACKGROUND INFORMATION

Tides are caused by the change in position of the Sun, Moon, and Earth relative to each other every day. The rise and fall of water along our shores is due to the changing gravitational forces exerted by the Sun, as the Earth moves around it, and the Moon, as it moves around the Earth. Tides are created because these huge bodies act as magnets on each other, pulling at each other's surfaces. Because water is liquid, it can actually be pulled and stretched away from Earth's surface by these gravitational forces.

Whether it is a high tide or low tide, and how MUCH of a high or low tide, all depends on the positions of the Earth, Moon, and Sun relative to each other.

Spring Tides

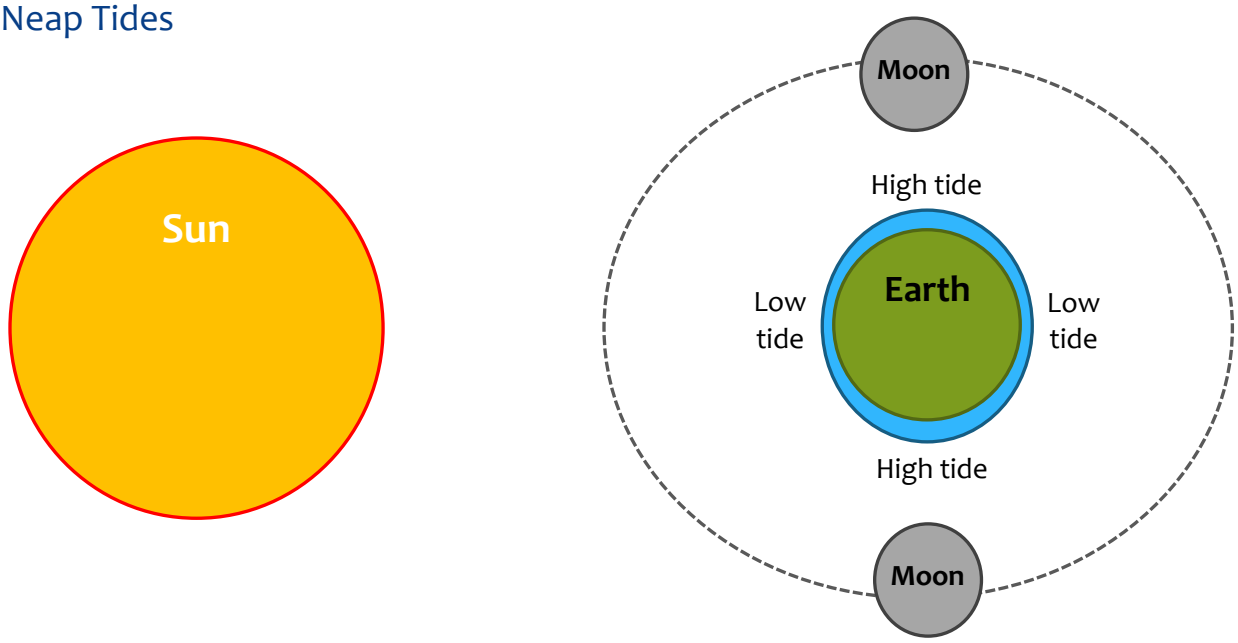


When the Sun, Moon, and Earth are lined up in a straight line, both the Moon and the Sun are exerting a gravitational force on the Earth that pulls water away from Earth's surface. At the same time, the Sun and Moon are also pulling at the Earth itself, which pulls the planet *away* from its water on the opposite side. Thus, when the Sun, Moon, and Earth are lined up, it is high tide on both sides of the Earth which are lined up with the Sun and Moon, and low tide on the other sides. When all three planets are exactly lined up and their combined gravitational forces are at the maximum – at the Full Moon and the New Moon – we have *spring tides*, which cause extremely high and extremely low tides.

LEARN MORE!

Check out Keith's Moon Page and NOAA for animated visuals and more information.

Neap Tides

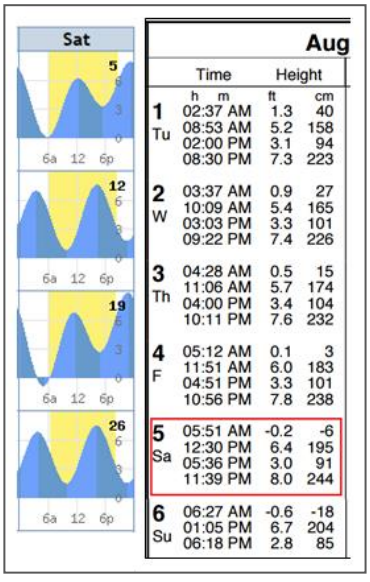


When the Sun, Moon, and Earth are perpendicular to each other, the gravitational forces of the Sun and Moon on the Earth are pulling in opposite directions and thus, they somewhat balance each other out. Water does not get pulled away from Earth's surface as dramatically, and thus, high tides are not as high and low tides are not as low. And while the Sun is a huge body and thus has a lot more gravitational force in general, it is much farther away from the Earth than the Moon. So for us, the Moon actually has a stronger tidal impact than the Sun. When all three planets are exactly perpendicular at the Quarter Moon phases, we have *neap tides* – very little change in water levels from high to low tide.

Because the Earth is also rotating around the Sun, all of these positions happen twice per day; thus there are two high tides and two low tides every day.

When is the best time to visit the tide pools?

When planning a trip to the rocky shore, it's important to first consult a tide chart or tide table. These tools predict what times the high and low tides will occur each day. It's best to visit the rocky shore when the tide is at its lowest, so that more of the tidepools are exposed and accessible. This is also the safest time, because the crashing waves will be furthest from shore. When reading tide charts, they will provide both times and heights. The average water line is considered zero; thus, a positive number denotes raised water levels, while negative numbers indicate very low water levels. The larger the number, the higher the tide. When water height is close to zero or negative (a "negative tide"), that's the best time to go to the beach!



D.Q. 2: HOW DO TIDES WORK?

STUDENT ACTIVITY: THE SUN, THE MOON, AND THE TIDES

Time: 30-45 minutes | **Materials:** Space for all students to sit in a circle and move around

Now that students know a little about how the tides affect rocky shore organisms, it's time to learn how tides work and why they happen! In this activity, students will use their bodies to model how the changing positions of the Sun, Moon, and Earth create tides.

Engage (5-10 mins): *What is gravity?* Elementary students should be familiar with this word, but it will be helpful to review. *Gravity* is the force that pulls an object towards the center of the Earth. It's why we can stand on the surface of Earth and not float away into space, and why a ball falls to the ground when it is released. It's not actually falling, but being pulled down by Earth's *mass*. The larger an object's mass, the more gravity it exerts. That's why astronauts on the Moon must bounce along slowly rather than walk as they can on Earth – the Moon is much smaller than the Earth, and thus has much less gravity pulling the astronauts down.

TIP: Use a video as part of your introduction to help visualize concepts, such as this one (a good overview) or this one (a simple animation).

Aligned Standards

Next Generation Science:

3-PS2-2. Make observations and/or measurements of an object's motion to provide evidence that a pattern can be used to predict future motion.

5-PS2-1. Support an argument that the gravitational force exerted by Earth on objects is directed down.

Ocean Literacy:

Principle 1: c. Throughout the ocean there is one interconnected circulation system powered by wind, tides, the force of Earth's rotation, the Sun, and water density differences.

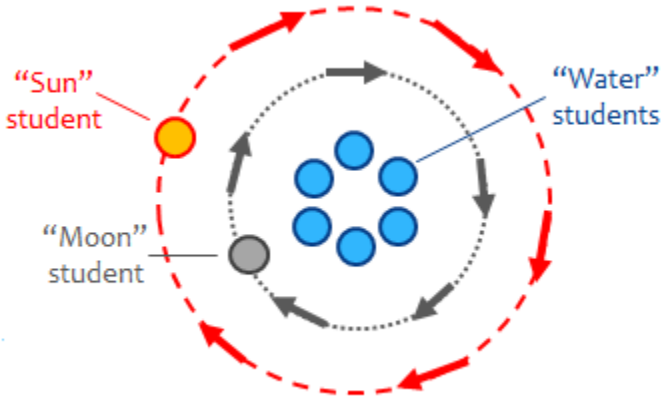
Though the Moon is small, it is large enough and close enough to Earth to have a strong gravitational force on Earth's surface. And because Earth, too, is exerting a gravitational force on the Moon, the Moon is trapped in an orbit, circling around the Earth once every month. Our oceans are stretched and pulled towards the Moon as it circles around our planet. This rise and fall of the oceans towards the passing Moon is what causes the rise and fall of water along our shores known as *tides*.

Explore (10 mins): For the first part of this activity, have students sit on the floor in a tight circle. These students represent the oceans on Earth's surface. Select one student to play the Moon and ask him or her to walk slowly around the outside of the circle. Tell students to lean their bodies towards the Moon as it passes; this represents the gravitational pull of the Moon on the oceans, causing the water to rise. After one or two revolutions of the Moon, pause and explain that it's a little more complicated than that. The Moon is also pulling on the Earth itself – pulling it AWAY from its oceans on the side opposite the Moon! This causes higher seas on the opposite side of the planet, too. Have the Moon walk around the circle again, only this time, have students by the Moon lean *towards* him or her as they pass, and

have students on the opposite side of the circle also lean back, *away* from the Moon. Continue until students can see the pattern of where sea rise occurs relative to the Moon.

Explain (5 mins): Explain that the students who are leaning out – either by the Moon or on the opposite side – represent the areas on Earth where it's high tide. The students *not* leaning out represent areas of low tide.

Expand – *for older or more advanced students only!* (15 mins): Introduce a complication to this pattern: the Sun! The sun is much, much bigger than either the Moon or the Earth, but it is also much further away. Therefore, it exerts a gravitational force on Earth, though a weaker one than the Moon. But it's strong enough that when joined up with the Moon's gravity, it causes a noticeable change in the tides.



Pull another student from the circle to play the Sun. Begin by placing the Sun next to the Moon so that all three planets are lined up. Explain that when the planets are lined up this way, there is an extra strong force on Earth's oceans – have the students closest to the Moon and Sun, and on the opposite side, lean ALL the way back to show the increased pull. When the planets are lined up this way, tides are extra high; these are called *Spring Tides.*

Next, have the Sun move around the circle so that the Sun and Moon are at a right angle to each other. *(Note that the Sun doesn't actually move around the Earth – the Earth moves around the Sun – we are just doing it this way to demonstrate!)* Ask students which way they think they should lean when the Sun and Moon are positioned this way. They will probably be torn about whether they ought to lean more towards the Sun or towards the Moon – and they're correct! When the planets are at a right angle like this, the gravity of the Sun and the Moon are competing, and the forces more or less balance each other out. Tell the students to lean towards the area between the Sun and Moon (or away from, on the opposite side), but only a little. When the planets are arranged this way, there is not much change in water levels even at high and low tides – these are known as *Neap Tides*.

Finally, ask both the Moon and the Sun to walk around the circle, and challenge students to lean towards or away from the planets as they pass without your guidance. The Moon should walk more quickly than the Sun to demonstrate that the Moon rotates around Earth much more quickly than the Earth rotates around the Sun (one month versus a year).

Evaluate (5 mins): Are students able to correctly demonstrate the gravitational forces of the Moon and Sun on the oceans without your guidance? Can they describe this process aloud?

FIELD TRIP 1: OREGON COAST AQUARIUM

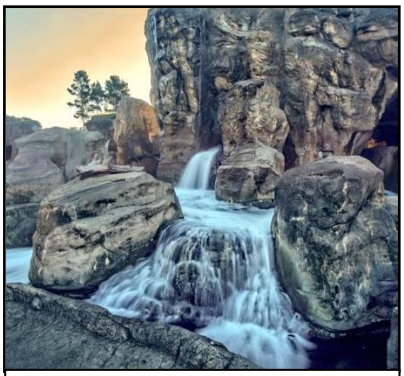
A field trip to the Aquarium helps to build student knowledge and understanding in a safe, accessible environment. It's a great way to both reinforce classroom learning and to prepare for forthcoming activities. While we have placed the field trip here ideally between the first two and last two Driving Questions, you may also opt to visit the Aquarium:

- *At the very beginning* – as an introductory and knowledge-building experience
- *At the very end* – to review knowledge gained and connect it to real animals and ecosystems that students can see and touch

Some teachers choose to combine their field trip to the Aquarium with their field trip to the beach on the same day. This can be a good strategy, because it means only one day of out-of-school time, and because Oregon Coast Aquarium is near a number of excellent tidepooling spots. If you choose to do both on the same day, we recommend you consult the tide charts and schedule your Aquarium visit during the time of highest tides, so you can be at the beach during low tide – the best time for tidepool viewing.

At Oregon Coast Aquarium, there are a number of galleries that directly relate to the activities in this curriculum, as well as opportunities for more structured student learning: check out our self-guided student activity book for Grades 3-5. **Enourage students to look for animal adaptations to life at the rocky shore, especially features which help them to withstand crashing waves!** We also have a number of lab programs aligned to various grade levels and topics, several of which relate to rocky shores ecosystems. "It's A Rough Life" explores the many ways tidepool residents are adapted to their extreme habitat. For younger students, "Coastal Comparisons" is a fun way to compare and contrast rocky shore versus sandy shore organisms. "Feeding Frenzy" focuses on marine food webs – a great way to explore the connections between the organisms they have been learning about, and an opportunity to discuss human impacts.

Our *Rocky Shores Gallery* is the most relevant exhibit to this curriculum, for obvious reasons! This gallery holds a total of 15 exhibits, including habitats for crabs, brightly-colored rockfish, and a wide range of sea stars, limpets and other invertebrates.The centerpiece of the Rocky Shores Gallery is our touch-pool. Staffed by volunteers, this exhibit lets visitors gently interact with tide pool residents like ochre stars, gumboot chitons and anemones. A simulated tidal surge tank allows visitors to watch what happens beneath the waves when the tide rolls in and out. Just outside this Gallery, a quiet rocky pool occasionally comes to life with crashing waves and splashing droplets.



Click here to get started planning your field trip to Oregon Coast Aquarium!

D.Q. 3: WHAT LIVES AT THE ROCKY SHORE?

BACKGROUND INFORMATION

Adaptations

You know now that the tide pools can be a tough place to survive. It won't come as a surprise that the organisms that live there must be just as tough. Rocky shore animals have a number of adaptations to survive the crashing waves and changing conditions. Some of these adaptations we can easily see; others are contained within the animal's physiology. The most visible adaptations of tide pool can be organized into three common categories:

Things that BEND

Animals like the Green Anemone pictured here are very flexible, allowing them to bend and sway with the currents rather than being broken by them. The ability to make their bodies rounded also allows water to flow over and around them more easily. Other tidepool organisms that are bendy and rounded include chitons and sea palms.

Things that STICK

Animals like the California Mussel pictured here are able to keep a very strong grip on the rocks to avoid being swept away by the waves. These mussels have glue-like byssal threads that attach them to the rocks, but other animals use suction-cup tube feet (sea stars) or a strong muscular foot (snails). Many seaweeds have holdfasts which grasp the rocks like vines.

Things with HARD SHELLS

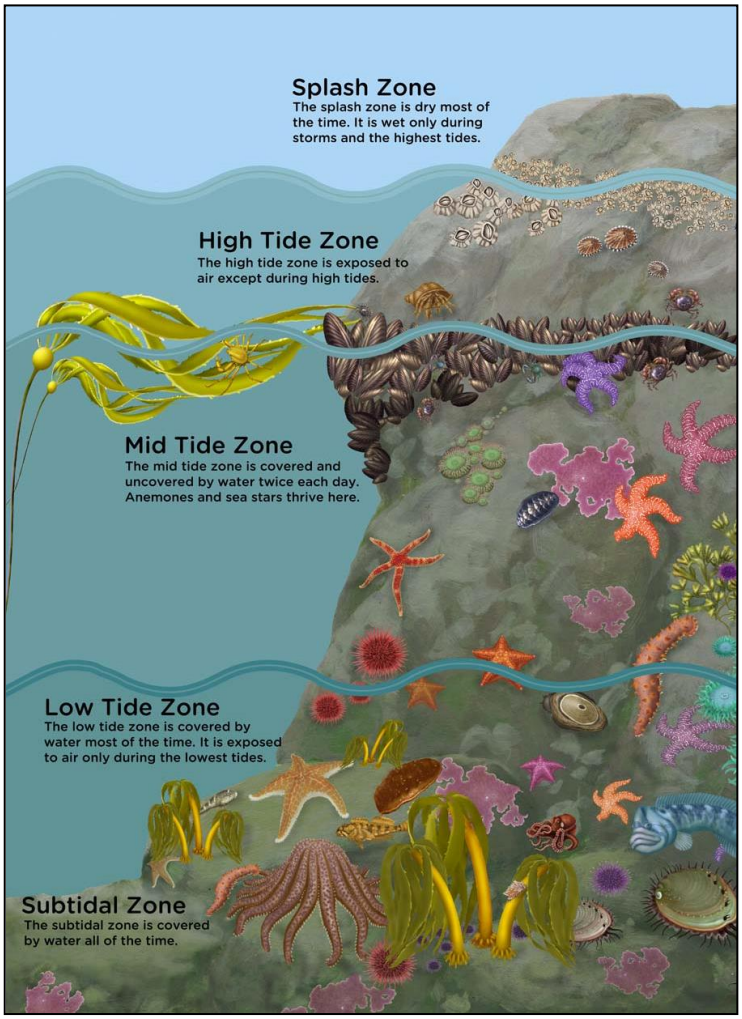
Animals like the Purple Urchin pictured here have a hard outer layer to protect them from both predators and the debris that can get washed in by waves. Some like the urchin have spines, while others such as shore crabs, barnacles, and hermit crabs have shells. Others, such as limpets, have hidden shells which are revealed when their mantles (soft body parts) are pulled in.

LEARN MORE!

Discover more species and adaptations at Monterey Bay National Marine Sanctuary

Different zones, different organisms

Life at the rocky shore is arranged by tidal zones, based on each species' adaptations and limitations. Some of these species are permanent residents in that zone, while others move in and out of different zones with the tides.



Splash Zone: You will find few tidal animals in this area because there is little water – it is only sprayed by the highest waves. However, it's a good area for spotting birds and marine mammals. Species commonly found here include the Black Oystercatcher, California Sea Lion, and Herring Gull.

Upper Intertidal: Animals in these areas have special adaptations which allow them to move between terrestrial and aquatic ecosystems, since this zone is dry except during high tides. Species commonly found here include the Giant Acorn Barnacle, Pickleweed, and the Proliferating Anemone.

Mid Intertidal: In a healthy intertidal area, this zone is rich both in diversity and numbers of organisms. It is covered by water with each high tide and revealed with each low tide. Species commonly found here include the California Mussel, Green Anemone, California Sea Cucumber, and Ochre Sea Star.

Lower Intertidal: Most of the animals in this area are not adapted to long exposure to air, since this zone is generally covered by water. Species commonly found here include the Featherboa Kelp, Grunt Sculpin, Red Urchin, and Hairy Hermit Crab.

Subtidal Zone: Underwater except during the most extreme low tides, this area is generally accessible only to SCUBA divers. The species living here are purely marine and cannot survive exposed to the air – with the exception of the Giant Pacific Octopus, which often crawls out onto the rocks to hunt in the tidepools. Other species commonly found here include the Sunflower Star, Bull Kelp, and Rockfish.

D.Q. 3: WHAT LIVES AT THE ROCKY SHORE?

STUDENT ACTIVITY: INVENT A ROCKY SHORE CREATURE

Time: 40-50 mins | **Materials:** Craft supplies (see pg 24); internet connection and screen to view video and slideshow of tidepool animals

In this activity, students invent a new species which can withstand the tough conditions in a tidepool, inspired by real tidepool organisms and their adaptations. This activity works best after your Oregon Coast Aquarium field trip, where they observed firsthand several tidepool animals and their unique features.

Engage (10 mins): Remind students that waves bring both vital resources (food, water, salt, cool temperatures) and challenges (big crashing waves, driftwood and other debris, predators) to animals living in rocky shore environments. Tidepool animals use a variety of physical features and behaviors to help them survive in this habitat.

Using the "Exploring Oregon's Tide Pools" slideshow at Oceanscape Network (right side of page, click to enlarge), ask students to name some adaptations that tidepool animals use to survive. These may include the ability to *stick* with a muscular foot, byssal threads, or tube feet which helps them hold on to the rocks and not get swept away; a *hard shell* which provides protection from big crashing waves and any debris that might be in the water; the ability to *bend* which helps them have a better grip on curved and bumpy rocks, and to flex with the waves; and a rounded body shape, which allows water to easily flow over and around them. Note that most rocky shores animals use a combination of these abilities to survive!

Then, have them watch this video of crashing waves in a tidepool and ask them to describe what they noticed. Write down these descriptive words on the board. Would they be able to survive in these conditions without being washed away?

Aligned Standards

Next Generation Science:

3-LS3-2. Use evidence to support the explanation that traits can be influenced by the environment.

4-LS1-1. Construct an argument that plants and animals have internal and external structures that function to support survival, growth, behavior, and reproduction.

Ocean Literacy:

Principal 5: d. Ocean biology provides many unique examples of life cycles, adaptations, and important relationships among organisms that do not occur on land.

Principle 5: f. Ocean life is not evenly distributed through time or space due to differences in abiotic factors such as oxygen, salinity, temperature, pH, light, etc.

Tell students they are going to design a tidepool animal they think could survive crashing waves without falling apart or being washed away. You can choose to have students work individually or in small groups. They should use real tidepool animals for inspiration, so remind them that they can refer to the slideshow and the list of features you created as a class. Distribute the crafting materials or give instructions for collecting them from the front.

NOTE: This activity comes from the Oregon Coast Aquarium education program, "Get A Grip".

Suggested crafting materials (use things that simulate bending, sticking, a hard shell, etc.)**:**

- Suction cups
- Play dough
- Tape
- Glue
- Velcro
- Yogurt cups
- Cardboard
- Pipe cleaners
- Hot glue sticks
- Plastic eggs
- Popsicle sticks
- Toothpicks
- Felt or fabric
- Whatever else you have on hand!

Tips on collecting materials

- Start early! Ask other teachers and/or students to bring in recyclables from home.
- Ask the cafeteria if they have any materials they can save.
- Raid the recycle bins at school.

Explore (20-25 mins): Move around the room as students to create their creatures, encouraging them to think creatively and to make predictions about what might happen to their organism if a big wave hit it. If time and resources allow, have students test their creations by placing them in a tub or sink filled with a few inches of water. Use a dustpan or their hands to create "waves" and see how their design holds up. If it falls apart, have students think about why it didn't work and what they could do to improve the design. Build, test, and rebuild designs for as long as time allows!

Explain (5-10 mins): Have students demonstrate their species designs to their classmates, highlighting the ways their organism stands up to waves and its other adaptations for survival. Ask students to relate these structural characteristics to real tidepool animal adaptations and features.

Expand (*if time allows*)**:** Discuss how, like animals, people have to be able to survive challenges in their own "habitats". Ask students to think about things buildings have to withstand (wind, rain, fire, etc.) so that humans can live and work safely inside. What are some ways people build buildings to be strong and stable? If time allows, take a tour of the school and look for safety features such as fire sprinklers and fire extinguishers, explore windows and doors to see how rain and cold is kept out, look for rain gutters and drains, etc. Compare the structures you see to any similar animal features you have discussed, or the ways that students designed their own creatures.

Evaluate: Do students reference prior knowledge and vocabulary gained throughout this unit? Are they able to describe what they learned through the design process and how that was applied to changes they made to their species? Do they use detail or specific examples when describing ways their design reflects real tidepool animal adaptations?

D.Q. 4: HOW CAN WE CARE FOR ROCKY SHORES?

BACKGROUND INFORMATION

Current issues facing this ecosystem

People visit the tidepools to enjoy the natural beauty, wild waves, and fascinating animals that live there. But they don't always realize the impact that their actions can have on these organisms. Being stepped on can injure or kill animals, even if they look like rocks or have hard shells. People prying animals off the rocks and moving them around can also have a devastating impact: they may be injured when pulled off the rocks, and you can inadvertently move them away from their zone of moisture, salinity, or temperature tolerance to somewhere they cannot survive. Once unattached from the rocks, these animals are also at risk of being washed away. Simply removing rocks or seaweed from a tidepool can also endanger animals, because these materials provide shade and protection for the organisms living beneath. Trash left behind by visitors can also harm wildlife.

What can we do to help?

When visiting the rocky shore, we should all follow **good tidepooling manners***:*

- *Watch your step!* When moving around, keep an eye on your feet and step carefully. Avoid wet rocks, seaweed (which can be slippery), and barnacles (which can puncture thin-soled shoes). Doing so will also help avoid hurting yourself and animals.
- *If you pry, it will die!* Many rocky shore organisms survive the crashing waves by attaching themselves firmly to the rocks. Pulling them off can injure these animals, and leave them vulnerable to being washed away. Never pry or tug on organisms.
- *Touch gently!* Use only one or two fingers to gently touch tidepool creatures. Do not poke them or push on them.
- *Leave no trace!* If you move seaweeds, rocks, or other materials to look beneath them, always return them exactly the way you found them. And never litter!
- *Don't take it home – alive OR dead!* Any living things you take home will quickly die. Left at the beach, these things could be become food or habitat for other organisms. It's illegal to collect these things at many Oregon beaches.
- *Clean it up!* Bring along a trash bag to remove litter each time you visit the beach.
- *Never turn your back on the waves!* Unusually large waves, known as "rogue waves", can occur unexpectedly and sweep you out to sea. Always keep your body facing the sea so you can keep an eye on the waves and make sure they don't get too close.

D.Q. 4: HOW CAN WE CARE FOR ROCKY SHORES?

STUDENT ACTIVITY: TIDEPOOL OBSTACLE COURSE

Time: 15 mins for prep, 45-50 mins for activity | **Materials:** list of "good tidepooling manners" from previous page; props representing tidepool animals and litter (see below for list); open floor space; sidewalk chalk (if doing activity outside) or masking tape (if doing activity inside)

In this activity, students will learn how they can take personal responsibility to care for the environment and its creatures when visiting the tidepools by following "good tidepooling manners". They will navigate through an obstacle course with items representing trash, tidepools, and sea creatures, demonstrating the proper choices they should make for each.

Prep (before students arrive) (15 mins): Set up the obstacle course. You may choose to set this up in an open space in your classroom, or outside on an open paved area. There are a number of ways you can design your obstacle course: for younger students, a traditional hopscotch layout works well, while for older students you may want to make it more complex. Use the sidewalk chalk, if outside, or masking tape if inside, to lay out the course that students should follow. Mark some areas with a large X to represent a tidepool full of water. How challenging you make it should be based on the age and abilities of your students (*see next page for an example*). Finally, set out your props throughout the obstacle course. You will need items to represent both tidepool animals and human trash, such as:

- Pictures of tidepool animals, printed and cut out, OR
- Toys to represent animals (rubber duckies etc.)
- Plastic bags, water bottles, soda cans, chip bags, etc.

Engage (10 mins): Ask students if they have to follow certain rules or manners around their house. Ask them to share what some of those rules for good behavior are (these may include manners at the dinner table, with their siblings, etc.). Tell students that when they go to the tidepools, there are certain manners they must follow as well. These guidelines for good behavior help to keep both them and all the creatures living there safe. Then, using the list on the previous page, introduce the rules for "good tidepooling manners". Engage students by asking them to volunteer their own ideas for proper behavior when visiting the rocky shore.

Aligned Standards

Next Generation Science:

5-ESS3-1. Obtain and combine information about ways individual communities use science ideas to protect the Earth's resources and environment.

Ocean Literacy:

Principle 6: g. Everyone is responsible for caring for the ocean. The ocean sustains life on Earth and humans must live in ways that sustain the ocean. Individual and collective actions are needed to effectively manage ocean resources for all.

Oregon Environmental Literacy:

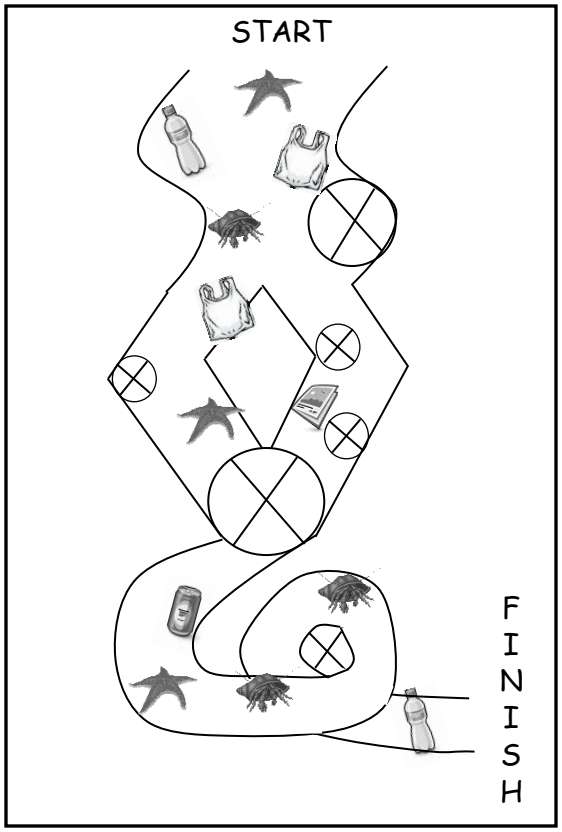
4b. Develop self-confidence in their effectiveness as citizens by understanding how their own actions affect environmental quality and sustainability.

Explore (30 mins): Have students gather around the outside edges of the obstacle course. Tell them they are going to pretend it's the real rocky shore. Point out the X's, the trash, and the pictures or objects representing the animals, and tell students what they each represent. Tell students they are going to take turns navigating the obstacle course, following the rules for good tidepooling manners that you just went over. For the obstacle course, this means:

- *Watch your step* – don't step on any of the "critters", or in the "tide pools"
- *Touch gently* – they can look at and touch the "critters", but not pick them up or move them
- *Leave no trace* – anything they accidentally kick or displace must be moved back to its original position
- *Clean it up* – each student should collect as much trash as they can along the way
- *Never turn your back on the waves* –designate one side of the room as the "ocean" and tell students they can never have their backs turned to it

Monitor each student as they go through the obstacle course and encourage the other students to help you enforce the rules. If they break any of the above rules they are disqualified (or you may allow them to start over, if time allows).

NOTE: To make the activity more exciting for older students, make it a competition! Time each student as they go through the obstacle course; the fastest time wins. Alternatively you can award winners for the most trash picked up. For younger students, you may wish to encourage careful rule-following rather than speed.



Explain (5 mins): Once all students have had the chance to go through the obstacle course, review the "good tidepooling manners" once more. Tell them that they will need to remember these rules when they go on their field trip to the rocky shore, and encourage them to share these manners with friends and family. Ensure that students understand *why* they should follow these rules – they are important both for their own safety, and to protect the environment and living things.

Expand (5 mins): Ask students what else they can do to help care for rocky shores. Ideas may include sharing the "good tidepooling manners" with their community, not bringing anything that could become litter to the beach, not feeding the birds or other animals at the beach, etc.

Evaluate: Can students recall all of the "good tidepooling manners"? Can they explain why they are important?

FIELD TRIP 2: TO THE ROCKY SHORE

Suggested sites for field trips

The Central Oregon Coast has a number of great tidepooling sites. Near Oregon Coast Aquarium, check out Seal Rock State Recreation Area or Yaquina Head Outstanding Natural Area. Both sites have restrooms and picnic facilities. Yaquina Head also has an Interpretive Center featuring rocky shore ecosystems, a great indoor alternative for high tides or poor weather. Wherever you go, be sure to check a tide table and schedule your visit during the lowest tide possible for best tidepool access!

The Oregon State Parks and Recreation department has created an interactive map of tidepooling sites, with accompanying tide charts, descriptions, and driving directions. You can also explore tidepooling sites with our Oceanscape Network's interactive map – just click on the different locations to view pictures, videos, and interesting historical facts. For more information on any of Oregon's coastal State Parks, with FAQ's and brocures, visit the Oregon State Parks website. Or give them a call at (541) 563-8500 – Park Rangers and Interpretive Specialists are always happy to talk to educators!

Preparing your students

Reserving plentiful time to prepare your students for their field trip will help reduce confusion and potential safety issues, as well as focusing them on their learning goals. Send home a list of things students will need to bring for the field trip, including:

- ✓ Rain gear: waterproof jacket and pants, if possible
- ✓ Sturdy shoes, such as sneakers or hiking boots – NO SANDALS!
- ✓ Warm layer, such as a fleece or sweater
- ✓ Sunscreen
- ✓ Hat
- ✓ Sunglasses
- ✓ Water bottle
- ✓ Field notebook

Emphasize the importance of these items by describing the conditions at Oregon's rocky shores: they are usually cold, windy, and wet, no matter what time of year it is. You may want to raid your school's lost-and-found for extra jackets and rain gear for students who forget or do not have these items.

Before leaving for your field trip, emphasize the importance of safety on this field trip. Review the "good tidepooling manners" discussed in the *Tidepool Obstacle Course* activity. We strongly recommend providing chaperones with a list of these rules as well, so they can help with student management at the beach and model good behavior.

At the beach

There are a number of activities you can do once you get to the beach, depending on your time and resource availability. Whatever activities you decide to do at the beach, **be sure to begin with time for free, unstructured exploration.** This will allow students to work out their energy and satisfy their natural curiosity and impulse to explore. When you feel students have had sufficient time to discover on their own and become comfortable with their surroundings, then you can gather the group and facilitate the structured activities.

The simplest activity is to allow students to independently explore, searching for tidepool creatures and identifying them once they are found. If this field trip occurs at the end of the unit, and after your Aquarium field trip, students should be able to identify the most common species. If you feel they may need an identification aid, there are a number of free tidepool field guides available online that you can print: check out this one from Oregon State Parks or this one from Cape Perpetua Scenic Area. If you have the funds to purchase field guides, we recommend the Pocket Naturalist Guide to Northwestern Seashore Life, which is both waterproof and lightweight. You can buy this online for between $5-$8; purchase enough copies for every 2-3 students to share.

Aligned Standards

Next Generation Science:

3-LS3-2. Use evidence to support the explanation that traits can be influenced by the environment.

Common Core Math:

3.NB2. Fluently add and subtract within 1000.

3.MD3. Draw a scaled picture graph and a scaled bar graph to represent a data set with several categories.

3.G2. Partition shapes into parts with equal areas. Express the area of each part as a unit fraction of the whole.

Ocean Literacy:

Principle 7.b: Understanding the ocean is more than a matter of curiosity. Exploration, experimentation, and discovery are required to better understand ocean systems and processes.

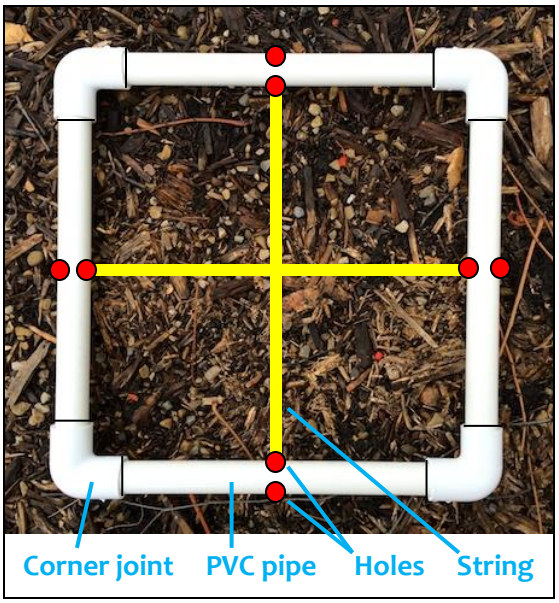
Activity Idea 1: Counting biodiversity using quadrats

A *quadrat* is a square plot used by ecologists to isolate a standard unit of study area. Scientists use quadrats to understand the populations of a large area by counting the number of organisms found within the quadrat in several different sample spots. Often, the quadrat is divided into smaller squares within it. This is useful in calculating percent coverage of certain species, such as plants or invasive species. This information helps scientists to understand the health of an ecosystem, and is used to develop plans for ecosystem restoration or management.

You can easily create your own quadrats with inexpensive supplies. You will need:

- Four ¾ inch pipes of equal length (between 16-20 inches)
- Four ¾ inch 90° corner ("elbow") joints
- Sturdy twine or rope
- A drill

Making a quadrat



- Create your square by attaching the pipes together with the corner joints. If desired, use glue to permanently secure the pipes to the joints.
- Use a ruler and permanent marker to mark the half-way points on each pipe to divide the quadrat into four equal squares.
- Drill a small hole at each of the halfway points, through both sides of the pipe, on each of the four pipes.
- Draw the string through the first set of holes and securely tie it off. Pull the other end of the string through the holes directly opposite, and tie it off so the string is taut. Repeat this process for the remaining two sets of holes.

NOTE: If time and resources allow, you can even have students work in small groups to create their own quadrats!

Lay the quadrats (one per every 3-4 students) on top of the rocks or over a tidepool, being careful that they aren't sitting on any sensitive creatures. Have students work in groups to identify all of the types of organisms they see within the quadrat using their field guides.

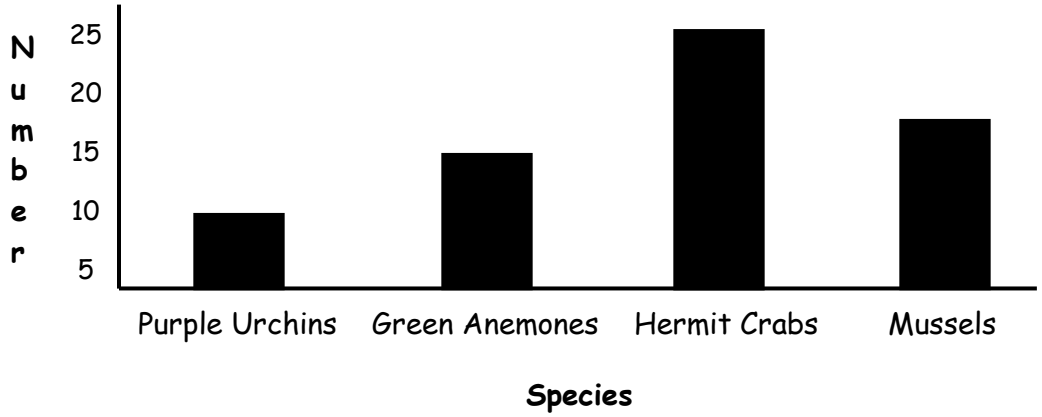
Then, have students count and record the number of individuals of *each species in each square*. At the end, they can calculate the *total number* of individuals of each species by adding up their results from all four squares. Below is a template for how students can set up their page and record their data:

TIP:
Draw this on the board and have students copy it into their field notebooks BEFORE leaving for your field trip!

Square A		Square B	
Species	Number	Species	Number
Square C		**Square D**	
Species	Number	Species	Number

Totals (A+B+C+D)	
Species	Number

To extend math practices back in the classroom, collect and combine all student data, displaying class totals on the board. Then ask students to create a bar graph displaying the results:



Ask students which species were the most common, and *why* they think those species were most common. Answers should be based on *adaptations* and *tidal zones* (i.e., if sampling took place in the Upper Intertidal Zone, species such as the Acorn Barnacle which have adaptations to prevent drying out should be most common). Help guide student understanding based on the activities from this unit they have already completed.

Activity Idea 2: Water quality sensors

Use digital tools, known as probes or sensors, to measure abiotic factors in the tidepools such as salinity, temperature, and dissolved oxygen. If your school does not already have these, they may be borrowed from your local STEM Hub Trailer. If your school is located in Tillamook County, kits may also be obtained from the Tillamook Estuaries Partnership. These materials should come with instructions for use. Be sure to familiarize yourself with these first, and ideally, do a test run to try them out. Explain to students how these sensors are to be properly used.

Instruct students to take water quality measurements in both the Upper Intertidal Zone and the Lower Intertidal Zone (and in between, if they wish). **SAFETY TIP: Be sure to keep a close eye on the students in the low tidal zone, making sure they don't have their backs to the ocean and that they don't get too close to the waves. "Rogue waves" can suddenly sweep in much higher than expected, knocking people over or sweeping them out to sea. Assigning a "lookout" student or chaperone can help prevent this.** Have students take turns with the sensors, and have them record their data in their field notebooks.

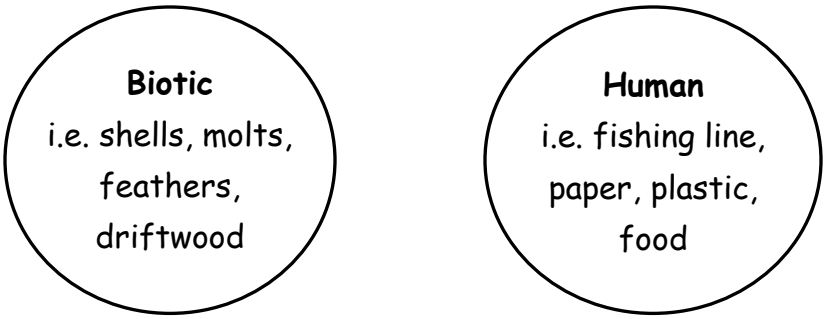
After students have had time to experiment with the sensors and record their data, gather the group together to discuss. Ask them to share the differences between the different tidal zones. Then, ask them *why* they think there were differences. Refer back to the "Moving with the Tides" activity to discuss the changing conditions at rocky shores, both in the different intertidal zones and at different times of day.

If tides are bad…

Sometimes, it's not possible to schedule your field trip during a period of low or negative tides. If you're at the beach when the tide is too high to observe many creatures, there are alternative activities you can do. Here are some more ideas:

Activity Idea 3: Kelp Surfing. "Kelp surfing" is an easy and fun exploration when the rocks are too dangerous for exploration. Students simply dig through the washed-up kelp and seaweed (known as the *wrack line*), searching for animals. If the tide has recently been high enough to wet the wrack line, students will be able to find anything from crabs to small shrimp to snails. You can also challenge them to find bits of plastic or other trash, collecting it for proper disposal. Have students record their findings in their field notebooks.

Activity Idea 4: Circles in the sand. Ask students to collect and categorize things they find on the beach. Draw two large circles in the sand, labeled *biotic* (living or once-living things), and *human* (man-made items). Give students time to collect as much as they can, and sort what they found into the two circles. **SAFETY TIP: Be sure to warn students not to pick up anything that looks unsafe, such as glass or sharp objects, and ensure chaperones carefully monitor the activity.** After re-gathering the group around the circles, discuss what they found, pointing out any surprises or mistakes. These may include things students may not identify as biotic but were once living (such as shells and sticks) and potentially confusing items (such as bits of trash that might look like living things or vice-versa). Point out the amount of trash versus living things they found, and use this to reinforce what they learned about caring for rocky shores during the "Tidepool Obstacle Course" activity. Complete the activity by asking them to collect all of the items from the "human" circle into a trash bag. You can even sort out what is recyclable and what is not for proper disposal.



WRAP-UP AND REFLECTION ACTIVITIES

By the end of their *Exploring Oregon's Rocky Shores* unit, students should be able to explain how tides work; identify common rocky shore organisms and explain their adaptations; understand how they can care for rocky shore habitats and creatures; and feel a greater sense of connection to rocky shores. The following activities will help you to assess the knowledge and understanding students gained, and to further foster that sense of connection to the beach – perhaps the most important outcome of all, because it encourages ongoing interest and care for rocky shores.

Rocky Shores Drawing, Part 2

At the very beginning of this curriculum, students drew their ideas of what a rocky shore looks like. Now, after completing all of the classroom activities and field trips, ask students to do the same exercise and draw the rocky shore again. Just like before, allow them to draw freely without any teacher guidance for some time.

Assess student learning by comparing their original drawings with the new drawings. Changes to look for include:

- Labeling of organisms and/or the intertidal zones
- Significant animal adaptations clearly drawn
- A greater number and diversity of rocky shore organisms
- Evidence of tides, such as crashing waves and the Sun/Moon
- Presence of human impacts, including trash or people

Invite students to compare their own drawings to reflect on, and gain pride in, all they've learned. Engage them in a discussion of what stayed the same and what changed.

Aligned Standards

Next Generation Science:

5-ESS2-1. Develop a model using an example to describe ways in which the geosphere, biosphere, hydrosphere, and/or atmosphere interact.

Common Core for English Language Arts:

College and Career Readiness for Reading – 7: Integrate and evaluate content presented in diverse media and formats, including visually and quantitatively, as well as in words.

College and Career Readiness for Writing – 3: Write narratives to develop real or imagined experiences or events using effective technique, well-chosen details, and well-structured event sequences.

Ocean Literacy:

Principle 5: f. Ocean ecosystems are defined by environmental factors and the community of organisms living there.

Principle 6: c. The ocean is a source of inspiration, recreation, rejuvenation, and discovery.

Free-Choice Writing Exercise

Engage students in an open-ended writing exercise that allows them to express their learning and reflect on their experiences. Allow students to choose what format they wish to write in: a poem, a short story, or a brief essay. The only restriction is that their writing must involve either *something they learned about the rocky shore* or *how the rocky shore makes them feel* – or both! If you wish, this could be given as a homework assignment to allow students more time to develop their thoughts and imagination. Have students share with their peers by reading works aloud, or displaying works somewhere in the school.

BIBLIOGRAPHY OF LINKS & ADDITIONAL RESOURCES

Pages 5-6

Oregon Parks and Recreation Department: https://www.oregon.gov/oprd/NATRES/Pages/RS_main.aspx

Nurseries for juvenile animals: http://www.academia.edu/24822309/Intertidal_pools_as_alternative_nursery_habitats_for_coastal_fishes

Marine Reserves: http://oregonmarinereserves.com/

Help restore populations in surrounding waters: http://www.oregonmarinereserves.org/ecological-benefits-of-reserves

Native peoples on the coast: https://oregonhistoryproject.org/narratives/this-land-oregon/the-first-peoples/the-first-peoples/#.WV1J9YTyuUk

Beaches used as a highway: http://www.beachconnection.net/news/beachhi022816_1028.php

Oregon Beach Bill: http://www.opb.org/news/article/50th-anniversary-of-oregons-beach-bill/

Check out the NGSS website: https://www.nextgenscience.org/

Consult the Oregon Common Core Standards: www.ode.state.or.us/go/commoncore/

Framework for Ocean Literacy for Grades K-12: http://oceanliteracy.wp2.coexploration.org/ocean-literacy-framework/

Pages 7-8

Oregon Environmental Literacy Plan: http://oelp.oregonstate.edu/oelp-plan/oregon-environmental-literacy-plans

Project-Based Learning: www.bie.org

Resources Page: www.bie.org/resources

Pages 10-11

Video: https://www.youtube.com/watch?v=Az2Ct1tUAEM&feature=youtu.be

NOAA Ocean Explorer's Virtual Tidepool: http://oceanexplorer.noaa.gov/edu/learning/player/lesson10/l10_ex.html

Page 12

Oregon Coast Aquarium's Oceanscape Network: http://oceanscape.aquarium.org/explore/general_articles/tide-pools

Oregon Tide Pools: http://oregontidepools.org/tidalzones

Pages 18-19

Keith's Moon Page: http://home.hiwaay.net/~krcool/Astro/moon/moontides/

NOAA Tides: http://oceanservice.noaa.gov/education/kits/tides/media/supp_tide06a.html

Consult a tide chart or tide table: http://www.tides.net/oregon/

Page 20

Narrated tides video: https://www.youtube.com/watch?v=5ohDG7RqQ9I

Animated tides video: https://www.youtube.com/watch?v=NqDEaFjIXPw

Page 22

Self-guided student activity book for Grades 3-5: http://aquarium.org/wp-content/uploads/2016/05/Grades-3-5-Updated-2016.pdf

Lab Programs: http://aquarium.org/education/on-site-school-programs/

Rocky Shores Gallery: http://aquarium.org/exhibits/rocky-shores/

Click here to get started planning your field trip to Oregon Coast Aquarium: http://aquarium.org/visit/field-trips/

Pages 23-24

Find information for all the species listed on this page and more at: http://oregontidepools.org/speciesguide/

Monterey Bay National Marine Sanctuary: http://montereybay.noaa.gov/visitor/TidePool/species.html

Find information for all the species listed on this page and more at:

http://oceanscape.aquarium.org/explore/general_articles/tide-pools

Page 25

"Exploring Oregon's Tide Pools" slideshow on Oceanscape Network: http://oceanscape.aquarium.org/explore/general_articles/tide-pools

Crashing waves video: https://www.youtube.com/watch?v=Az2Ct1tUAEM&feature=youtu.be

Page 30

Seal Rock State Recreation Area: http://oregonstateparks.org/index.cfm?do=parkPage.dsp_parkPage&parkId=147

Yaquina Head Outstanding Natural Area: https://www.blm.gov/learn/interpretive-centers/yaquina

OPRD interactive map of tidepooling sites: http://oregontidepools.org/popular_tidepools/map

Oceanscape Network's interactive map: http://s3.amazonaws.com/oceanscape-production/file_assets/files/000/000/137/original/Oceanscape_Network_Oregon_Tide_Pool_Locations.pdf?1421357855

Oregon State Parks website: http://oregonstateparks.org

Page 31

Field Guide from Oregon State Parks: http://oregonstateparks.org/index.cfm?do=main.loadFile&load=_siteFiles%2Fpublications%2Ftidepool082936.pdf

Field Guide from Cape Perpetua Scenic Area: https://www.fs.usda.gov/Internet/FSE_DOCUMENTS/stelprdb5329431.pdf

Pocket Naturalist Guide to Northwestern Seashore Life: http://www.waterfordpress.com/products/pocket-naturalist-guides/regional/northwest-seashore-life.html

Page 33

STEM Hub Trailers: http://oregoncoaststem.oregonstate.edu/resources/kits

Tillamook Estuaries Partnership: http://www.tbnep.org/education-kits.php

Additional Resources

Oregon Tide Pools – Field Trip Tips: http://oregontidepools.org/teach

Video – PBS Studios' "The Intertidal" (great short introductory video for students): https://www.youtube.com/watch?v=DR1gP5S6Bsk

Oregon Conservation Strategy – Rocky Intertidal Zone: http://oregonconservationstrategy.org/oregon-nearshore-strategy/habitats/rocky-intertidal/

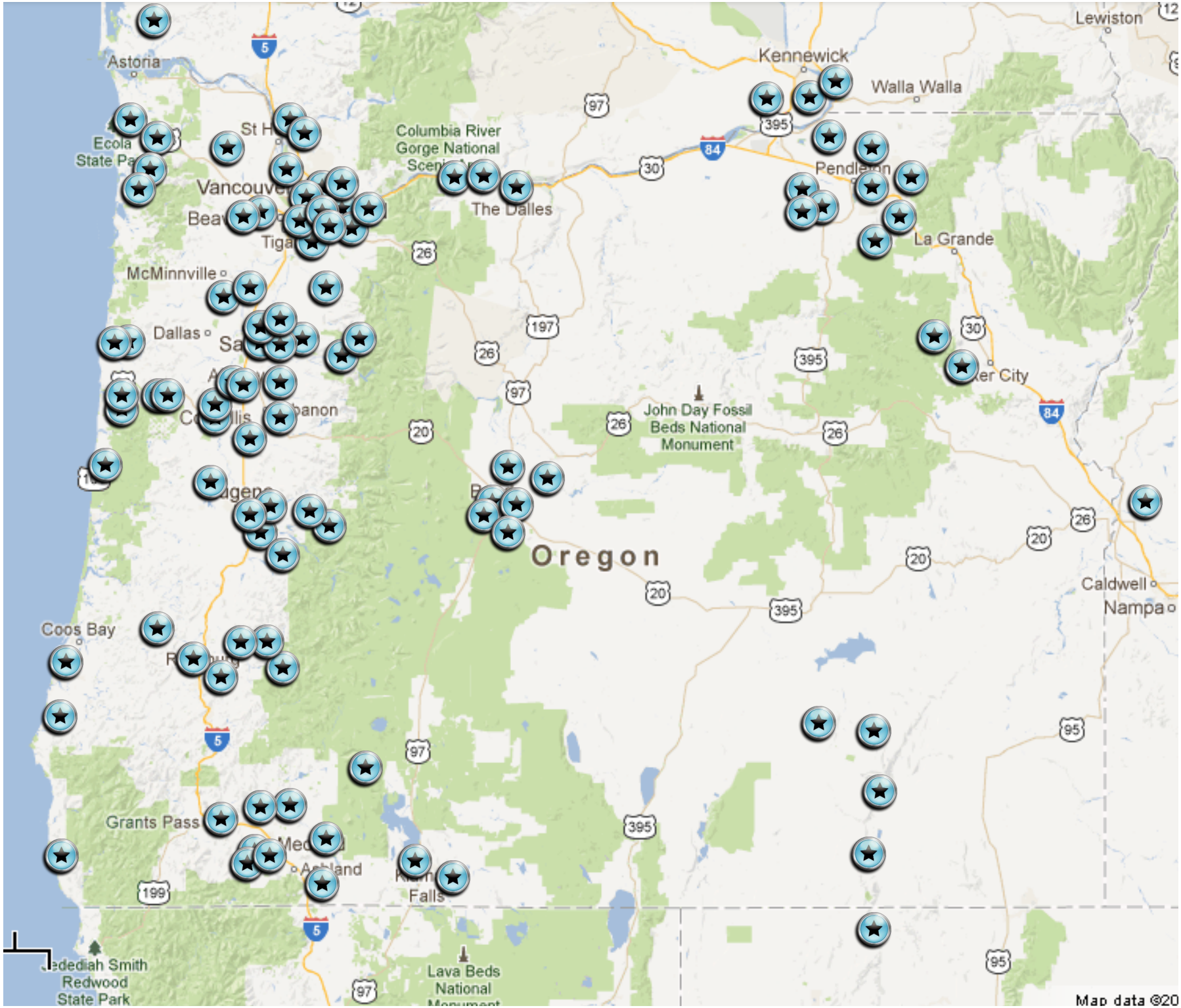
Hatfield Marine Science Center – Rocky Intertidal Lab Program: http://hmsc.oregonstate.edu/sites/hmsc.oregonstate.edu/files/visitor-center/education-programs/docs/previsit_rocky_intertidal.pdf

Oregon Coast Education Program – Coastal Education Modules: http://www.pacname.org/oregon-coast-education-program/

Northwest Ocean Observing Systems (NANOOS) – Historical and live data by region and category: http://www.nanoos.org/products/products.php

Wild Classroom – Intertidal Biome: http://www.thewildclassroom.com/biomes/intertidal.html

NOAA Education Portal: http://www.noaa.gov/education/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