Slater Museum of Natural History

presents

Nature in the Classroom

A multidisciplinary science-based curriculum
for 4th and 5th graders

Purpose At-a-Glance: This multidisciplinary curriculum brings the rich diversity of Tacoma's natural history into the classroom using teaching specimens from the Slater Museum of Natural History. Students will gain an appreciation for and familiarity with the natural world as they practice observation skills and study structure, function, adaptations and interactions among species. The lessons were designed in consultation with the Tacoma School District to ensure they meet 4th and 5th grade science standards.

Time Commitment: Nature in the Classroom contains three lessons requiring approximately 1.5 hours each. Learning extensions allow teachers to expand on a given topic depending on interest and time available. Lessons can also stand alone.

Suggested Uses: We've designed the lessons to be a "field trip in a box," so students can experience some of what the Slater has to offer without leaving their classrooms. Teachers can use the curriculum with other teachers, rotating through the three lessons so each class within a certain grade completes all of the lessons in one day. The curriculum can also be used by individual teachers presenting one lesson a day for three days, all three lessons in one day, or something in between. We suggest starting with Lesson 1, which provides a foundation for observation skills.

Care and Handling: Many of the specimens are fragile and hard to replace. Before using them, please review the Specimen Use Guidelines (page 4) with your class. We recommend having at least two adults in the classroom while teaching these lessons to help oversee specimen handling.

Classroom Logistics: The lessons are designed to be taught in a regular classroom with a computer and projector that can run PowerPoint or access the Internet (for Lesson 3). Because there are several activities designed with shared specimens for small groups of students, tables or desks grouped together (to act as one surface area) make it easier for students to work together.

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Washington State Science Standards Emphasized in "Nature in the Classroom"

Biodiversity	Scientific Thinking Skills
4-5 LS 1A: Plants and animals can be sorted according to their structures and behaviors. 4-5 LS1B: Each animal has different structures and behaviors that serve different functions. 4-5 LS1D: Plants and animals have structures and behaviors that respond to internal needs.	4-5 INQA: Scientific investigations involve asking and answering questions and comparing the answers with evidence from the real world. 4-5 INQD: Investigations involve systematic collection and recording of relevant observations and data. 4-5 INQH: Scientists communicate the results of their investigations verbally and in writing. They review and ask questions about the results of other scientists' work.

Background

The Nature in the Classroom curriculum provides a foundation for nature studies. By studying structure, function, adaptations and interactions among species, students will gain a new appreciation for and familiarity with the natural world around them. Knowing more about plants and animals is the first step towards caring more about the world around us. Whether it's a crow in the backyard, a squirrel in the park or a beetle on the playground, students will be inspired to ask—What is that animal doing and why? Where does it live and what does it eat? And ultimately—How do I fit into the natural world? These questions provide a basis for an awareness of nature and inspire outdoor experiences that have declined as technology has permeated our daily lives.

In *Last Child in the Woods*, author Richard Louv activated a widespread "call to nature" that has alerted parents and teachers to the importance of making time for children to play in nature. Ideally students would learn about local natural history by going on field trips to one of Tacoma's wide variety of parks and green spaces. However, budgets, time and liability concerns often limit the number and kinds of school-sponsored field trips. In consultation with the Tacoma School District, we designed these lessons to provide students and teachers the opportunity to experience the city's natural history in their own classrooms, and to give students the tools to become better and more informed observers of the world around them.

The curriculum's main themes explore the diversity and natural history of animals that make up our ecosystems (biodiversity). These lessons introduce students to the array of animals and plants that inhabit Tacoma's ecosystems and teach how they are adapted to thrive. With a focus on honing observation skills, we hope to teach the value of taking time to look more closely at the world around us, and prepare students for continued study of the natural world.

The Slater Museum of Natural History's goals are to preserve and provide a collection of specimens to be used for research, education and inspiration. We have one of the best regional collections of Pacific Northwest bird, mammal, reptile, amphibian and plant species.

Specimen Use Guidelines

The Slater Museum has one of the Northwest's best natural history collections. We're excited to share some of these with you in your classroom. To ensure that many other students will have a chance to use *Nature in the Classroom* in the future, please take care in using the specimens by following these guidelines:

1. We encourage you to touch the specimens, but they are not for role-playing or games. Though bird beaks look like swords and it's tempting to clack a skull's teeth together, please don't. Please treat them respectfully.

2. Some of the specimens are more fragile than others. When handling any of them, pick them up gently. When possible, place each specimen on your desk while observing it to avoid dropping it.

3. We encourage you to touch the bird specimens, but please don't ruffle their feathers. Stroke the feathers like you would pet a cat.

4. Do not try to pull out the wings or move the legs, necks or beaks of the birds—they will break.

5. When working with the skulls, please don't pull on the teeth or jaws.

6. For any of the specimens, if something comes loose or breaks off, please place all of the parts in a bag with a note describing the problem so it can be repaired for the next class.

Classroom Management Strategy

Before you begin the lessons, refer to the *Suggested Classroom Management Strategy for Hands-on Lessons* in this notebook for tips on how to help students succeed during group tasks and make it easier to manage the use of museum specimens.

Lesson 1: Nature Journals—Naturalists-in-Training

Subjects covered: Science, Art

Goal

Students will hone their powers of observation and develop their naturalist skills using their senses and the tools provided.

Learning Objectives

Close observation, note-taking

Prediction (hypothesis) generation

Practice comparing and contrasting using a Venn diagram

Secondary Learning Objectives

Drawing with and without magnification

Using a magnifying lens

Background

One of a scientist's most important skills is careful observation. Keeping a nature journal is one way to systematically record and collect observations so that we can study and keep track of what's happening where we live and in places that we visit—allowing us to see things in new ways. Great places to start making observations are right around our own homes, in the school yard and, in this case, our classroom. Things in nature are always changing—plants may be in flower, may have ripening berries or may be getting new leaves. Some birds are around all year; others come and go in a fairly regular annual procession. With a little practice, we can explore a place we've been many times before and still learn something new.

Nature journals have been kept for centuries, if not millennia—from writings on cave walls to detailed ships' logs—they help us learn about other places and times, as well as other times in the places we live now. For example, Lewis and Clark's nature journals are the best record of their important journey. The Slater Museum's collection is made up of the nature collections and observations of naturalists who studied nature in the Pacific Northwest in the late 1800s and 1900s. (A naturalist is someone who studies nature and natural history—relationships between plants and animals, where they come from, their

behaviors, population numbers, and how they evolve over time.) Naturalist John Slipp's detailed notes provide the best accounts of Tacoma's natural history from the late 1930s and early 1940s.

Today, people continue to contribute important information to the museum's store of knowledge by bringing in dead birds and mammals. For example, a bird found in Portland, Oregon turned out to be a tropical seabird never before seen in the Northwest: a Masked Booby. General patterns emerge from lots of observations—for instance, naturalists who keep track of where butterflies and birds live have found them further and further north every year. Others who closely follow bird nesting patterns have discovered that many birds are laying their eggs earlier in the spring than they did 20 years ago. These observations help demonstrate the impacts that climate change is having on the organisms around us.

Some people who record their daily nature sightings share their information with scientists. They are called "citizen scientists," and scientists use this information to add to their store of knowledge about local animals and plants. For example, they might use changes in the numbers of birds visiting an area to help protect wild places or learn more about global warming. The quality of the information is important. The most important information to include in each record is the place and the date of the observation. Less important, but still useful, are the time and the weather conditions. Some citizen science programs that students can participate in to help contribute to nature records are listed in Additional Resources at the end of this lesson.

In this lesson, students will practice close observation. They will carefully examine, make predictions about, draw and make notes on one object from nature that they could find on a walk somewhere in Tacoma – in one of the gulches, parks, or on one of the beaches. Next they will find other students in the class with objects similar to their own. Working together they will fill in a Venn diagram detailing similarities and differences about their objects. Finally, students can refer to the Wild Things Box Key for photos of and facts about their objects.

The nature journal is theirs to use at any time to practice their skills as a naturalist—at school, at home, when they spend time anywhere outside, or even sitting inside and recording what they observe through a window. The journal also contains worksheets for the lessons in this curriculum.

Learning Experience

Once we begin to pay attention, nature is everywhere—not just in parks and on beaches, but in cracks in the sidewalk and store parking lots, too. How do we learn to notice nature? Just like anything we want to get better at, we practice. In this lesson, students will use their senses to take a closer look at an object that was found somewhere in Tacoma. They will take notes and answer questions about it, and draw it in detail. Working in small groups, students will compare and contrast similar objects.

Before beginning the lesson review the Specimen Use Guidelines on page 4 with your class. Model both appropriate and inappropriate behavior.

To begin, practice observing together with your class. **(10 mins.)** Choose a common object in the classroom (a pencil, book or water bottle—something everyone can see). Describe it together as a group. What color and shape is it? Does it remind you of anything else you've seen before? Pass it around so students can smell it, listen to it and touch it (no tasting, please!). Ask them to think of one- or two-word phrases to describe what they observe. Record their observations for the whole class to see. Have them explain their answers.

1. Pass out the nature journals and explain to the students that they will be making notes about their own object from the Wild Things Box, drawing the object in their nature journals, and then finding others with like objects. Working in small groups, they will compare and contrast their objects.
2. **(5 mins.)** Invite students one at a time to reach in and choose a box from within the Wild Things Box. Remind them that all of these Wild Things were found in Tacoma and that none of these things were killed for museum use; they died and were preserved to be used in programs like this one. **Note: Explain that they will have a chance to look at all of the Wild Things before the lesson is over.**
3. **(10 mins.)** Have the students spend ten minutes taking notes about their object. Invite them to use their senses to observe their object and make notes about it in their nature journals: What color is it? What does it smell like? Does it make any sound? Is it hollow or solid? Close your eyes and touch it—describe what you feel. Look at it closely from all angles—does its shape remind you of any other object? Have you seen anything like it before? How does its shape serve the animal/plant? (Some examples: feathers are shaped to help birds fly, a snail shell protects the vulnerable soft animal within, seed pods hold and protect seeds.) Short phrases will do; use descriptive words:

Feels light as a pencil, smooth like the top of my desk, purple like a grape Popsicle. Useful sentence starters: I noticed…, I wonder about…
Note: If a student has an object they are already familiar with, they have an extra challenge. Ask them to think about describing it over the phone to someone from another planet. Have them try to find and describe details that they never noticed before.

4. **(5 mins.)** Now each student will generate a prediction (or hypothesis) about their object. They will fill in the "My prediction" area with a full sentence about their object. What is it and where do you think it could be found in Tacoma? How did it get there? Think like a detective and go beyond the obvious: What was it used for? Was it part of an animal or plant—if so, what kind, and how did it "lose" this part of itself? What did it eat and/or what ate it?
   Sample prediction: I think this is a sea creature because it has a shell like ones I have found at the beach before. I also found some sand on the shell. I think the shell protects the creature from being eaten. I think it was found because the creature that lived inside died and the shell washed up on the sand.
5. Pass out the Naturalist Kits containing magnifying glasses, colored pencils and rulers.
6. **(20 mins.)** Now students will have the opportunity to draw their Wild Thing in the boxes provided in their nature journal. The first box is for a drawing of the whole object. The second box is for a drawing of the object under magnification or from a different angle (the opposite side or one part of the whole). Ask students to use regular No. 2 pencils to trace or draw their object with as much detail as possible. Then they can use the colored pencils (not erasable) to add color highlights. **Remind students to fill up all of each box with their drawings so we can really see the details.**
7. **(10 mins.)** Next the students will try to find others in the class with similar objects. Have the students leave their objects out on their desks so they are easy for others to see. Invite everyone to quietly walk around the room looking for objects similar to their Wild Thing. Once they have found two similar objects, have them sit in a group with the students with those similar objects. Some of the similarities are difficult to see. Refer to the Wild Thing group listing (inside the Wild Things box lid) to help all of the students find their partners.
8. **(15 mins.)** Using a Venn diagram, students can now compare and contrast different elements of their objects and understand relationships between objects. Explain how to use the Venn diagram in their nature journal. First,

have students label the circles with the numbers on the three objects. Each circle represents one of the objects, with any like information written into each of the shared (overlapping) parts of the circles. If needed, work through a sample diagram comparing three objects with the class before they begin.

9. **(10 mins.)** Next, pass out the Wild Things Box Key so the students can learn some facts about their object and see a photo of the living animal/plant. Have them label the Venn diagram circles with the names of the three objects they compared and contrasted.
10. **(5 mins.)** Ask the students to look back at their prediction (hypothesis) to see if it was correct. Have them write down three facts about their object in the space provided on their worksheet.
11. **(10 mins.)** Ask for volunteers to stand up and show their object to the class and share an interesting fact that they learned about the object.
12. Remind students that this is their own nature journal and encourage them to add drawings and observations to it at any time (there are blank pages after the lessons provided for this exploration), beyond the lessons in the curriculum.

Language Arts Extension

Invite students to work with a partner to create a story about their two objects. Have the students write a story (at least three paragraphs long) that involves some kind of interaction between their two objects—it can be factual or fantastical, based on a real experience, or completely imaginary. Have them refer to their descriptive notes for details to add to their story. If they're having trouble getting started as a team, one method is to take turns writing sentences.

Nature Journal Extension

Bring your class outside into the school yard or to a nearby park. Have them choose a place to sit, make observations and draw in their nature journals (make sure they fill in the basics such as place, time and weather) for 20 minutes. Return to this same place every day for a week, or once a month, to note seasonal and other changes.

Materials

- Nature journals
- Naturalist Kits: magnifying glasses, colored pencils, rulers
- Wild Things Box
- Wild Things Box Key

Assessment

Teachers review nature journals to check observation skills including drawing from different angles (magnification), detailed notes, and that students understood the concept of prediction (or hypothesis). Review Venn diagram comparisons.

Grades: 4-5

Lesson length: 1.5 hours

Resources for Further Exploration:

1. ***Citizen Science Projects***

The Washington NatureMapping Program, http://depts.washington.edu/natmap/

The Great Sunflower Project, http://www.greatsunflower.org/

1. ***Related Local Links for Continued Learning***

Slater Museum of Natural history collections, http://www.pugetsound.edu/academics/academic-resources/slater-museum/biodiversity-resources/

Washington Department of Fish and Wildlife species fact sheets, http://wdfw.wa.gov/living/species/

Burke Museum of Natural History collections, http://www.washington.edu/burkemuseum/collections/index.php

Lesson 2: Urban Bird Diversity—Birdiversity!

Subjects covered: Science, Math, Art

Goal

Students will compare beaks and feet of bird specimens to understand how adaptations allow birds to get different foods and live in a variety of habitats.

Main Learning Objectives

- Close observation
- Understand how body adaptations relate to food choices
- Prediction (hypothesis) generation
- Learn to identify three or more Tacoma bird species

Secondary Learning Objectives

- Drawing with and without magnification
- Using a field guide, note-taking
- Practice measuring in centimeters, writing decimals

Background

Did you know that more than 250 kinds of birds have been recorded in Tacoma, and more than 175 make their home here for all or part of the year? From the tiny Rufous Hummingbird weighing as much as a ping-pong ball, to the Bald Eagle with a seven-foot wingspan, Tacoma is a great place to watch and learn about birds.

Why watch birds? Because birds show up almost everywhere we go and offer a great way to start learning the natural history of our home. When we begin to notice birds, they become a useful, available subject for practicing observation and identification skills. Once you begin to pay attention to birds, you might be surprised to find such a variety of interesting behaviors, beautiful coloring and striking songs. Birds are also important to a healthy, balanced ecosystem. What would happen to the insect population if suddenly all the birds disappeared? And what would happen to us if there were no birds to eat the insects? How would plants with berries spread their seeds? Bird population records also provide important information about changes to our environment that can help guide decisions regarding land use and development.

Teacher Overview

Tacoma's rich abundance of bird life provides great opportunities for observing how birds are adapted to their specialized environments. You can watch a Great Blue Heron use its spear-like bill to nab fish, a Red-breasted Nuthatch spiral down a tree trunk in search of small insects and spiders, or a Surf Scoter pull mussels from pilings. Each is using its own specially adapted beak and feet to obtain and eat its favorite foods. (Note: What people usually call a bird's foot are actually its toes—a bird's ankle bone is located about halfway up its leg. For ease of reading, we refer to feet rather than toes in this lesson.)

To better appreciate birds and communicate with others about what we observe it's important to be able to identify different species. In this lesson we will study a few of Tacoma's common species. Using close observation, we will learn about some of the characteristics that help birds live in different habitats. Looking closely at these characteristics will help us begin to notice differences between birds and ultimately identify different species. In doing this, we'll also learn about how birds' bodies are adapted to feed on different foods and live in different habitats.

Learning Experience

Explain to the students that they will be studying birds that live the whole year or part of the year in Tacoma to learn how their beaks/bills and feet are adapted to help them get different foods. Please emphasize that none of the bird specimens were killed for this purpose—they were found dead mainly as the result of being hit by cars, flying into windows or being attacked by cats.

Before beginning the lesson review the Specimen Use Guidelines on page 4 with your class. Model both appropriate and inappropriate behavior.

1) **(10 mins.)** Go through the Beaks and Feet Background sheet to teach how different body structures serve birds. Explain that birds use their beaks and sometimes their feet as tools to get their food. Explain that beaks and feet are not actual tools, they only work like tools, and not all beaks and feet fit neatly into the tool categories on our sheet. Some look like one tool and act like another, and many beaks and feet have multiple uses. Explain that the best way to learn how a bird uses its beak and feet is to watch it closely. Each bird's body is adapted to help it get food in different ways allowing birds to live in many different habitats. Talk about what foods these birds might eat with their specially shaped bills and feet.

2) **(5 mins.)** Divide the class into groups of three and explain that they will be measuring and observing a bird specimen, and looking for clues about how the bird "makes its living." Pass out the Beaks and Feet Background sheet for them to use. Give each group three bird specimens—one for each student (bird tags are color-coded in groups of threes to provide good contrast within each group—see the Bird Specimen List at the end of this lesson). Remind them that all of these birds are species found in Tacoma. **Note: Explain that they will have a chance to look at all of the birds before the lesson is over.**
3) **(10 mins.)** Ask the groups to use the rulers to measure the beak, feet and length of their bird in centimeters, filling in the information on Worksheet 1 in their nature journals. Depending on their math skills, they can round to the nearest centimeter, or write a decimal.
4) **(20 mins.)** Have the students trace or draw a sketch of the beak and a foot in the spaces provided on the worksheet. Have students use the magnifying glass to include as much detail as possible and label any parts they can. Emphasize that they need to be gentle with their birds. **Note: There is a measuring guide at the beginning of this lesson in the nature journal that shows how to measure beaks and feet.** (If they finish early, have them draw the whole bird on the back of the worksheet.)
5) **(10 mins.)** Next, have each student make a prediction (hypothesis) what food their bird might eat and what habitat it might be found in. On the worksheet in their journal, have them write a few sentences to support the prediction.
6) **(10 mins.)** When they are done, ask them to do a short presentation for the two others in their group about what they wrote and why, pointing to the parts of the bird that led to their prediction.
7) **(5 mins.)** Give the students a chance to look at the other birds in the room. Have them leave their birds out on their desks for others to see, then walk around the room to see the other bird specimens. They can touch them, but don't have them pick them up during this time.
8) **(10 mins.)** Next, have them return to their original group of three students. Pass out the bird field guide cards (laminated bird photos with details about each bird) and the *Birds of the Puget Sound Region* field guides. Have them check their own work to see if their guesses about what their bird ate and where it might live were correct. Ask them to write down the name of their bird on Worksheet 2. Have students look up their bird in the field guide (the birds are listed alphabetically in the index under the type of bird: e.g. hawk, hummingbird, duck). Ask students to

write down any corrections (about what the bird eats and where it lives) and at least three interesting facts about their bird on the worksheet.

9) **(10 mins.)** Wrap up/sharing: When the groups have finished, get together again as a class and ask for volunteers to share one thing they learned about how their bird's beak or feet help the bird get food.

Math Extension

Ask each group to plot their bird's body length (on the X axis) and beak length (on the Y axis) on a large piece of graph paper hanging in the front of the classroom. As a class, look at the general trend in beak and body lengths. Draw a line through the average beak length for a given body length—we call this a trend line. Ask the students what that line tells us. The pattern shows that beak sizes generally increase with bird length. In general, it's telling us that an animal's parts get bigger as it gets bigger. This is a general pattern in organisms. Another way to describe the line is that it represents an average beak length for a given body length. Points below the line are birds that have shorter than average beaks while birds that are above the line have longer than average beaks. These are outliers. What do these points tell us? Again, have the class brainstorm. The points tell us that the outlier species have beaks different from *most* species, which is a good indication that these species are specially adapted to gather food in a way different from most birds. For instance, Great Blue Herons and Belted Kingfishers have longer than average beaks and use their beaks for spearing fish.

Another math challenge using beak and bird length measurements: First have the students arrange the lengths in order from smallest to largest. Next ask them to find the range, mean, median and mode for both the bird beaks and the bird lengths.

Nature Journal Extension

Have students keep notes in their nature journals of the number and kind (have them try to identify them) of birds they see over a one-week period. Start each school day by having students record what they have seen in the past 24 hours (For example: A flock of 15 robins eating on school lawn). With each entry, make sure they include the nature journal basics: place, time and weather. If they don't know a bird's name, have them describe what it looked like, where they saw it and what it was doing, the more specific the better. (For example: 30 black birds grouped on telephone wire by bus stop—their bodies were about the length of a new pencil). Or have them use a field guide to help them try to identify the bird (we've included copies of *Birds of the Puget Sound Region*). This extension can be used as a daily field-trip (see how many different kinds of birds you

record in one week, for example) to the school yard or a local park as a group birding activity. Look at BirdSleuth eBird, the Great Backyard Bird Count and Celebrate Urban birds citizen-science projects to see how your class can participate in a larger citizen-science effort.

Language Arts Extension

Ask students to invent and draw their own bird. Before they begin, have them think about what their bird will eat and where it will live in the city. Ask them to draw detailed beaks and feet. Next have them name their bird and write a paragraph that explains how its beak and feet help it get its favorite food. Have them explain where would it live in Tacoma and why.

Materials

- Bird specimens
- Nature journals
- Naturalist Kits: magnifying glasses, colored pencils, rulers
- Beaks and Feet Backgrounder
- Bird Specimen List
- Field guides (*Birds of the Puget Sound Region* by Morse, Aversa, Opperman), 15 copies
- Birdiversity bird field guide cards
- Graph paper for math extension

Assessment

Teachers review journals to see if students understand concept of bird adaptations for different foods. Check for: measuring accuracy, predication generation, correct bird names, beak/feet sketches, sentence descriptions of what different birds eat and why.

Grades: 4-5

Lesson length: 1.5 hours

Resources for Further Exploration:

2. Citizen Science Projects

Project Feeder Watch, http://www.birds.cornell.edu/pfw/Overview/over_index.html

Celebrate Urban Birds, http://www.birds.cornell.edu/celebration

BirdSleuth eBird, http://ebird.org/content/birdsleuth/

Great Backyard Bird Count, http://www.birdsource.org/gbbc/

Project Pigeon Watch, http://www.birds.cornell.edu/pigeonwatch

3. Related Links for Continued Learning

Slater Museum of Natural history wing image collection, http://www.pugetsound.edu/academics/academic-resources/slater-museum/biodiversity-resources/birds/wing-image-collection/

Tahoma Audubon Society in Tacoma, http://www.tahomaaudubon.org/

Seattle Audubon Society BirdWeb guide to birds of Washington, http://www.seattleaudubon.org/birdweb/

The Cornell Lab of Ornithology All About Birds bird guide, http://www.allaboutbirds.org/guide/

Lesson 3: Tooth Sleuth—Tacoma Mammal Puzzler

Subjects Covered: Science, Math, Art

Goals

Students will use a dichotomous key to identify a mammal skull, and learn that teeth provide information about whether the animal is a carnivore or herbivore. Observing the different types of teeth and their different uses, students will notice how structure relates to function.

Learning Objectives

- Close observation
- Prediction (hypothesis) generation
- Learning about adaptation and structure/function (how teeth can indicate whether an animal is an herbivore or carnivore)
- Learn four main types of mammal teeth
- Learning how to use a dichotomous key

Secondary Learning Objectives

- Drawing with and without magnification
- Practice measuring in centimeters
- Comparing and contrasting using a T chart

Background

Teeth, skulls and bones provide a surprising number of clues about the living animals they were once part of—so many, in fact, that some scientists can correctly guess an animal by looking at just one of its bones. In the late 1700s, French paleontologist Georges Cuvier was known for his skill at this. In his groundbreaking work known as "Cuvier's principle of correlation of parts," he wrote, "…*Because the number, direction, and shape of the bones that compose each part of an animal's body are always in a necessary relation to all the other parts, in such a way that— up to a point—one can infer the whole from any one of them and vice versa.*"

Even without Cuvier's knack, we can identify different animals based on their teeth.

(NOTE: The following information is included in the PowerPoint presentation intended for use with your class.)

Teacher Overview

There are four main types of teeth: incisors, canines, molars and premolars. **Incisors** are the teeth at the very front of the mouth and have a simple shape. Incisors are most often used for grasping, cutting and gnawing. **Canines** are located next to the incisors and are generally longer than all of the other teeth. Canines are used for stabbing and holding prey, and are generally absent or reduced in size in herbivores. **Molars** and **premolars** vary in size and are located at the sides and back of the mouth. Though their shapes also vary, they are primarily used for chewing, gripping and tearing, and breaking up tough material. **Note: In this lesson, we have grouped premolars and molars together as "molars" to make it easier for students to count the teeth.**

Teeth can help determine whether an animal is carnivorous (eats meat) or herbivorous (eats plants). For example deer and elk have many large flat molars for grinding, indicating plants as their main food source. A coyote's large canine teeth are used to tear meat. (Note: Some animals are omnivores—they eat both animals and plants. It's not easy to determine this by observing only teeth, so in this lesson we will focus on whether the animal is *mainly* carnivorous or herbivorous. The teeth of omnivores look most similar to those of carnivores.)

In our identification activity we will use types of teeth, measurements and a dichotomous key to determine which animal each skull belongs to. A dichotomous key is a pathway of paired facts used to identify something. As you match your object to the correct fact, you are directed to another pair of facts, with the facts eventually leading to one conclusion. In this case, we use facts about skull size and teeth to identify each animal.

Learning Experience

Before beginning the lesson review the Specimen Use Guidelines on page 4 with your class. Model both appropriate and inappropriate behavior.

Use the PowerPoint presentation (Part 1) to teach the students characteristics of the four main different types of teeth (canines, incisors, premolars and molars), and teach them what the different types of teeth are used for **(10 mins.)**. You can also access the Tooth Sleuth PowerPoint online at:
http://www.pugetsound.edu/files/resources/6498_L3_Tooth%20Sleuth%20Powerpoint_2_8_10.pdf

Discuss how teeth give clues to whether an animal is *mainly* an herbivore or carnivore (e.g. fang-like canine teeth help kill prey and tear flesh). **Stop when you get to the slide that reads, "Part 2."** You will present Part 2 of the PowerPoint at the end of this lesson.

1. **(5 mins.)** Divide students into groups of three. Explain that each group's task is to try and see how many distinctly different teeth are in their assigned skull and to make a prediction (hypothesis) both about what types of food the animal eats based on its teeth, and what kind of an animal it might be. They will sketch each of the distinctly different teeth and the whole skull in their journal. Generally, they will be able to find 2 to 3 different types of teeth in each skull. Remind students that their animal may not have all of the different types of teeth, or that they may find one type in the top jaw but not in the bottom jaw (for example the black-tailed deer has incisors in the bottom jaw, but not in the top). **For help in remembering types of teeth, refer students to the Tooth Type Diagram on page 13 of their Nature Journal.**
2. Pass out one skull to each group. Remind the students that all of the skulls are from animals found in Tacoma.
3. **(15 mins.)** Have the students take 15 minutes to observe the skull and teeth, make tooth sketches and write predictions (hypotheses) about what the teeth indicate the animal might have eaten, and what kind of animal they think the skull is from (in their nature journals).
4. Next, explain that the groups will have a chance to figure out which mammal their skull is from using measuring skills and their newly gained knowledge about tooth types, with the use of a dichotomous key.
5. **(5 mins.)** Pass out the dichotomous keys, going through the first pair of facts together as a group to help students get used to the key.
6. **(25 mins.)** Have the students work with their group to try and identify their skull using the dichotomous key, noting the skull number and animal name in the space provided in their journal.
7. After a group has identified a skull, have them raise their hands and have an adult check that they have correctly identified the skull (a key is located in the back of this notebook and inside the skull box lid.) If they are correct, bring them a new skull. (Return the identified skull to the box for another group to use.) If they are incorrect, go through the key with them for the first skull. Have them repeat the process on each new skull using the dichotomous key. Have them do this until they have identified up to seven different skulls in the time available. For each skull, the groups should fill in the name of the animal and whether it is an herbivore or a carnivore (and why they think so) on their worksheet.
8. **(15 mins.)** Explain that now two groups will work together to compare and contrast two skulls, filling in the skull comparison worksheet (T-chart) in their nature journal. Assign groups based on the color of the skull numbers: a group

holding a skull with a red number will be paired up with a group with a skull with a blue number (this is to ensure an interesting comparison session examining the differences between herbivores and carnivores). Ask them to write notes about similarities in the box above the chart, noting differences in the T-chart below.

9. **(10 mins.)** Have the class reconvene as a whole and show the PowerPoint (Part 2). The PowerPoint slides show each skull, identify it with brief notes on foods and how the teeth function to feed on different foods, and include a photo and facts about each of the animals. The slide also includes the scientific name of each animal—the universal name used by scientists around the world when they refer to a particular organism. The first word in the scientific name is the genus of the animal and the second word is the species. For example, the scientific name for coyote is *Canis latrans* (*Canis* is the genus and *latrans* is the species).
10. **(5 mins.)** In closing, ask students to share one thing they learned today or during one of the other lessons about Tacoma Wild Things and birds. Encourage students to add to their nature journals at home and see what kind of discoveries they can make by paying closer attention to Tacoma's natural treasures.

Math Extension

Help students take the first step in understanding scale bars. Explain that using scale bars allows people to get a sense for how big or small something is in a drawing or photograph. You may want to show them a map scale as an example. For this exercise, give the students the skulls they drew in their notebook. Ask them to use the straight-edge of the ruler to draw a line underneath the skull going from the tip of the nose to the back of the skull. Next they need to measure their skull from the tip of the nose to the back of the skull. They then write in the skull length under the line they drew in their notebook. This distance tells the students the length that their line represents. That line is a scale bar.

Language Arts/Science Extension

In this exercise students will explore scientific names, the Greek and Latin words that compose the genus and species of each organism. These universal names are used by scientists around the world when they refer to a particular organism. The first word in the scientific name is the genus and the second word is the species. For example, the scientific name for coyote is *Canis latrans* (*Canis* is the genus and *latrans* is the species). Have students choose a mammal from the skull lesson and research its scientific name. Is it made up of Greek or Latin words? What do the words mean? What does their

combined meaning tell the student about the animal? *Canis latrans* means "barking dog" in Latin. What does this name tell us about coyotes?

As a second part to this extension, ask students to make up a genus and species name for the bird they invented in the Birdiversity language arts extension. Did they choose Greek or Latin? Why? What does the name tell us about their bird? Students can research Greek and Latin roots online, or use a book of Greek and Latin roots.

Materials

- 12 Skulls
- Tooth Sleuth PowerPoint presentation (Parts 1 and 2)
- Dichotomous keys (10)
- Nature Journals
- Naturalist Kits: magnifying glasses, colored pencils, rulers

Assessment

How many groups identified their animals correctly by using the dichotomous key? Was there general understanding of how teeth relate to the type of food consumed? Review the nature journal sketches.

Grades: 4-5

Lesson length: 1.5 hours

Resources for Further Exploration:

1. ***Citizen Science Project***

The Washington NatureMapping Program, http://depts.washington.edu/natmap/

2. ***Related Links for Continued Learning***

A Teacher's Guide to Skulls of Alaskan Mammals; additional tooth/skull lessons, http://www.wildlife.alaska.gov/education/pdfs/skulls.pdf

Smithsonian Mystery Skull interactive identification game, http://humanorigins.si.edu/evidence/human-fossils/mystery-skull-interactive

eNature online field guide to North American mammals and other animals, http://www.enature.com/fieldguides/