

2008

Alien Invaders! On-Site Programming (Grade 6)

Discover Mojave: Forever Earth

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GRADE 6

ALIEN INVADERS!

ON-SITE PROGRAMMING



2008/2009 Edition

ALIEN INVADERS!

OVERVIEW

Alien invaders don't just come from outer space! An invasive alien species can be any species on earth that moves from its native ecosystem into a new ecosystem and then causes or is likely to cause economic or environmental harm or harm to human health. In January, 2007 quagga mussels were found in Lake Mead, the first discovery of these invasive mussels in western United States. Quagga mussels are an aquatic species that are native to Eastern Europe and were introduced into the Great Lakes in the late 1980s.

In the "Alien Invaders!" program, students investigate how quagga mussels might affect Lake Mead. Students collect water quality data such as clarity, pH, and temperature to determine current habitat conditions that have allowed quagga mussels to thrive in Lake Mead. Students learn about the consequences that quagga mussels could have on the lake and its living and non-living resources. Using the knowledge they've gained, students create their own management plans to prevent the spread of quagga mussels to other waterways.

OUTLINE

On-Site Programming

On-site programming includes activities that take place aboard Forever Earth and activities that take place on shore (typically the Callville Bay picnic area). For a large group, it is convenient to split the students into two or more groups. One or more groups can participate in the shore-based activities while one group is aboard Forever Earth; student groups switch when the Forever Earth group returns to the marina.

Forever Earth

- Part 1 ▶ [Welcome, Introductions, and Safety Talk](#)
- Part 2 ▶ [Introduction: Invasive Species](#)
- Part 3 ▶ [Investigation: Could Quagga Mussels Thrive in Lake Mead?](#)
- Part 4 ▶ [Impact: Potential Effects of Zebra Mussels on the Living and Non-living Components of the Lake Mead Ecosystem](#)
- Part 5 ▶ [Synthesis: What Can We Do to Prevent the Spread of Quagga Mussels to other Lakes and Rivers?](#)

Shore

- [CSI: Who Stole All the Water?](#)
- [Chillin' with the Chubs](#)

Corresponding Pre-Visit Lessons

- Introduced and Invasive Species
- Water Characteristics

Corresponding Post-Visit Lesson

- Invasive Species Public Service Announcement

THEME

Introduction of an invasive species upsets the balance of an ecosystem.

KEY QUESTIONS

Why are quagga mussels thriving in Lake Mead? What effects might quagga mussels have on plants, animals, and people? How can we prevent the spread of quagga mussels?

GOAL

Students will understand how invasive species affect the living and non-living components of ecosystems.

OBJECTIVES

Students will:

- explain how quagga mussels are introduced into an aquatic ecosystem;
- describe habitat requirements for quagga mussels to thrive in an aquatic ecosystem;
- describe the effects of quagga mussels on living and nonliving components of the Lake Mead environment;
- create a management plan to prevent the spread of quagga mussels to other waterways.

NEVADA SCIENCE CONTENT STANDARDS

- N.8.A.1.** Students know how to identify and critically evaluate information in data, tables, and graphs.
- N.8.A.5.** Students know how to use appropriate technology and laboratory procedures safely for observing, measuring, recording, and analyzing data.
- N.8.B.1.** Students understand that consequences of technologies can cause resource depletion and environmental degradation, but technology can also increase resource availability, mitigate environmental degradation, and make new resources economical.
- L.8.C.3.** Students will evaluate how changes in environments can be beneficial or harmful.
- L.8.C.4.** Students will know inter-related factors affect the number and type of organisms an ecosystem can support.

CLARK COUNTY SCHOOL DISTRICT OBJECTIVES (GRADE 6)

Students will:

- display data in appropriate charts, graphs, and tables;
- use proper lab equipment correctly and safely; and
- discuss the costs and benefits of human and natural caused changes in an environment.

SNAP CONSERVATION EDUCATION AND INTERPRETATION THEME CORRELATIONS

The on-site grade 6 activities support the following guiding themes developed by Clark County-based educators:

- Increasing human activity on highly sensitive and easily damaged lands has profoundly altered the natural environment of Southern Nevada, affecting native biota including threatened and endangered species and requiring active management of native and non-native species.
- Maintaining growth and quality of life, and protecting watershed, water quality and adequate water supplies for all life in both developed and natural communities challenges people to resolve the issue of long-term sustainability.

PREREQUISITE CLASSROOM EXPERIENCE

Classroom Visit. A pre-visit classroom trip will be made by Forever Earth or National Park Service staff to introduce students to the Forever Earth program and what to expect during their field trip. Students learn and agree to the “conduct rules” of Forever Earth, understand basic water safety concepts, and observe how and when to put on a Personal Flotation Device (PFD) during their time aboard Forever Earth.

VOCABULARY

- | | | |
|--------------------|----------------------|------------------|
| • calcium | • range of tolerance | • probe |
| • ecosystem | • management plan | • turbidity |
| • environment | • native species | • veliger |
| • dissolved oxygen | • non-native species | • water clarity |
| • habitat | • pH | • water hardness |
| • invasive species | • plankton | |

ON-SITE ACTIVITIES: Forever Earth

Part 1 ▶ Welcome, Introductions, and Safety Talk

Forever Earth staff greets students. Students are divided into groups and given team lanyards. Facilitator welcomes students to Lake Mead National Recreation Area and Forever Earth and introduces the concept of National Parks and public lands, emphasizing that the field trip is taking place on public lands. **Facilitator Reference:**

Lake Mead NRA Fast Facts contains information to answer common questions about Lake Mead. The Captain or facilitator leads the safety presentation (see **Facilitator Reference: Safety Talk Outline**).

Part 2 ▶ Introduction: Invasive Species

Students are informed of the explosive way an invasive species overtakes a new environment and understand the dramatic changes that an invasive species makes to its new environment.

The facilitator first introduces students to the concept and definition of invasive species. The Fact or Fiction activity (**Demonstration: Invasive Species Fact or Fiction**) provides students with graphic examples of how these species can impact an environment.

The example of the quagga mussel is introduced with background information (**Facilitator Reference: Quagga Mussel Fast Facts**). A discussion is facilitated with students on how quagga mussels are introduced into new environments, what types of effects they have on their new environment, and that they have recently been found in Lake Mead.

Part 3 ▶ Investigation: Why Are Quagga Mussels Taking Over Lake Mead?

Students are told they are going to analyze Lake Mead to determine the characteristics that have allowed quagga mussels to thrive and take over Lake Mead. Data are recorded on the **Student Worksheet: Data Collection Sheet**.

Students are divided into 2 groups:

Group 1 Students use probes to collect data for dissolved oxygen, water temperature, and pH.

Group 2 Students use a Secchi Disk to measure turbidity.

Students use a plankton net to collect plankton. Students assist

TIME 15-20 minutes

MATERIALS

Color-coded badges (colors indicate teams) attached to lanyards

Facilitator Reference:

Lake Mead NRA Fast Facts

Facilitator Reference: Safety Talk Outline

TIME 20 minutes

MATERIALS

PDA's

Demonstration: Invasive Species Fact or Fiction PowerPoint

Facilitator Reference:

Quagga Mussel Fast Facts

TIME 20 minutes

MATERIALS

Student Worksheet: Data Collection Sheet

Group 1 Station

Probes: pH/ temp

Plastic beakers (3; 500 ml)

Van Dorn Water Samplers

Surface Water Collector

Student Reference: pH Scale

facilitator in making slides for stereoscope observation. Students view collected plankton on TV monitor. Facilitator supports students with basic identification of collected microorganisms.

Groups 1 and 2 compare data and average their results. If time allows, Groups 1 and 2 switch so that both groups have a chance to collect all of the data.

Students compare collected data to the known survival ranges and optimal ranges for quagga mussel survival. With the help of the facilitator, students review the data in their entirety to determine why quagga mussels have taken over the Lake Mead aquatic environment.

Part 4 ▶ Impacts of quagga mussels on the living and non-living components of the Lake Mead ecosystem – Mussel Maneuvers

In small groups of three, students are a set of activity cards that they lay out in four rows of three cards each, with the “A” cards comprising the bottom row and “D” cards on the top row (**Student Activity Materials: Mussel Maneuvers Cards and Tracking Sheet**). For this activity, each student is a quagga mussel. The group begins by choosing a card from Row A and reading the text on the back of the card. The card has two parts. The first block of text describes what is happening to the quagga mussels, and the group is instructed to choose a card from the same row or the next row. The second part of the card describes what effects the quagga mussels are having on an environmental or social factor. As students progress through the rows of cards, they keep track of the “benefits,” “harm,” and “no effect” that quagga mussels have on particular components. As students maneuver through the rows of cards they learn about how quagga mussels affect a variety of living and non-living components of an ecosystem.

Note: Facilitator involvement is critical for the success of this activity; additional information can be found within **Facilitator Reference: Possible Solutions to Mussel Maneuvers Consequences**.

Discussion questions: *What were some of the negative effects? The positive effects? How were fish affected? How would the turbidity of the lake be changed? Is that a positive effect? Was there anything that quagga mussels had no effect upon?*

and Examples (E-book or sheet)

Group 2 Station

- Collection trays
- Digital stereoscope
- Digital microscope
- Eye droppers
- Laptop computer
- Petri dishes (2)
- Secchi disks (2)
- Plankton net

Student Reference: Plankton and Veliger I.D. (E-book or sheet)

TIME 20 minutes

MATERIALS

Student Activity Materials: Mussel Maneuvers Cards and Tracking Sheet

Facilitator Reference: Possible Solutions to Mussel Maneuvers Consequences

Part 5 ▶ Synthesis: What can we do to prevent the spread of quagga mussels to other waterways?

Students analyze the advantages and disadvantages of different management options for preventing the spread of quagga mussels to other lakes and rivers.

Students are divided into teams of 3-4 students. The facilitator tells them that they are National Park Service managers and are being given a \$150,000 budget to prevent the spread of quagga mussels to other lakes and rivers. By reviewing the **Student Reference: Quagga Mussels Management Options Booklet**, students examine several “real” management options and discuss the advantages and disadvantages of each. They choose those options that they think will be most effective—but the costs have to fall within their budget. Each group prepares its management plan by recording their choices on chart paper or provided worksheet (**Student Worksheet: Budget Sheet**).

When students are finished, the facilitator asks each group what they chose to do and why: *What are some of the advantages of what they chose? Disadvantages?*

Questions for discussion:

Was there any one choice that would solve the problem? What could you do personally to help prevent quagga mussels from spreading? What could you do as a class?

TIME 25 minutes

MATERIALS

Chart paper
Markers

**Student Reference:
Quagga Mussels
Management Options
Booklet**

**Student Worksheet:
Budget Sheet**

ON-SITE ACTIVITIES: Shore

CSI: WHO STOLE ALL THE WATER?

In this activity, students are introduced to the concept of invasive species by solving a fabricated crime.

Students will:

- Identify several species of native and non-native plants found in the Mojave Desert.
- Use deductive reasoning to determine which plant species is an invasive species and learn about its impacts.

Part 1 ▶ Introduction

TIME 10 minutes

Students are welcomed to Lake Mead National Recreation Area with a brief discussion of the concept of public lands, national parks, and the role of the National Park Service.

Introduce the activity by dramatizing that a crime was committed last week at the picnic area. Over 800 gallons of water was stolen. It is up to the students as eco-detectives to determine who stole the water. In order to solve the crime, the students will need a description of the crime scene and procedures to follow.

Begin a discussion of how water is a precious resource in the desert, and plants and animals that live in the desert possess adaptations that allow their survival. Introduce the concept of native species by discussing plant adaptations that minimize water loss such as:

- Small leaves or no leaves
- Waxy coating
- Light color
- Hairy coverings
- Pads to store water

Part 2 ▶ Solving the Crime

The students are divided into groups, and each group is given a **Student Materials: Crime File** containing **Mug Shots** of the most likely suspects and **Procedure Checklists**. The most likely suspects are plants in the surrounding area (picnic area and adjacent desert wash). Discuss the procedures to be used as well as safety guidelines for examining the crime scene:

1. Find the plant depicted in the mug shot and discuss each item listed below with your group.
2. Use your hand lens to examine the leaves.
3. Use the PDA to take a picture of the suspect.
4. If your group believes a suspect to be innocent, place the mug shot in the “INNOCENT” pocket of your Crime file.

Instruct students on how to use a hand lens as well as how to take pictures with a PDA.

Make sure that students understand that, just as in real detective work, there may be clues that lead to false conclusions. The guilty plant may not be obvious.

MATERIALS

TIME 15 minutes

MATERIALS

Student Materials: Crime File containing **Mug Shots** and **Procedure Checklists**

Hand Lens

PDA (Personal Data Assistant)

Part 3 ▶ GUILTY!

After examining all the suspects, students should have identified a most likely suspect. Facilitate a discussion among the students by asking:

Who do you think stole the water?

Why is this plant most likely to be guilty?

What other plants were likely suspects?

Why do you think these plants are innocent?

How does the tamarisk affect other desert plants? What other impacts might it have?

Include discussion of the concepts of native and non-native plants as well as invasive species.

TIME 10 minutes

MATERIALS**CHILLIN' WITH THE CHUBS**

Note: This activity is adapted from the Discover A Watershed: The Colorado River activity book. For additional information, refer to the activity write-up beginning on page 211.

In this simulation activity, students examine the effects of introduced species and dams on native fish populations in the Colorado River.

Students will:

- Compare pre-dam and post-dam habitat conditions in the Colorado River.
- Describe the effects that introduced species and dams have on native fish populations.
- Discuss solutions for protecting native fish populations

Part 1 ▶ Introduction to Chillin' with the Chubs

Students are welcomed to Lake Mead National Recreation Area with a brief discussion of the concept of public lands, national parks, and the role of the National Park Service.

Begin by asking students what types of fish they have caught or seen in the area. Introduce the concept of native and non-native species.

Ask if they have ever heard of a Colorado pikeminnow or a razorback sucker (use fish models as a visual aid); discuss how these fish were very common in the Colorado River prior to dams being built and to increased human occupation along the river. Ask students to suggest reasons why these native fish populations declined so rapidly. Lead the discussion so that three main factors, or stressors, emerge:

- 1) Construction of dams changed the physical environment of the river including variation of flows, water

TIME 30 minutes

MATERIALS

Models of Colorado pikeminnow and razorback sucker

Cones for marking boundaries

- temperature, and turbidity.
- 2) Introduction of nonnative species changed the ecosystem; they prey on eggs and young of native fish.
- 3) Over-fishing by humans has reduced populations, especially of Colorado pikeminnow and totoaba.

Part 2 ▶ Chillin’ with the Chubs

Tell students that they are going to be a native Colorado River fish and experience how populations of different species have changed in response to the different stressors they just discussed. Divide students into five (or fewer) groups with each group consisting of at least four students. Have each student in group wear lanyards representing a native fish such as humpback chub, bonytail chub, razorback sucker, Colorado pikeminnow, or desert pupfish. Assign one student to be the environmental stressor; this person represents the three different environmental facts that have led to declines in these native fish populations.

Tell students that their goal is to make it across the playing field without being tagged by the stressor. However, they will have hindrances that make it harder to cross. These obstacles represent how these native species are intolerant of new environmental changes. Refer to the table below to explain what students in each group must do as they cross the playing field.

Species	Hindrance
Humpback chub	Must stop every 8 steps and do 3 jumping jacks
Bonytail chub	Must walk sideways
Razorback sucker	Must hop on one foot
Colorado pikeminnow	Must spin in a circle every 5 steps
Desert pupfish	Must walk backwards, stopping to touch the ground every 10 steps

Record on flip chart paper the number of students in each group. Tell students that these numbers represent conditions in 1800, before dams and non-native species were introduced, and before commercial fish. The subsequent rounds represent later time periods when these factors were introduced.

For Round 1, the fish will try to make it to the end of the playing field

Lanyards with Fact Cards

Flip chart paper

without being tagged by the stressor. Students can walk fast, but not run. Record the number of fish that make it to the safe area. Students that get tagged should flip their Fact Cards to show the non-native or tolerant species or environmental stressor. These students move to the middle of the playing field to become stressors. Record the total number of environmental stressors and non-native species.

Repeat the procedure for 3-4 more rounds. With more students as stressors, the number of native species left at the end of each round will be fewer. Record numbers of fish for each round.

Part 3 ▶ Conclusions

Have students discuss the results. Because this is a simplified model, the decrease in native species happens at the same rate as the increase in non-native species. In actual situations, the rates would differ since the factors involved are more complicated.

Ask students to brainstorm ideas to help protect these endangered species. Ideas may include removing non-native fish, finding ways to increase water temperature and make flows more similar to pre-dam flows, banning certain types of fishing, etc.

ADAPTATIONS FOR DIVERSE LEARNERS

- Consult with teachers prior to field trip to determine specific needs of the class or individuals; decide which aspects of the program content or delivery to appropriately alter for culturally/linguistically, behaviorally, and cognitively diverse learners and for the gifted and talented.
- Implement peer assistance by involving teachers in the process of creating color teams.
- Provide diagrams, photos, or other visual organizers as appropriate for processes and techniques.

ADDITIONAL ON-SITE ACTIVITIES: Shore

NOTE: This activity may be used to replace or augment “CSI: Who Stole All the Water?” and/or “Chillin’ with the Chubs.”

INVASIVE PLANTS AT LAKE MEAD NRA – A GUIDED HIKE

Students take a short walk to discover native plant adaptations and learn about impacts of native species.

Students will:

- identify at least two plant adaptations and explain how those adaptations relate to survival in Mojave Desert conditions;
- measure, record, and compare wind speed and temperatures;

- compare and contrast an area with native plants with an area with non-native plants;
- be able to define the terms: native species, non-native species, and introduced species; and
- be able to explain two strategies for preventing invasive species from being introduced into natural areas.

Part 1 ▶ Introduction

The hike activity, which begins at the picnic area, is set up by first asking students what kinds of weather conditions we deal with in the Mojave Desert (e.g., high temperatures in summer, wind, and little rainfall). Native plants have a variety of adaptations that make it possible for them to survive in the extreme conditions of the Mojave Desert. Students are asked to list what they brought with them for the hike (e.g., water, hat, sunglasses, sunblock, wore light-colored clothing, etc.). These items or strategies can be compared to some of the adaptations of native plants. Many of these adaptations will be discovered during the hike. Students are reminded of some basic rules for the hike.

Part 2 ▶ Concept Development

First stop: beavertail cactus

A cactus is a common plant associated with the desert. Just as the students are each carrying a water bottle, some plants like the beavertail cactus are able to hold large amounts of water in their thick pads. Water is taken up by the roots which are generally short and just below the soil surface in order to quickly absorb water after a rain shower. Beavertail cacti use the water to form a gel-like substance, which can be stored within the plant. Students are asked to look for other plants with fleshy stems as they continue to hike.

Second stop: creosote bush

The students are asked to make observations of a creosote bush, especially the leaves and stems. Students smell the plant by cupping part of it in their hands. They gently blow on the cupped part of the plant, and the moisture from their breath brings out the smell of the creosote. On rainy days in many parts of the desert, you can smell the creosote bush. Many plants limit what moisture they lose through evaporation by covering their leaves or pads with a wavy or oily coating. This works much the same way as sun block in protecting us from “drying out” and burning our skin in the sun. Native desert plants also have very small leaves or no leaves (some have spines instead) in order to reduce surfaces exposed to the sun.

TIME 90 minutes

MATERIALS

Wind meters
Digital thermometers
Clipboards
Pencil
Paper
Hand lens
Photos of tamarisk

Third stop: rocky outcrop

At this stop, students conduct several weather measurements.

Working in small groups, the students measure and record on **Student Worksheet: Data Collection Sheet** the following: wind speed; air temperature; ground temperature under a plant; ground temperature in full sun; rock surface temperature in full sun; etc. Results are then discussed with review of the difficulties of living in the desert and that the key to survival is the ability to have and/or hold water.

(This is the turn-around point for the hike.)

Fourth stop: view of Callville Bay Campground

While looking down at the campground, students compare how different it is from the area where they are standing. Students are asked to explain why the two areas are different. The differences relate to the types of plants and water availability. The campground is on an irrigation system. The plants in the campground are mostly non-native species that require an irrigation system for survival. Examples of these non-native plants include oleander, olive, palm trees, and mulberry. When the campground was built back in the 1960s, these were the plants that were chosen for the campground. Currently, the Park Service is working on a plan that will, over time, replace these non-native species with native species, where appropriate.

There are native plants in the desert that require large amounts of water, but they live around natural springs where water is available all the time. One non-native invasive species is the tamarisk or salt cedar. This invasive species can be found all around the shore line of Lake Mead and can be found near all of the 40 springs within the recreation area. The Park Service has a very intensive tamarisk removal program, concentrating in the areas near springs. Tamarisk competes directly with the native plant species for water and can crowd out and prevent native plant species from growing. This can affect water availability for wildlife and can impact the biodiversity within the spring community.

Student Worksheet: Data Collection Sheet