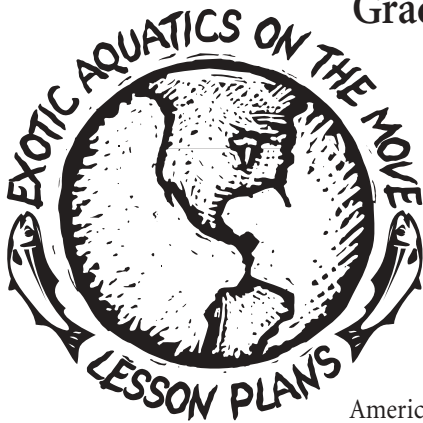


HYACINTH JEOPARDY

Grade Level: 6th –12th grades



Overview

This Jeopardy game will help students understand basic information about water hyacinth.

Background

Water hyacinth came from South America and has spread quickly, clogging many waterways over the past century. Millions of dollars have been spent trying to control this exotic species. It grows quickly into a dense cover, cutting off sunlight and killing other light-dependent species in the water. See Attachment #2 for Student Summary of Water Hyacinth Information.

Setting

Classroom

Objectives

When learners have completed this activity, they should be able to discuss basic information about the water hyacinth. This information will include the origin, distribution, movement, consequences and solutions dealing with the water hyacinth.

Geographic Standards

Standard 14. How human actions modify the physical environment

Standard 15. How physical systems affect human systems

Standard 16. The changes that occur in the meaning, use, distribution, and importance of resources

Keywords

Exotic, fragmentation, habitat, water hyacinth, ecosystem, food web

Materials

This game can be done a number of ways. A game board like the one used in Jeopardy can be made from stiff cardboard or transparencies (as described in the procedure that follows), or teachers can simply use a blackboard to create the categories.

Schedule

Three class periods: one class period to familiarize students with exotics and the problems associated with water hyacinth invasions; one class period to play the game; one class period for evaluation.

Prerequisite Skills

Students should discuss the basic information about exotic species and the water hyacinth, provided in Attachment #2.

Curriculum Connections

Science

Author

Peggy Meaux

School

Acadiana High School

City

Lafayette

State

Louisiana

Grade Levels Taught

High School

Procedure

Pre-lesson preparation: Make the transparencies of the game board and the game cover as provided in Attachment #1. Use an exacto knife to open each of the award windows. This cut should be made on three of the four sides, so that one side is left to act as a hinge. Optional: use a small tab to close each window and provide a means of easily opening each award window.

1. Day One: Introduce the background information on the water hyacinth that is provided in Attachment #2. These two attachments can be handed out to students. Students should be led in a discussion of the important concepts, as outlined by the questions provided in Attachment #3.
2. Day Two: Divide the class into five teams. Conduct the Jeopardy Game using the game board. Suggested “correct questions” are listed on the teacher handout, Attachment 4. Keep track of the points accrued by each team.
3. Day Three: Create an evaluation based on the material covered the previous two days. Suggested questions can be found in Attachment #5.

Teacher Notes

The teacher should read information about the water hyacinth before beginning the unit. The teacher can contact their local and state department of natural resources to obtain information about locations and any control measures currently available and/or being implemented in their area.

Applications

Through this exercise students will become informed, share knowledge, learn to identify invasive species, and be able to make wise choices. They can remove the exotics from their yards, and volunteer to help remove exotics from their community.

Evaluation

A test the day after the game can be given, using the same question as used in the game. Visual evaluation can also be made based on the students’ interest.

Resources

Excellent websites that contain great water hyacinth information:

USGS, Nonindigenous Aquatic Species website: <http://nas.er.usgs.gov>

University of Florida, IFAS, Center for Aquatic Plants: <http://aquat1.ifas.ufl.edu/hyacin2.html>

Excellent websites that contain general information on exotic species:

National Invasive Species Council: <http://www.invasivespecies.gov>

Exotic Aquatics on the Move website: <http://ag.ansc.purdue.edu/EXOTICSP/>

University of Florida, IFAS, Center for Aquatic Plants: <http://aquat1.ifas.ufl.edu/>

Other products:

Guyton, John, Burrage, D., and Kastner, R., *Nonindigenous Species Activities for Youth*, Mississippi State University Extension Service, Biloxi, MS, 79 pp. Can be downloaded for FREE from <http://msstate.edu/dept/crec/publish/nis.wpd>

Credits

Prepared by author.

ATTACHMENT #1

HYACINTH JEOPARDY GAMEBOARD

- Make the transparencies of the game board and the game cover as provided in Attachment #1.
- Use an exacto knife to open each of the award windows. This cut should be made on three of the four sides, so that one side is left to act as a hinge.
- Optional: use a small tab to close each window and provide a means of easily opening each award window.

WATER HYACINTH JEOPARDY

ORIGIN

DISTRIBUTION

MOVEMENT

CONSEQUENCES

SOLUTIONS

100

100

100

100

100

200

200

200

200

200

300

300

300

300

300

400

400

400

400

400

500

500

500

500

500

Tropical regions of South and Central America	Name two vegetative strategies used by water hyacinths	Birds and storms	Major negative consequence on human recreation	Taxpayer money
Event at which the water hyacinth was introduced	The number of states & countries in which it is found in today	Characteristic enabling water hyacinths to move across water	Major negative consequence on the ecosystem	Easier boat navigation, accessible fishing and recreational areas
Year in which it was introduced	Number of days it takes the water hyacinth to double in size	Two ways humans move water hyacinth	Major negative consequence on economy	Development of a herbicide that kills water hyacinth without harming other plants/animals
City where introduction was first made in the U.S.	Recreational fishing and boating	Internal stem characteristic enabling plant to float	Major negative consequence on biodiversity	Most effective control method
The beauty of the plant with its violet flower	Pond and nursery trade	Climatic requirements for water hyacinths	Major beneficial consequence on water quality	Proposed beneficial uses for water hyacinth

WATER HYACINTH BACKGROUND INFORMATION FOR STUDENTS

Water hyacinths are native to Central and South America but were brought into the United States for the Cotton States Exposition held in New Orleans in 1884. Because of their beauty, they were given as gifts for visiting the Japanese Pavilion at the Expo. Attendees took them home to add to backyard ponds. By 1900, water hyacinths had escaped cultivation and had become a serious pest, clogging waterways throughout the coastal states.

Water hyacinth's success in its new habitats within the United States can be traced to a number of characteristics:

- Water hyacinths reproduce very effectively by two vegetative methods. They can make new plants by the process of fragmentation, or breaking into smaller pieces. Fragmentation can be caused by the churning propellers of motor boats, the thrashing of swimming animals, grazing by animals and by being tossed around by wave action during storms. They can also reproduce by forming plantlets at the end of a shoot that grows from the base of the stems. This method of reproduction is very effective at making many new plantlets in a relatively short time.
- * Water hyacinth stems are spongy and filled with air spaces, which allow them to stay afloat easily.
- Water hyacinth leaves are fanlike and slightly cupped. This shape makes a very effective sail and allows the plants to spread easily over water bodies when the wind blows.
- Water hyacinth have a feathery network of roots, which allow them to gather nutrients very easily from the water.

All these characteristics give the water hyacinth a tremendous advantage over other native floating aquatic plants. A small number of plants are able to cover the surface of their new aquatic habitat in a relatively short period of time. Today, water hyacinths are found in 13 states within the United States and in 53 countries.

The effects of water hyacinths on natural systems in which they are not native can be devastating. As hyacinths cover the water's surface, they restrict life-sustaining sunlight that submerged native plants need in order to grow. Eventually the shaded underwater plants die and decay. The decaying process depletes the amount of dissolved oxygen in the water. As the oxygen

level declines, fish such as bass, perch, and bream, seek new habitat areas, leaving fish such as catfish, carp, and gar, all of which can tolerate lower oxygen levels than the more desirable fish. Once oxygen levels become so low that even these less desirable fish cannot not survive, the waters below water hyacinth masses become devoid of most life.

Humans are also affected by the invasive overgrowth of water hyacinths. Dense mats of the plants interfere with boat navigation, clog drainage systems, and prevent fishing, swimming and other recreational activities.

EFFORTS TO CONTROL WATER HYACINTH POPULATIONS HAVE MET WITH MIXED RESULTS.

- Mechanical methods used to chop up the water hyacinth cannot reach all the water hyacinth in a given water body and result in fragmentation—one of water hyacinth's reproductive strategies.
- Herbicides are very effective in killing water hyacinth plants. Spray programs are costly and in many cases are only used on waterways necessary for navigation or heavily used in recreation.
- The use of natural predators, in particular a weevil species from Argentina and a carp species from the Soviet Union, both of which use the water hyacinth as a food source, would mean introducing other exotic species that may, in time, become as serious a pest as water hyacinth has become.

When growing out of control, water hyacinths are a nuisance, but some researchers have suggested uses for this exotic that would make it a harvestable resource.

- Use as food for cattle.
- Use as fertilizer and soil conditioner.
- Produce a biogas fuel similar to natural gas to meet some energy needs.
- Use the plants as part of a filtration system for water purification systems.

Even though these are all possible uses, so far the negative impact of these aquatic plants on their adopted habitat far outweighs their contributions to the environment.

DISCUSSION QUESTIONS FOR THE INTRODUCTION OF EXOTIC SPECIES

1. What is an exotic species?
A plant not native to the area.
2. What does the term invader mean?
A plant or animal that takes over a native environment or ecosystem. The invader is usually a threat to the environment in which it's growing and developing.
3. Are all exotics plants invasive?
No. Some exotic plants survive in their new environment without taking over the habitat.
4. Why do exotics plants become invasive?
When they reproduce rapidly, adapt to the environment, and gather nutrition easily and have no or few natural enemies or disease.
5. What do you think would happen over the long-term to an area in which an invasive exotic species is introduced?
The invading plant would overtake it, disrupting the natural ecosystem.
6. What is an adaptation?
It is a trait allowing change that helps something live and reproduce in its environment.
7. What is a food web?
Each organism, through feeding, is interconnected to many other organisms. This interconnection is called a food web.
8. Will exotic species introduced into an area alter the food web?
Invasive organisms do alter the food web because they become integrated into the ecosystem. They feed on other organisms (or extract nutrients from the water, in the case of the water hyacinth). They are also fed upon by other organisms in the ecosystem. In the case of water hyacinth, nutria sometimes eat them.
9. How are exotic species introduced into a new area?
Introductions happen in many ways. Humans either on purpose or accidentally introduce exotics. For example, hyacinth was at first cultivated by water gardeners, whose ponds eventually were overrun by the plant.
10. What things may be needed for the success of an exotic?
Extra plants were tossed into lakes or bayous rather than being disposed of properly. Other methods of introductions by humans include transportation of water plants on boat engines and trailers, releases of unwanted aquarium plants and fish. Occasionally storms and water currents can help spread them.
Exotic species need to be able grow fast, reproduce quickly, be good at getting life's necessities (food, water, shelter and space) and have few, if any, natural predators.

KEY TERMS

Exotic Species - foreign plants or animals that are introduced to a habitat.

Habitat - the area where a particular species lives. It provides all the species requirements for life.

Ecosystem - a natural interrelated environment in which plants and animal lives coexist with each other. They function together as a whole environment dependent on each other to function.

Fragmentation - a type of asexual reproduction that occurs when part of a parent plant breaks off and begins to grow independently.

Food web - the complex feeding relationships among the organism in an ecosystem.

Water hyacinth - a free-floating plant, but typically is found in large, compacted beds. The leaves are dark green, glossy and oval-shaped. The stems are bulbous and spongy on the free-floating plants. Plants vary in size from a few inches to several feet in height. The flowers are blue, violet, or white and have an orchid-like appearance. The roots are dark, feathery and fibrous.

HYACINTH JEOPARDY GAME ANSWER/QUESTION PAIRS

NOTE:

- Teachers will need to use their judgment on accepting a correct “desired question” as an answer to any particular award level.
- The categories follow the five major geographic strands. Questions in each category relate to the Category Title. Students should be alerted to this so that they can frame their questions accordingly.

ORIGIN

100 TROPICAL REGIONS OF SOUTH AND CENTRAL AMERICA.

Desired Question: Where is the water hyacinth native?

200 EVENT AT WHICH THE WATER HYACINTH WAS INTRODUCED.

Desired Question: What is the Cotton States Exposition?

300 YEAR IN WHICH WATER HYACINTH WAS INTRODUCED TO THE U.S.

Desired Question: What is 1884?

400 CITY WHERE INTRODUCTION WAS FIRST MADE IN THE UNITED STATES.

Desired Question: What is New Orleans?

500 THE BEAUTY OF THE PLANT WITH ITS VIOLET FLOWER.

Desired Question: What characteristic made the water hyacinth appealing to be chosen as the gift for visiting the Japanese Pavilion at the Expo of 1884?

DISTRIBUTION

100 NAME TWO VEGETATIVE REPRODUCTIVE STRATEGIES USED BY WATER HYACINTH.

Desired Question: What are fragmentation and stolons?

200 THE NUMBER OF STATES IN THE U.S. IN WHICH WATER HYACINTH IS FOUND TODAY.

Desired Question: What are 13 [American states]?

300 NUMBER OF DAYS IT TAKES THE WATER HYACINTH TO DOUBLE IN SIZE.

Desired Question: What is in as little as 12 days?

400 RECREATIONAL FISHING AND BOATING.

Desired Question: What are two ways that water hyacinth is spread by humans?

500 POND AND NURSERY TRADE.

Desired Question: What is one intentional reason for the distribution of the water hyacinth?

MOVEMENT

100 BIRDS AND STORMS.

Desired Question: *What are two ways the water hyacinth is spread by nature?*

200 CHARACTERISTIC ENABLING IT TO MOVE ACROSS WATER.

Desired Question: *What is the cupped sail shape of its leaves?*

300 TWO WAYS HUMANS MOVE WATER HYACINTH.

Desired Question: *What are boat propellers and trailers, fishing and recreational equipment?*

400 INTERNAL STEM CHARACTERISTIC ENABLING PLANT TO FLOAT.

Desired Question: *What is spongy tissue?*

500 CLIMATIC REQUIREMENTS FOR WATER HYACINTH.

Desired Question: *What are humid tropical climates, where it does not freeze?*

CONSEQUENCE

100 MAJOR NEGATIVE CONSEQUENCE ON HUMAN RECREATION.

Desired Question: *What is blocking boat traffic and preventing or restricting swimming and fishing?*

200 MAJOR NEGATIVE CONSEQUENCE ON THE ECOSYSTEM.

Desired Question: *What is preventing sunlight from penetrating the water? or What is depleting oxygen from the water?*

300 MAJOR NEGATIVE CONSEQUENCE ON THE ECONOMY.

Desired Question: *What are expensive control methods? or What is reduced boat traffic, resulting in lost tourist and transportation dollars?*

400 MAJOR NEGATIVE CONSEQUENCE ON BIODIVERSITY.

Desired Question: *What are reduced numbers of native submerged aquatic vegetation? or What is change from desirable to less desirable fish species?*

500 BENEFICIAL CONSEQUENCE TO WATER QUALITY.

Desired Question: *What is water filtration?*

SOLUTION

100 TAXPAYER MONEY.

Desired Question: *How are control methods for water hyacinths paid for?*

200 EASIER BOAT NAVIGATION, ACCESSIBLE FISHING AND RECREATIONAL AREAS.

Desired Question: *What are the possible benefits of removing water hyacinths?*

300 DEVELOPMENT OF A HERBICIDE THAT KILLS WATER HYACINTH WITHOUT HARMING OTHER PLANTS/ANIMALS.

Desired Question: *What is the importance of limiting the negative effects of a spray program on other organisms or desirable plants?*

400 MOST EFFECTIVE CONTROL METHOD.

Desired Question: *What are costly spray programs?*

500 PROPOSED BENEFICIAL USES FOR WATER HYACINTH.

Desired Question: *What are fertilizer and soil conditioner? or What is cattle feed? or What is natural gas for energy needs?*

EVALUATION QUESTIONS.

1. Where is the point of origin of water hyacinth?
The Amazon Basin of South America.
2. Who introduced the plant into the U.S.?
The Japanese delegation to the 1884 Cotton States Exposition in New Orleans.
3. Why was it introduced at the Expo in 1884?
Because water hyacinth was considered a beautiful plant suitable for use in backyard ponds.
4. To how many American states and countries has this plant spread?
Thirteen American states and 53 countries worldwide.
5. What are the factors that limit its distribution?
Water hyacinth is limited by freezing temperatures. Water hyacinth will not inhabit ponds and lakes that freeze over during the winter.
6. Why does water hyacinth spread so easily?
Water hyacinth is able to reproduce rapidly (it doubles its size in as little as 12 days), gather nutrients effectively, has several different vegetative reproduction strategies, and has few natural predators or diseases in the U.S.
7. What are a few ways that water hyacinth are spread?
Water hyacinth can be spread by humans (boat and recreational activity and from backyard water gardens) as well as during storms.
8. How does water hyacinth interfere with boating and fishing?
It clogs waterways.
9. What is one of the beneficial aspects of water hyacinths?
Research shows they may be useful in removing harmful chemicals from polluted water.
10. How does water hyacinth affect an ecosystem's biodiversity?
Water hyacinth prevents sunlight from penetrating water resulting in the death of submerged native aquatic vegetation. In addition, as the dissolved oxygen is depleted from the water, less desirable fish begin to dominate the fish population until even these low-oxygen demanding fish are driven from the area as the oxygen continues to be depleted.
11. How does water hyacinth affect the economy?
Water hyacinth control requires costly herbicide spray programs and as waterways become clogged with the water hyacinth mats, recreational boaters must find new locations to utilize. This can result in business loss or closure. Parks and recreation areas are also affected as water hyacinth infestations restrict areas that can be used by patrons.
12. What are some suggested uses for water hyacinths?
Water hyacinths can be used as fertilizer, compost, and soil condition. They can also be used as feed for cattle and other animals. They can be used to produce some form of natural gas for energy needs.