Table Rocks Curriculum

Champion Weed Seeds

Objective: In order to investigate plant reproduction, seed ***dispersal***, and the ***dispersal adaptations*** of some ***weed*** species, students will inspect and draw a variety of real seeds. They will then design and build their own ***weed*** seeds. Students will identify some ***noxious weeds*** that grow locally and may conduct an experiment to explore the ability of ***noxious weeds*** to survive when exposed to various management treatments.

Benchmarks Targeted: 2 and 3 (Grades 4-8)
Oregon Standards Achieved:

Subject Area: Life Science

Common Curriculum Goals: Diversity/Interdependence: Understand the relationships among living things and between living things and their environments.

Benchmark 2: Describe the relationship between characteristics of specific habitats and the organisms that live there. Describe how adaptations help a species survive.

Benchmark 3: Identify and describe the factors that influence or change the balance of populations in their environment.

Subject Area: Social Sciences

Common Curriculum Goals: Geography: Understand the geographic results of resource use and management programs and policies.

Common Curriculum Goals: Understand how people and the environment are interrelated.

Benchmark 2: Understand how physical environments are affected by human activities.

Benchmark 3: Understand how human modification of the physical environment in a place affects both that place and other places.

Subject Area: Scientific Inquiry

Common Curriculum Goals: Forming the Question/Hypothesis: Formulate and express scientific questions or hypotheses to be investigated.

Benchmark 2: Make observations. Ask questions or form hypotheses based on those observations, which can be explored through scientific investigations.

Benchmark 3: Based on observations and scientific concepts, ask questions or form hypotheses that can be explored through scientific investigations.

Common Curriculum Goals: Designing the Investigation: Design safe and ethical scientific investigations to address questions or hypotheses.

Benchmark 2: Design a simple scientific investigation to answer questions or test hypotheses.

Benchmark 3: Design a scientific investigation to answer questions or test hypothses.

Common Curriculum Goals: Collecting and Presenting Data: Conduct procedures to collect, organize and display scientific data.

Benchmark 2: Collect, organize, and summarize data from investigations.

Benchmark 3: Collect, organize, and display sufficient data to support analysis.

Common Curriculum Goals: Analyzing and Interpreting Results: Analyze scientific information to develop and present conclusions.

Benchmark 2: Summarize, analyze, and interpret data from investigations.

Benchmark 3: Summarize and analyze data including possible sources of error. Explain results and offer reasonable and accurate interpretations and implications.

Length of Lesson: 45-60 minutes (more if Extensions and Scientific Inquiry are applied)

Materials:

- ✓ Seed specimens, including wind-dispersed, water-dispersed, and animal-dispersed seeds (see Background section for suggestions)
- ✓ Paper and pencils for drawing
- ✓ Hand lenses
- ✓ Various art supplies: construction paper, pipe cleaners, tissue paper, egg cartons, foam shapes, glue, string, springs, empty plastic water bottles, film canisters, yogurt containers, etc.
- ✓ "Parts of a Flower" and "Parts of a Plant" diagrams (provided at end of the Botany chapter)
- ✓ "Most Wanted Weed" cards (included at the end of the Botany chapter)

Key Vocabulary: *adaptation, dispersal, habitat, native, nonnative, noxious weed, weed*

Background:

For more extensive information on ***noxious weeds***, see the Background section of the "Amazing Weed Parts" lesson. The following information includes a brief summary of ***noxious weeds*** in general, but focuses more specifically on seed ***dispersal***.

Noxious Weeds

Noxious weeds are one of the principal threats to ***native*** ecosystems in our region. A ***weed*** is simply a plant growing in a place it is not wanted; a ***noxious weed*** is one that spreads aggressively and causes significant economic or ecological damage. Typically, ***noxious weeds*** damage cropland or pastureland or displace ***native*** vegetation. A ***native habitat*** supports a rich array of animal species because of the diversity of homes and foods it provides. A uniform stand of a single ***weed*** species does not.

Noxious weeds are not ***native*** to the ecosystems they invade; in most cases they were brought here from overseas. One reason they are able to spread and take over is that their natural controls – the species that eat them and parasites that are specially adapted to exploit them, and which serve to keep them in check in their ***native*** ecosystems – have been left behind. Another characteristic of ***noxious weeds*** is that they are adapted to exploit environmental disturbances. Because they grow and spread rapidly, reproduce early and in great numbers, and ***disperse*** efficiently, they are able to invade areas that have recently been cleared by a disturbance such as a forest fire or development before ***native*** plants have a chance to grow. A ***noxious weed*** can also spread into more populated areas, but it may not be as successful because there is more competition for resources.

Seed Dispersal

In biology, to ***disperse*** means to spread. Seed ***dispersal*** is a crucial stage in the life of a plant, because it is a means of escaping competition and overcrowding. A seed which germinates too close to the parent plant will generally lack sufficient water, nutrients, and

light required for normal growth; one that germinates some distance away has a much better chance of survival.
Plants have evolved an astounding diversity of ways to ***disperse*** their seeds, but these various mechanisms can be grouped into four basic types: wind ***dispersal***, water ***dispersal***, animal ***dispersal***, and explosive ***dispersal***. Many students will be familiar with wind-dispersed seeds such as dandelion, maple, and black cottonwood, which have special ***adaptations*** to allow them to float on the breeze. Water-dispersed seeds are able to float and to resist water damage; they typically occur in riparian and island-dwelling species. A fascinating example is the coconut palm, whose seeds (coconuts) can float on ocean currents for years, allowing the plant to ***disperse*** to remote islands. Animal-dispersed seeds depend on animals for transport. Some animal-dispersed seeds are enclosed in tasty fruits and are adapted to withstand passage through an animal's digestive system. Others, such as the acorns of oak trees, count on birds and rodents to forget the locations of at least a few of the many acorns they gather and store for the winter. Still others, such as hound's tongue, cocklebur, or medusa head grass, are not good to eat but are adapted to catch in a passing animal's fur (or in a person's socks)! Finally, some seeds are housed in dry fruits which burst violently, propelling the seeds many feet through the air. Explosive ***dispersal*** is common in the pea family, which includes our ***native*** lupines as well as the ***noxious weed*** Scotch broom. ***Noxious weeds*** are usually excellent ***dispersers***; their ability to lots of seeds and ***disperse*** them widely and rapidly helps make them effective invaders.

The following table presents some examples of plants representing the four modes of seed ***dispersal***. Except for the coconut palm and the mangrove, all these plants can be found locally.

Dispersal Method	**Plant Name**	**Plant Status**
WIND	Dandelion (*Taraxacum oficinale*)	Nonnative weed
	Yellow starthistle (*Centaurea solstitialis*)	Noxious weed
	Fireweed (*Epilobium angustifolium*)	Native
	Black cottonwood (*Populus trichocarpa*)	Native
	Big-leaf maple (*Acer macrophyllum*)	Native
	Mountain mahogany (*Cercocarpus betuloides*)	Native
ANIMAL	Himalayan (Armenian) blackberry (*Rubus discolor*)	Noxious weed
	Oak mistletoe (*Phoradendron flavescens*)	Native
	Ponderosa pine (*Pinus ponderosa*)	Native
	White oak (*Quercus garryana*)	Native
	White-leaf manzanita (*Arctostaphylos viscida*)	Native
	Pacific madrone (*Arbutus menziesii*)	Native
	Cocklebur (*Xanthium sp.*)	Nonnative weed
	Medusahead (*Taeniatherum caput-medusae*)	Noxious weed
	Hound's tongue (*Cynoglossum grande*)	Native
WATER	Purple loosestrife (*Lythrum salicaria*)	Noxious weed
	Coconut palm (*Cocos nucifera*)	Not found locally
	Mangrove (*Rhizophora sp.*)	Not found locally
EXPLOSIVE	Scotch broom (*Cytisus scoparius*)	Noxious weed
	Lupine (*Lupinus sp.*)	Native

Procedure:

Preparation:
Begin by discussing with students the purpose of seeds in the life of a plant. Make sure students understand that all organisms reproduce and that seeds are a plant's means of reproduction. Next, move the discussion toward the question of where seeds come from and how they are formed. Use the "Parts of a Flower" and "Parts of a Plant" diagrams included at the end of this lesson. Information in the Preparation section of the "Plant Identification" lesson is also useful for reviewing floral anatomy and the processes of pollination and fertilization.

Once a flower's ovules have been fertilized and have developed into mature seeds, what happens next? (You may wish to pose the question, "Do plants move?" If students say they don't, ask how plants spread – how does a field or a garden become filled with ***weeds***, or how does a forest encroach on a meadow?) Ask for students' ideas, and guide them to the understanding that seeds must be ***dispersed*** (i.e., they must travel some distance away from the parent plant) before they germinate and begin growing. A discussion of why ***dispersal*** is necessary may present the opportunity to discuss the basic requirements for plant survival (sunlight, water, air, space, and nutrients). Ask students to consider whether a seedling is more likely to have enough of these resources if it is growing directly beneath its parent, or some distance away from its parent. You may personalize the discussion by asking students whether we human beings ***disperse*** too. ("Will you live with your parents forever?")

Next, discuss modes of ***dispersal***. Begin by asking students to brainstorm all the ways people can travel (e.g., walking, boating, cars, airplanes, horseback, etc.) and list their ideas on the board. How many of these modes of travel do seeds use? Explain the four basic modes of seed ***dispersal*** and create a table on the classroom board like the one presented in the Background section. Fill in the table according to students' suggestions before completing it with the examples of ***native*** plants and local ***weeds*** listed.

Activity:
1) Divide students into groups of 2-3. Give each group several seed specimens representing different ***dispersal*** modes. Pass out pencils, drawing paper, and hand lenses. Ask students to inspect each seed closely, make hypotheses regarding their modes of ***dispersal***, make drawings of each one, and label its ***adaptation***(s) for ***dispersal***. When students are finished drawing, have them share their drawings and ideas with the class.

2) Hand out a "Most Wanted Weed" card to each group. Ask students to read the card to find out how their ***weed disperses*** its seeds and to discover any other ***adaptations*** that help it outcompete ***native*** plants. Show students seed specimens that belong to ***noxious weeds***. Ask students how each of these seeds travel and what evidence supports their conclusions.

3) Students may work individually or in groups of 2-3 for the following activity. Tell students they are going to design and create a "Champion Weed Seed" using the materials provided. The goal is to create a seed that is able to travel great distances via

wind, water, animals, explosive ***dispersal***, or a combination of these methods. Have them consider the following:

- How will my seed travel?
- How is my seed protected? (How can it survive harsh conditions?)
- Does my seed require specific conditions to germinate?

Follow-up:
Grades 6-8: Have students invent profiles for the plants that produced their invented ***weed*** seeds. The profile should include the following information:

- Where did this plant come from (country/region of origin) and how did it get here?
- The number of seeds produced by the plant and how they are ***dispersed***.
- Description of the ***habitat***(s) it invades and why it thrives there (water, nutrients, etc.).
- Description of the plant, including size, shape, flower color, etc.
- ***Adaptations*** or defenses such as thorns, poisonous sap, tolerance to fire, resprouting, deep roots, hard shelled seeds, etc.
- Common name and scientific name

Extensions:

- Using the information provided on the "Most Wanted Weeds" cards, have students work in groups of 3-4 to produce a short performance (e.g., play, newscast, or talk show interview) about a ***noxious weed*** that grows on the Table Rocks and the effects it has on the ***native*** plants and animals in that environment. Alternatively, students might look up profiles of other state-listed **noxious weeds** at <http://www.oregon.gov/ODA/PLANT/weed_statelist2.shtml>.

- **Grades 6-8:** Have students choose one of the "Most Wanted Weeds" and research the methods that have been successful (and unsuccessful) in controlling its spread. From this information, have them develop a hypothesis and write an experimental design that could be used to test the comparative effectiveness of these control methods.

- **Grades 6-8:** Have students research biological control as a method of controlling ***noxious weeds.*** Biological control involves importing and releasing a predator or parasite from the ***weed's native*** ecosystem to help control it. Each student might research a different ***weed*** and a biological agent that has been successful in controlling it, highlighting the control agent's ***adaptations*** that make it specially suited to exploit the ***weed*** species in question. Ask students to explore the risks involved with biological control. Has biological control always worked well? Are there any cases in which biological control backfired? What are some risks involved with biological control?

- **Grades 6-8:** Have each student present a rare plant to the class in a creative format. They should include information about ***habitat*** loss due to ***noxious weeds***, if applicable. Profiles of threatened and endangered plants of Oregon can be

viewed at< http://plants.usda.gov/threat.html> by checking the box beside "Oregon" and clicking on the "display search" button at the bottom of the page. Additional information is available in the "Oregon Threatened or Endangered Plant Field Guide" at <http://oregonstate.edu/ornhic/plants/index.html>. Additionally, the BLM has published a guide entitled "Rare Plants of Southwest Oregon," available at the Medford District Office.

Discussion Questions:

Define the terms *weed* and *noxious weed*. Give some examples of *noxious weeds* that grow on the Table Rocks.
*Generally, the term **weed** is used to describe any plant growing in a place where it is not wanted. The term **noxious weed** refers to plants that spread aggressively, infest large areas, and cause economic or ecological damage. **Noxious weeds** have usually been brought here from foreign ecosystems and can outcompete **native** plants because they have left their natural population controls (predators and parasites specially adapted to exploit them) behind in their native lands. Some examples that grow on the Table Rocks are Medusahead**,** hedgehog dogtail (both are non-native annual grasses that choke out the **native** bunch grasses), blackberry, and yellow starthistle.*

Define the term *dispersal*. Why is it important for plant seeds to *disperse*?
***Dispersal** means spreading. It is important for plant seeds to **disperse** because young plants have a better chance of survival if they are not too close to the established parent plants. By colonizing new territory, seedlings avoid overcrowding and competition for sunlight, water, and soil nutrients.*

What are the four basic modes of seed *dispersal* in plants? For each mode, give an example of a *noxious weed* that uses it.
*The four modes are wind **dispersal** (yellow starthistle and dandelion), water **dispersa** (purple loosestrife), animal **dispersal** (Himalayan blackberry), and explosive **dispersal** (Scotch broom).*

What are some methods you think land managers might use to control *noxious weeds*? Which method do you think is the most effective?
***Weed** control methods fall into four general categories:*

- *Cultural- planting **native** plants to compete with **weeds**, using livestock to eat **weeds**, educating people about **noxious weeds** and how to contain them*
- *Mechanical- hand-pulling, mowing, digging or chopping **weeds***
- *Biological- using natural enemies (typically herbivorous insects or diseases) to control a **weed***
- *Chemical- using herbicides to kill **weeds** or inhibit their growth or reproduction*

*Generally, a combination of these four methods is needed to manage or eradicate **noxious weed** populations. Factors include the species of **weed**, the type of environment, and the time of year. A note on biological control: Insects will only persist in areas where the populations of host plant are great enough to sustain them from year to year. Remember, biological control agents do not usually eliminate their food sources entirely.*

*If they did, their populations would not survive. It may take 10-20 years for a biological control project to successfully control a **weed** at the regional scale.*

Do you think that introducing a nonnative organism (such as a biological control agent) might create more problems than it solves for *native* plants and ecosystems?
*The Oregon Department of Agriculture (ODA) works with the USDA and other scientists to find the natural enemies (herbivorous insects, diseases) of **noxious weeds** in their **native** lands. Before they are introduced, these potential biocontrol agents are rigorously tested for host specificity. That is, scientists try to make sure that they will affect only the target **weed** and not **native** plants or crops. Once a potential control agent is determined to be safe, USDA scientists make sure it is free of disease and parasites before it is released in Oregon. The ODA has adopted the International Code of Best Practices for Biological Control of Weeds, which dictates that only safe, effective, and approved natural enemies will be used for biological control. However, there is always some risk involved should the species be able to invade and spread despite efforts to keep it under control.*

What are some ways that we can help prevent the spread of *noxious weeds*?
*Doing our part to control **noxious weeds** is easier than you might think. By following a few simple guidelines we can slow the spread of **weeds**:*

- *Before returning home from a hike or a trip outdoors, check your clothing and/or pets for seeds. Many animal-dispersed **weed** seeds love to stick to fur and socks! Remove seeds before you leave the site.*
- *Plant native or non-invasive vegetation in gardens. Established vegetation makes it harder for **noxious weeds** to invade.*
- *Check the tires of your car or bicycle to make sure **weed** seeds are not lodged in them.*
- *Educate yourself (learn to identify **noxious weeds**) and volunteer to help remove **noxious weeds** in your community.*

References:

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