



Weeds of Mass Destruction

Grade: 9 to 12

Length: two class sessions

Subjects: life science/drawing

Topics: weed facts

Objectives

Exercises in this lesson help students achieve the following objectives:

- Understand how weeds can disrupt life
- Understand how seeds function
- Understand how plants, humans, and animals help disperse seeds
- Demonstrate an understanding of weeds and seed dispersal by designing a weed and its seed

Introduction

Invasive weeds can quickly disrupt an ecosystem. Weeds often have no natural enemies, and many weeds have developed adaptations that enable them to successfully overcome native plant populations. Weed seeds in particular have developed adaptations that enable the seeds to survive a wide range of environmental conditions.

Students will learn about how weeds disrupt an ecosystem and the functions of seeds in general. After learning about unique seed adaptations that some invasive weeds have developed, students will apply their knowledge to design a weed and its seed for use as a biological weapon. Before teaching this lesson, read the entire lesson and make sure all materials are available.

If students need more information about weeds and their reproductive potential, teach the lesson *Weed Invasion* before teaching this lesson. Adapt *Weed Invasion* to a higher grade level by including a discussion about topics such as limiting resources, population density, and carrying capacity.

Background

When weeds become so wide-spread that they threaten crops, livestock, or native species, or they pose a threat to humans, they are usually classified as “noxious.” The definition of noxious weed varies by state, and each state has its own “state list” of noxious weeds. Each state usually develops its own methodical approach to attack the noxious weeds on the state list.

Noxious weeds are problematic due to physiological and cultural factors. Growth characteristics of weeds contribute to the physiological factors. Cultural factors are problems that arise because of human interactions.

Physiological factors

Noxious weeds are not native to our country; they tend to thrive here because they lack natural enemies. When the insects, diseases, and animals that keep weeds under control in their native countries are absent in a new country, the introduced weeds can out-compete native plants for water, sunlight, and nutrients. Most noxious weeds are not palatable to grazing animals. As noxious weeds overcome native plant populations, cattle, sheep, and wildlife will lose valuable food sources.

Many noxious weeds produce toxins. Some toxins enter the soil and prevent the growth of native plants. Some toxins cause illness or death in hu-

mans or animals that come in contact with them. In some cases, toxins act slowly, and they may cause death in animals months after the animal eats the weed. Some weeds produce chemicals that cause skin and respiratory irritation.

Weeds can help harmful insects and diseases to survive from one growing season to another. An insect might lay its eggs in a weed during the late summer. The weed protects the eggs from winter cold and insecticide sprays. In the spring, eggs hatch, insects emerge from the weeds, and the insects begin decimating crops.

Many noxious weeds cause physical damage. For example, some weed seeds can puncture tires or penetrate the skin of animals, causing discomfort and death. Some weeds cause pavement to fail prematurely by growing through asphalt and concrete.

Many noxious weeds are prolific seed producers; and the seeds can remain viable in the soil for long periods of time. Most noxious weeds **disperse** their seeds very effectively. Some seeds are dispersed by air, others by water. Some seeds pass through an animal's digestive system and disperse through the feces. Seeds are often dispersed when they cling to clothing, animal fur, or vehicle tires.

Some noxious weeds have developed adaptations that enable them to out-compete native species. For example, downy brome or cheat grass is a winter annual. Seeds from the previous generation enter the soil and germinate in the fall. The emerging young plant survives the winter. When moisture from spring rains or snow melt is available, the young plant absorbs the moisture before native plants have a chance to develop.

Weeds can have a detrimental effect on wildlife. In colder climates, wild mammals depend on their fur to insulate and protect them from the elements. Noxious weeds that have developed an ability to cling, such as hound's tongue or burdock, can get into an animal's fur. The seeds cause the fur to mat, the fur loses its insulating value, and the animal can die during periods of extreme cold. Most noxious weeds are deep-rooted and lack surface roots. These weeds often crowd out native, shallow-rooted plants along a stream bank. During periods

of snow melt or heavy rain, the noxious weeds are unable to hold back the runoff, and topsoil washes into streams. Fish and other wildlife then die as a result of the excessive amount of topsoil in the stream.

Most noxious weeds are very vigorous. When a fire or human activity, especially construction, disturbs an area, noxious weeds are some of the first plants to grow in the disturbed area. Noxious weeds can thrive in environmental conditions that stress or kill native plants. Many noxious weeds produce large amounts of biomass. When the weeds die and their remains dry, they create the potential for severe brush fires.

Cultural factors

The U.S. economy is a market-based economy; profits are a major driving force. When the costs of controlling weeds drive down a farmer's profits, some farmers ignore the weeds. As the weeds thrive, the productivity of the land decreases, profits dip even lower, and the cycle spirals downward until the land becomes worthless. If one landowner allows weeds to overtake his property, landowners who have property adjacent to the infected property are seriously affected.

Perception or awareness of noxious weeds is often a problem. Many landowners simply do not perceive or understand the damage weeds can cause. It is more costly and time consuming to manage weeds after they overtake property.

Public lands comprise a significant portion of the land in the western United States. Much of this land has marginal value for farming or ranching because it is extremely dry. In areas that were homesteaded, the owners were unable to survive on the land. Public agencies, such as the Bureau of Land Management (BLM) and State Lands, now manage these lands, which often cover vast areas. A small group of government employees oversee the lands. Traditionally, these lands have been used for cattle and sheep grazing, since farming the land is impractical. Today, public agencies lease a large portion of these lands to cattle and sheep ranchers. Noxious weeds pose a serious threat to our public lands for the following reasons:

- Public lands cover a vast area, and it is difficult for the small number of government employees to monitor the lands on a regular basis.
- The costs of managing weeds escalate, while federal and state budgets are reduced.
- Most ranchers who lease public lands are conscientious stewards of the land. However, as weeds invade and profits drop, these ranchers are forced to abandon their leases.
- Some ranchers are poor stewards. These ranchers tend to overgraze land and ignore good grazing practices, which leaves the land susceptible to weed invasion. Once weeds invade an area, they quickly spread to adjacent grazing allotments.
- People are using public land more frequently. Traditionally, public land has been the domain of ranchers or miners. Now backpackers, all-terrain vehicle riders, horse enthusiasts, hunters, and others use the land for recreation. These people often do not understand the impact they have on public land. Recreational use compounds the weed problem on public land. Animal feed, vehicles, and clothing carry and spread seeds over extremely large distances. Most people who recreate on public land do not use the land to generate income, so they have no incentive to protect the land for profit motives.

Noxious weed seeds

When pollen, carried by wind or insects, fertilizes an ovum, **sexual reproduction** occurs and seeds result. A seed generally has an outer protective layer called the **seed coat**, a living component called the **embryo**, and a supply of food for the developing embryo. Under suitable conditions, the seed coat breaks down, and the embryo sends a root toward water and leaves toward the sun. This growth process is called seed **germination**. Each plant has its own set of conditions that must be met before the seed will germinate. A seed remains **dormant** until conditions for germination are suitable. For most plants in temperate climates, seeds need a period of cold followed by a period where temperature and

moisture reach certain levels simultaneously. This process is called **stratification**.

Seeds are often dispersed away from the parent plant. Wind, water, and animals are instruments of seed dispersal. In some cases, seeds are dispersed short distances from the parent plant. In other case, seeds can be dispersed miles, even thousands of miles. Seeds must be able to survive the process of dispersal.

Many weeds have developed seed adaptations that enable them to out-compete native plants. One adaptation is the number of seeds a plant produces. Most weeds produce far more seeds than native plants. Another adaptation is viability. Many weed seeds can remain viable for longer periods than seeds of native plants.

Preparation

Materials

- copies of *Invasives: What About Weeds?* – Have available one copy for each student.

1 Have students read *Invasives: What About Weeds?* and review information with students.

2 Lead a discussion about weeds. Ask students the following questions:

If you could be a nasty weed that causes problems for humans and animals, what would you be like?

What kind of damage would you cause?

What weeds are a problem in your area and why?

Activity

Materials

- copies of the *Weed Trivia* and *Design a Weed* worksheets – Have available one copy for each student.

- poster board and colored pencils or computer software that allows students to design and illustrate

1 Give each student a copy of the *Weed Trivia* worksheet. Discuss the information.

2 Once students understand adaptations that enable weeds to succeed, ask students to design or engineer their own weed of mass destruction. Make sure students realize that their weed design must explain how the seeds will disperse.

3 Give each student a copy of the *Design a Weed* worksheet. Use the grading rubric included with the worksheet, or develop one of your own.

4 Have students draw their weed, with explanations, on poster board, or design the weed using computer software.

5 After grading the weed designs, have students present their designs to the class.

Conclusion and Evaluation

- Conclude the lesson after students have made their presentation to the class.
- Evaluate students according to the grading rubric on the worksheet.

Independent Practice and Related Activities

- As students present their weed designs, encourage the class to comment on unique ideas that students have developed.
- Place the posters around the classroom. If students used computer software, have students show the electronic version of their weed design.

Vocabulary

dispersal, dormant, embryo, germination, seed coat, sexual reproduction, stratification

Resources

Kingsbury, J.M. *Poisonous Plants of the United States and Canada*. Pages 396-397. Englewood Cliffs, New Jersey: Prentice-Hall, Inc., 1964.

Whitson, Tom, ed., Larry C. Burrill, Steven A. Dewey, David W. Cudney, B.E. Nelson, Richard D. Lee, and Robert Parker. *Weeds of the West*. 5th ed., Jackson: Pioneer of Jackson Hole, 1999.

Invasives: What About Weeds? Supplemental material included with the curriculum *Invasives: Plants on the Move*.

Your local Bureau of Land Management weed specialist may have videos, such as *Meet the Menace*, available about noxious weeds.

More information about yellow starthistle and chewing disease is available from:

<http://wric.ucdavis.edu/yst/impacts/impacts.html>

http://wric.ucdavis.edu/yst/yst_entire_pub.pdf

National Science Education Standards

As a result of activities in grades 9 to 12, students should develop abilities in and an understanding of the following areas:

Life Science - Content Standard C: interdependence of organisms, behavior of organisms

Science in Personal and Social Perspectives - Content Standard F: personal and community health, environmental quality, natural and human-induced hazards

Weed Warrior Worksheet

Weed Trivia

Seeds from the puncturevine can harm animals that eat them, and the seeds puncture tires. Vehicle tires and animals spread the seeds.



puncturevine

Yellow starthistle seeds have thorns up to $\frac{3}{4}$ -inch long. When horses eat this weed, they can develop a neurological disorder of the brain called nigropallidal encephalomalacia or "chewing disease." If the horse continues to eat yellow starthistle, it will develop brain lesions and ulcers in its mouth. There is no known treatment. In most cases, the horse will die due to starvation or dehydration.

Seeds from field bindweed can remain dormant in the soil for up to 50 years.

When seed capsules from leafy spurge dry, the seed capsules explode and eject the seeds up to 15 feet from the parent plant. Leafy spurge has a milky sap that can irritate an animal's mouth, which may result in the animal's death.

All parts of the water hemlock plant are poisonous, including the root. The plant's stem is hollow, and children have been poisoned by using the stems as pea shooters. The plant closely resembles wild parsley. People have been poisoned by water hemlock because they mistook the plant for wild parsley. The toxicity of the plant increases as the growing season progresses.



hound's tongue

Seeds from hound's tongue mat the fur on animals, such as deer and elk. Matting reduces the ability of the animal's fur to provide insulation. During periods of extreme cold, young deer and elk can perish if their fur does not provide adequate insulation against the cold.

Weedy Definitions

dispersal - the natural distribution of plant seeds over a wide area by various methods

dormant - in an inactive state, when growth and development slow or cease, in order to survive adverse environmental conditions

embryo - a plant in its earliest stages of development; in seed-bearing plants, the embryo is contained within the seed

germination - the process of growing from a seed or spore into a new plant

seed coat - outer, protective layer on a seed

sexual reproduction - a natural process by which some plants and animals produce offspring as a result of the production of eggs and the fertilization from another plant or animal

stratification - to store seeds in chilled, moist sand, peat moss, or other material to induce germination or preserve the seeds



Weed Warrior Worksheet

Design a Weed

Use your knowledge of weeds and weed seeds to design a weed and its seed for use as a biological weapon. Draw your weed and seed on poster board, or use computer software to create your weed and seed drawings.

1 Decide what types of problems you want your weed and its seed to create. See the *Weed Trivia* worksheet for some ideas about how weeds can be destructive. Consider the following ways in which weeds can cause problems:

- Disrupt food or water supplies
- Harm humans and animals
- Disrupt transportation

2 Think of **unique** adaptations your weed will have and **unique** ways in which the weed will disperse its seed.

In your drawings, illustrate the unique adaptations of your weed and its seed, and explain the unique manner in which the seed is dispersed. Be creative! Develop new adaptations rather than using adaptations you already know about in other plants.

Grading Guidelines

You will be graded according to the guidelines shown in the table below.

Grade	Ideas	Presentation
A	Weed characteristics are unique and numerous, and the weed design demonstrates that you understand weed issues.	Presentation is clear and well done, and it explains all aspects of the weed design.
B	Weed characteristics are unique, but they are limited in number.	Presentation has minor flaws, and it does not fully explain all aspects of the weed design.
C	Weed characteristics are limited in number, and characteristics are explanations of existing weeds.	Presentation is adequate, but it has numerous flaws and does not fully explain the weed design.