

Most Wanted!

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Target Grade/Subject – 5th Grade Science and Writing

Duration – Three one-hour class sessions. (Students may also need additional research time on the Internet or at the library.)

Lesson Overview

A region's environment is shaped by the life forms that inhabit the area. This lesson will demonstrate how a region's life forms change based on human intervention and adaptations of the life forms that live in those environments. Largely due to food webs, energy chains, and other environmental factors, all life forms that live in a particular ecological system are interdependent. These life forms are affected by changes to their ecological system. Life forms living in the United States are not static, but are constantly changing due to natural and human activities. Plants and animals not native to Virginia watershed habitats are introduced and subsequently adapt in ways that enable them to survive.

These three-part lessons will introduce and explore Virginia's non-native species, demonstrate how invasive species can negatively impact the biodiversity of the area, and analyze how life forms including humans and animals intentionally and unintentionally carry non-native species from various parts of the world.

Sources Consulted

Chesapeake Bay Program. (2011). The Chesapeake Bay Program: Bay Pressures. July 6, 2011 from www.chesapeakebay.net/

Geology for Kids, The Study of the Earth. (2011). Drainage Basin/Watershed. July 7, 2011 from <http://www.kidsgeo.com/geology-for-kids/>

United States Department of Agriculture, National Invasive Species Information Center. (2011). Invasive Species. July 6, 2011 from www.invasivespeciesinfo.gov/

University of Maryland. (2011). Non-native Species – Maryland Sea Grant. July 6, 2011 from www.mdsg.umd.edu/exotics

USGS Chesapeake Bay Activities. (2011). Chesapeake Bay Activities: Land Use, Climate, Water, Habitat. July 6, 2011 from chesapeake.usgs.gov/

USGS Science for a Changing World. (2011). Nonindigenous Aquatic Species (NAS) Database and Queries. July 7, 2011 from nas.er.usgs.gov

Learning Objectives

At the end of this lesson, students will be able to:

- Identify non-native species to Virginia ecosystems and demonstrate how a non-native species changes a balanced ecosystem by participating in a hands-on activity.
- Research non-native species from the Chesapeake Bay watershed area and classify them by Kingdom and habitat by using resources gathered from the internet or library.
- Create posters describing an invasive, non-native species using information collected from research.
- Evaluate how shipping and water recreation impacts the introduction of non-native species, and illustrate attempts to control or eliminate them by analyzing charts and graphs.
- Predict future trends in the introduction of non-native species based on current trends using information gained in the lesson.

State or National Benchmarks Addressed Virginia Standards of Learning (SOLs)

Science: The fifth-grade standards focus on student growth in understanding the nature of science. This scientific view defines the idea that explanations of nature are developed and tested using observation, experimentation, models, evidence, and systematic processes. The nature of science includes the concepts that scientific explanations are based on logical thinking; are subject to rules of evidence; are consistent with observational, inferential, and experimental evidence; are open to rational critique; and are subject to refinement and change with the addition of new scientific evidence. The nature of science includes the concept that science can provide explanations about nature, can predict potential consequences of actions, but cannot be used to answer all questions.

SOL 5.1 e

The student will plan and conduct investigations in which predictions are made using patterns, and simple graphical data are extrapolated.

To successfully complete this standard, students will make predictions based on trends in data. This requires the recognition of patterns and trends and determination of what those trends may represent. Student will define/make observations and inferences.

SOL 5.5 b

The student will investigate and understand that organisms are made of cells and have distinguishing characteristics. Key concepts include kingdoms of living things.

To successfully complete this standard, students will compare and contrast the distinguishing characteristics of the kingdoms of organisms, group organisms into categories, using their characteristics: living things (kingdoms), plants (vascular and nonvascular), and animals (vertebrates or invertebrates). Name and describe two common examples of each group.

English

Oral Language

At the fifth-grade level, students will continue to refine their oral-communication skills. They will further develop their ability as active listeners and as effective participants in large- and small-group activities. They will improve their skills in planning oral presentations and using grammatically correct language and specific vocabulary when delivering oral presentations, as

well as including visual aids and appropriate dramatic gestures to enhance their delivery. Students will become able to summarize their presentations before delivery and summarize the presentations of others after listening to them.

5.1 The student will listen, draw conclusions, and share responses in subject-related group learning activities.

- a) Participate in and contribute to discussions across content areas.
- b) Organize information to present reports of group activities.
- c) Summarize information gathered in group activities.

Reading

At the fifth-grade level, students will become increasingly independent readers of a variety of literary forms. Strategies such as word analysis and the use of context clues and word references will help students increase fluency as well as comprehension. They will begin to read text critically in order to examine implied relationships and understandings, recognize how character and plot are developed, and formulate and justify opinions about the text. They will organize the information they extract from the text and represent their understandings on charts, maps, and graphs.

5.6 The student will read and demonstrate comprehension of nonfiction.

- a) Use text organizers, such as type, headings, and graphics, to predict and categorize information.
- c) Locate information to support opinions, predictions, and conclusions.
- d) Identify cause-and-effect relationships.
- e) Identify compare-and-contrast relationships.
- g) Identify new information gained from reading.

Materials Needed (per class and per student group)

Day 1

- dry erase boards and markers (one set per group)
- pennies (about 75 per group)
- cylinders (one per group)
- invasive species resources (consult school library for fact sheets and books)

Day 2

- invasive species resources (consult school library for fact sheets and books)
- poster size paper (one per student)
- drawing/coloring materials (class sets)

Day 3

- Most Wanted! student activity packets (see lesson plan; one per student)
- Nonindigenous Aquatic Species (NAS) Graphs and Charts (used for stations; see lesson plan)
- Clipboards (optional; one per student)

New Vocabulary: list new terms and their definitions

Ballast Water - water pumped into and out of tanks on a ship controls the vessel's stability while traveling across the water

Brackish - water that has lower salinity than seawater but higher salinity than fresh water. Brackish water occurs naturally in areas where fresh water and saltwater mix, such as the point where rivers flow into oceans.

Ecosystem - includes all of the plants, animals, soil, rocks, microorganisms and people in an area living and working together. Ecosystems can be as small as a puddle or as large as an ocean.

Freshwater - consist of streams and rivers, wetlands, and ponds and lakes. Freshwater provides much of the world's drinking water.

Invasive Species - a species that is non-native (or alien) to the ecosystem. An invasive species causes or is likely to cause economic or environmental harm or harm to human health.

Marine - pertaining to navigation or shipping. Other marine terms include nautical, naval, or maritime.

Native Species – a species that normally lives and thrives in a particular ecosystem. This can include any species that developed with the surrounding habitat and can be assisted or affected by a new species.

Non-native Species - a species living outside its native habitat. Non-native species are usually brought into a new area by human activity either deliberate or accidental. Some introduced species are damaging to their new ecosystem, while others have no negative effect.

Non-indigenous – does not exist, or grow naturally in a region or country. Non-indigenous species are not native to a habitat or ecosystem.

Species - .a naturally existing population of similar organisms that are given a unique name to distinguish them from all other creatures.

Watershed –an area where rainfall naturally runs and either soaks into the ground or runs off in order to flow to a common water body like a stream or a river. Watersheds are important to wildlife, aquatic life and to humans because they provide habitat and clean water.

Focus Question(s):

What is an ecosystem and what happens when a non-native species enters a balanced ecosystem?

What routes do invasive species use to find their way to new habitats and what effect do they have on their new ecosystems?

How do shipping and recreational water activities impact the spread of non-native species to freshwater, brackish and marine areas in Virginia? What human activities can help solve the problem?

Classroom or Field Activities

Day 1

Focus Question: What is an ecosystem and what happens when a non-native species enters a balanced ecosystem?

1. Place students in groups of 4. Using a small square dry erase board and markers, have students label the four corners of the dry erase board with the following: carnivores, herbivores, plants, decomposers. Explain that each corner represents the types of organisms found in a geographic habitat. Students can draw arrows to show the energy cycle where the carnivores eat a certain number of the herbivores. Herbivores eat a certain amount of plants. Subsequently the plants and animals die which provides food for the decomposers. Decomposers provide nutrients to the plants. This cycle of energy helps the populations of species to survive in a balanced ecosystem.
2. Students will balance the dry erase board on a cylinder and place approximately 10 pennies on each corner. This represents an ecosystem that is in balance.
3. Suggest that a new species has been introduced into the balanced ecosystem from another habitat. Explain how the new species has no predators in the new ecosystem, and how it eats many of the plants in the ecosystem. Ask, "What happens to the population of the new species?" Students should draw conclusions that the population of the new species will increase which significantly decreases the plant life in the new ecosystem. Students will add animal pennies and subtract plant pennies from the corners demonstrating an imbalance in the ecosystem.
4. Have students explain what happens when a new plant or animal is introduced to a balanced ecosystem or habitat. Explain the concepts of native and non-native species. Ask students to think about examples of native and non-native species in the area where they live. Discuss how certain non-native species are considered invasive and have caused problems in water environments like the Chesapeake Bay and in other environments in the United States.
5. Depending on ability, students can work independently or in pairs to research one of the following non-native species found in the Chesapeake Bay area of Virginia. Assign a variety of species including those found on land and in water, include species from the animalia, plantae and fungi kingdoms.

Animalia	Plantae
Asian longhorned beetle (<i>Anoplophora glabripennis</i>)	Eurasian water milfoil (<i>Myriophyllum spicatum</i>)
Asiatic clam (<i>Corbicula fluminea</i>)	hydrilla (<i>Hydrilla verticillata</i>)
comb jelly (<i>Mnemiopsis leidyi</i>)	kudzu (<i>Pueraria montana</i> var. <i>lobata</i>)
grass carp (<i>Ctenopharyngodon idella</i>)	phragmites (<i>Phragmites australis</i>)
green crab (<i>Carcinus maenas</i>)	purple loosestrife (<i>Lythrum salicaria</i>)
gypsy moth (<i>Lymantria dispar</i>)	yellow iris (<i>Iris pseudacorus</i>)
mute swan (<i>Cygnus olar</i>)	
	Fungi

nutria (<i>Myocastor coypus</i>)	anthracnose fungus (anthracnose)
starlings (<i>Sturnus vulgaris</i>)	Chestnut blight (<i>Cryphonectria parasitica</i>)
veined rapa whelk (<i>Rapana venosa</i>)	
zebra mussel (<i>Dreissena polymorpha</i>)	

6. Assist students in conducting research on their assigned species. Students will take notes on the organism's characteristics. Provide graphic organizer to support note taking.

Name of the organism
 Drawing/picture of most wanted species
 Kingdom and description of native habitat
 Problems that occur as a result of the non-native species
 Way(s) to prevent the spread of this species

7. Students volunteer to report their findings to the class.

Day 2

Focus Question: What routes do invasive species use to find their way to new habitats and what effect do they have on their new ecosystems?

How do shipping and recreational water activities impact the spread of non-native species to freshwater, brackish and marine areas in Virginia? What human activities can help solve the problem?

1. Using the information collected from their research, students will create "Most Wanted" posters showing characteristics of their non-native species. Posters must contain the following:
 - Name of the organism (Most Wanted Name – common aka scientific),
 - Drawing/picture of most wanted species (Picture),
 - Kingdom and description of native habitat (Hometown),
 - Problems that occur as a result of the non-native species (Crime)
 - Way(s) to prevent the spread of this species (Method to Capture)
2. Students will display their posters and report findings to the class. Discussions should focus on the following questions: How was the species introduced? What damage does the non-native species create in the new ecosystem? What methods could be used to control the species? Students must draw conclusions or make inferences as to how the species affects the ecosystem.
3. Students will suggest ways to categorize their posters: water vs. land species; animal, plant, fungus; freshwater, saltwater; etc.

Day 3

Focus Question: How do shipping and recreational water activities impact the spread of non-native species to freshwater, brackish and marine areas in Virginia? What human activities can help solve the problem?

1. Divide students into 5 groups. Provide clipboards, pencils, and “Most Wanted!” student activity packets. Students will rotate through five stations. Station activities require that they answer questions related to the invasive species that they researched (Most Wanted Posters), and that they interpret aquatic species information provided on charts and graphs collected from the [U.S. Department of the Interior | U.S. Geological Survey](#) website (Nonindigenous Aquatic Species (NAS) Graphs and Charts) at URL: <http://nas.er.usgs.gov> on July 6, 2011. These charts and graphs compare data collected for the United States and for Virginia.

Station 1: Cumulative number of nonindigenous aquatic species that have been introduced in the United States and Virginia up to the last year listed.

Station 2: Ways that nonindigenous aquatic species are introduced into an ecosystem.

Station 3: Percent of nonindigenous aquatic species introduced into either freshwater or marine areas of the United States and Virginia.

Station 4: Numbers of nonindigenous aquatic species introduced into the United States and Virginia.

Station 5: Most Wanted Posters (These posters were created by students on Day 2.)

2. Discuss with students how the species shown on the Most Wanted Posters can cause problems with the ecosystems where they are introduced. Also discuss how species introduced to aquatic areas impacts other life forms in an ecosystem. Each group of students will summarize their thoughts about what was learned in this exercise. Student discussions must (1) address how shipping and water recreation impacts the introduction of non-native species, (2) tell about attempts to control or eliminate them, and (3) predict what future trends may occur as a result of what they have learned.

Non-Native Species Research Organizer

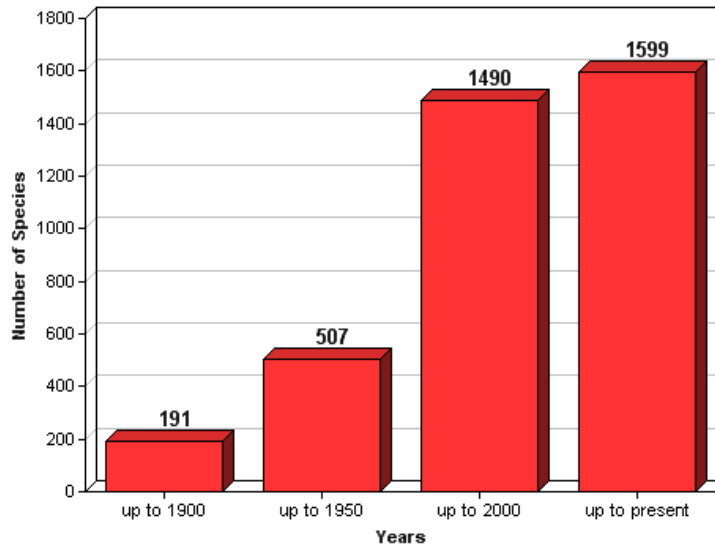
Student Name: _____ Date: _____

<p>Name of the organism (<i>common and scientific name – 2 points</i>)</p>	
<p>Description of species (<i>include descriptive details – 3 points</i>)</p>	
<p>Kingdom and description of native habitat (<i>include descriptive details – 5 points</i>)</p>	
<p>Problems that occur as a result of the non-native species (<i>discuss the threats to other species in the habitat and tell how it changes the ecosystem – 5 points</i>)</p>	
<p>Way(s) to prevent the spread of this species (<i>discuss ways to prevent the spread of the non-native species and management options – 5 points</i>)</p>	

Station 1: Cumulative number of nonindigenous aquatic species that have been introduced in the United States and Virginia up to the last year listed.



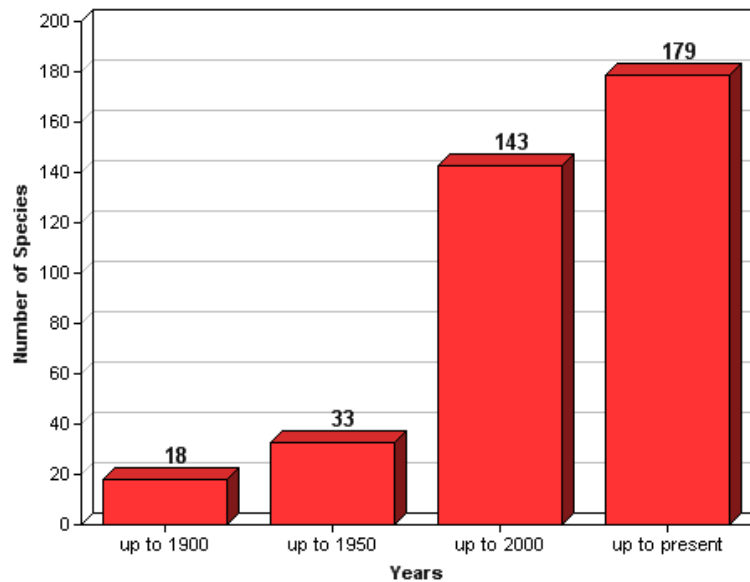
Introduced Species in the United States



(graph created: 7/6/2011 7:41:57 PM by the United States Geological Survey)



Introduced Species in Virginia



(graph created: 7/6/2011 7:43:57 PM by the United States Geological Survey)

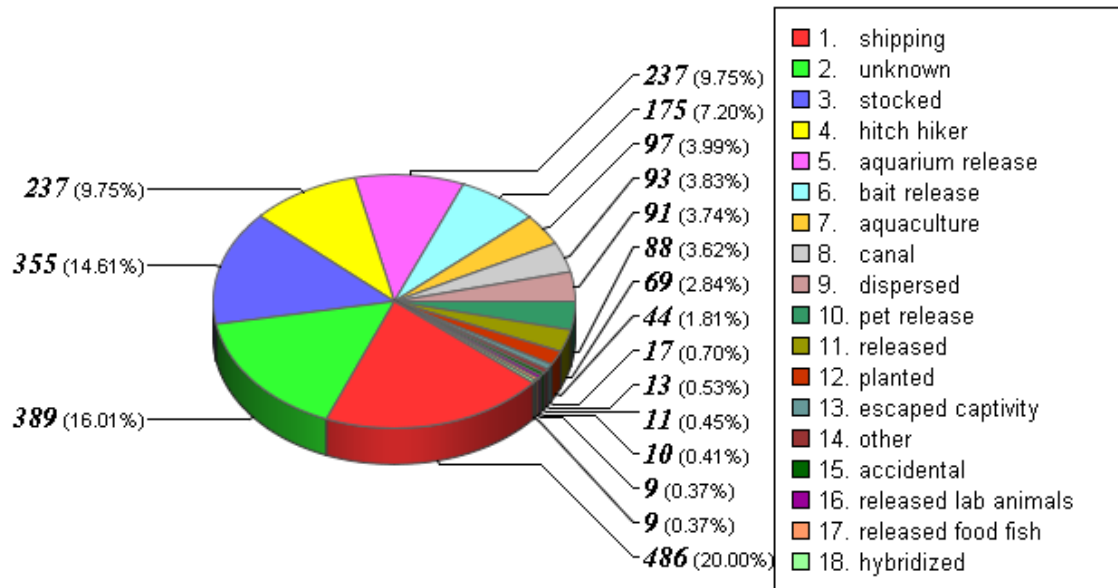
[U.S. Department of the Interior](http://www.doi.gov) | [U.S. Geological Survey](http://www.usgs.gov)

URL: <http://nas.er.usgs.gov>

July 6, 2011

Station 2: Ways that nonindigenous aquatic species are introduced into an ecosystem. *Note: A single species can be introduced by more than one pathway and may be counted more than once.*

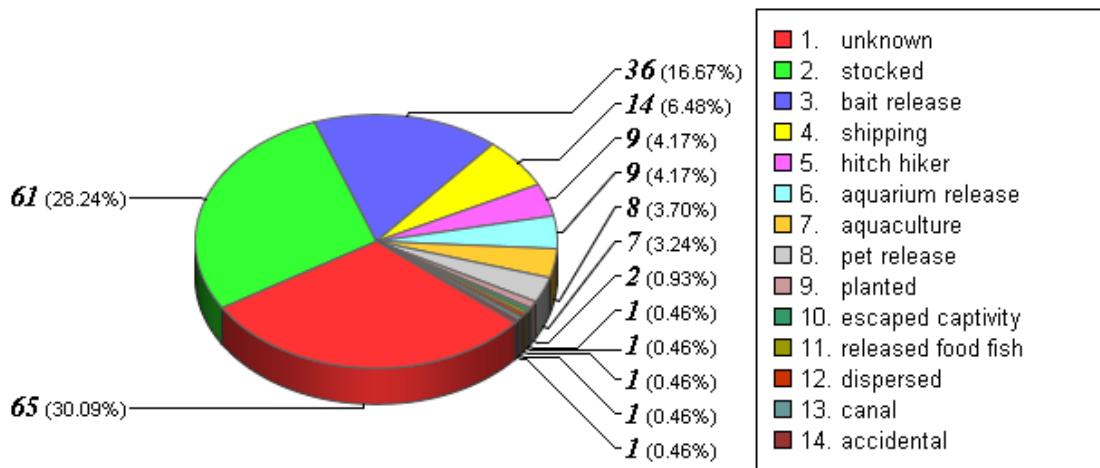
Introduction Pathways for the United States



(graph created: 7/6/2011 7:41:58 PM by the United States Geological Survey)



Introduction Pathways for Virginia



(graph created: 7/6/2011 7:43:57 PM by the United States Geological Survey)

[U.S. Department of the Interior](http://www.doi.gov) | [U.S. Geological Survey](http://www.usgs.gov)

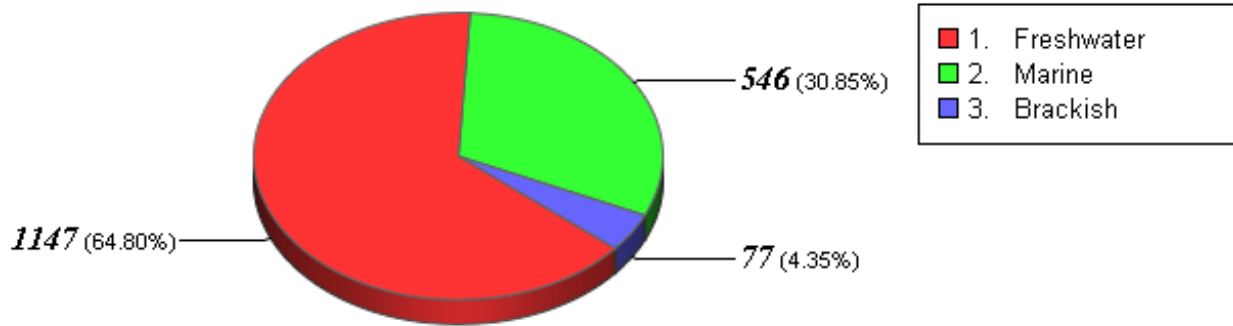
URL: <http://nas.er.usgs.gov>

July 6, 2011

Station 3: Percent of nonindigenous aquatic species introduced into either freshwater or marine areas of the United States and Virginia. *Note: Estuarine species are included as marine.*



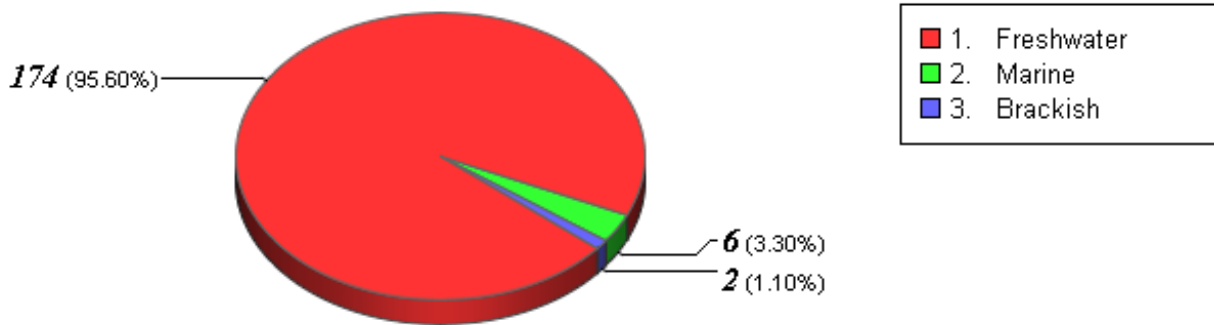
Marine versus Freshwater of Introduce times in the United States



(graph created: 7/6/2011 7:41:58 PM by the United States Geological Survey)



Marine versus Freshwater of Introductions for Virginia



(graph created: 7/6/2011 7:43:57 PM by the United States Geological Survey)

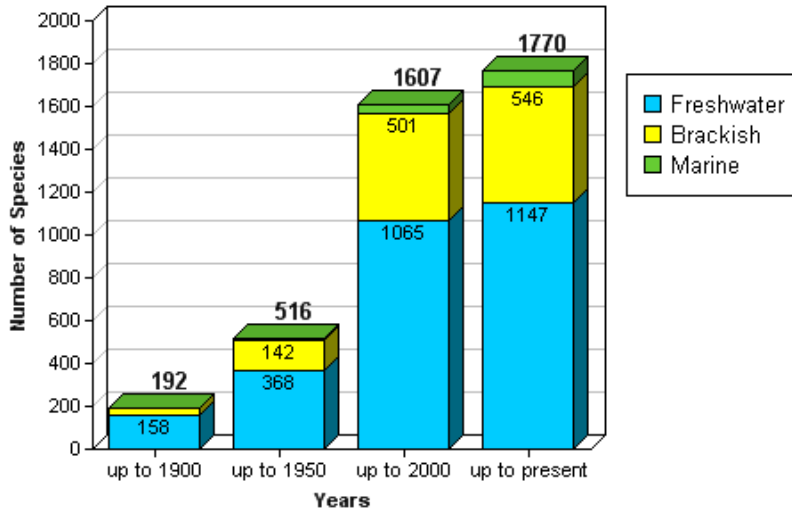
[U.S. Department of the Interior](#) | [U.S. Geological Survey](#)

URL: <http://nas.er.usgs.gov>

July 6, 2011

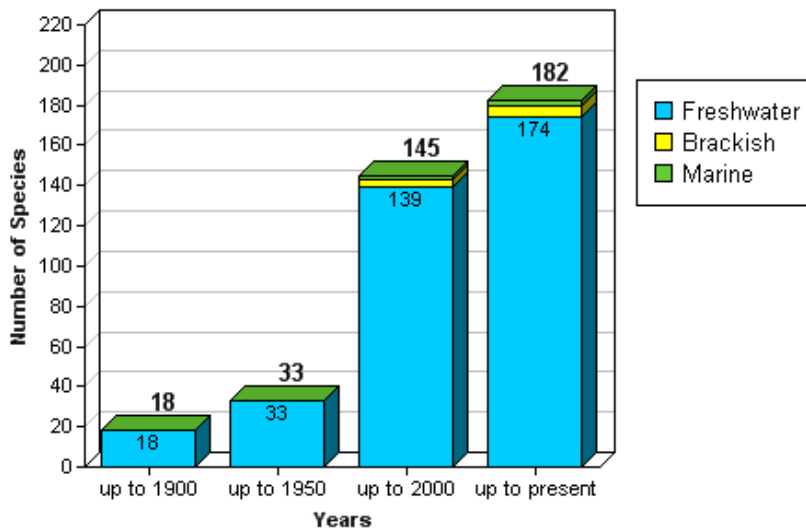
Station 4: Numbers of nonindigenous aquatic species introduced into the United States and Virginia. *Note: This data includes species that did not become established.*

USGS Freshwater/Marine Introductions Over Time
science for a changing world



(graph created: 7/6/2011 7:41:58 PM by the United States Geological Survey)

USGS Freshwater/Marine Introductions Over Time in Virginia
science for a changing world



(graph created: 7/6/2011 7:43:57 PM by the United States Geological Survey)

[U.S. Department of the Interior](http://www.doi.gov) | [U.S. Geological Survey](http://www.usgs.gov)

URL: <http://nas.er.usgs.gov>

July 6, 2011



Most Wanted!



Student Name: _____ Date: _____

Station1: Cumulative number of nonindigenous aquatic species that have been introduced in the United States and Virginia up to the last year listed. (2 points each question)

<p>How are the graphs alike?</p>	<p>How are the graphs different?</p>
<p>What years showed the greatest increase in the numbers of species introduced into the United States and Virginia?</p>	<p>Tell two reasons that may have caused an increase in the number of new species.</p>

Station2: Ways that nonindigenous aquatic species are introduced into an ecosystem. (2 points each question)

<p>According to the chart, what are the top four pathways that aquatic species are introduced into the United States?</p>	<p>What are the top four pathways that aquatic species are introduced into Virginia waters?</p>
<p>Look at all the pathways shown. Name three pathways that could be prevented and tell why?</p>	<p>How does the data on these charts help you to better understand what could be happening to ecosystems in the United States?</p>

Station3: Percent of nonindigenous aquatic species introduced into either freshwater or marine areas of the United States or Virginia. (2 points each question)

<p>What is brackish water?</p>	<p>Where would you find brackish water?</p>
<p>How does brackish water affect the ecosystem?</p>	<p>How many marine species were introduced into the United States? _____ How many marine species were introduced into Virginia? _____ Tell one reason why you think those numbers are so different?</p>

Station4: Numbers of nonindigenous aquatic species introduced into the United States or Virginia. (2 points each question)

<p>What is a watershed?</p>	<p>How does watershed differ from brackish? Name some ways that species are introduced into freshwater waterways?</p>
<p>Tell two or more ways that can help to prevent the spread of land or aquatic species in an ecosystem.</p>	<p>Based on the information you learned about the growth of invasive species, predict what may happen in the future.</p>

Station5: Most Wanted Posters

Most Wanted Name And Kingdom	How did this non-native species get into the new habitat?	Where is its habitat? (circle all that apply)	How could the spread of this non-native species be prevented?
		Marine Brackish Freshwater Land	
		Marine Brackish Freshwater Land	
		Marine Brackish Freshwater Land	
		Marine Brackish Freshwater Land	

Tell what you learned about how a non-native species affects an ecosystem.



Most Wanted!

(Answer Key)



Student Name: _____ Date: _____

Station 1: Cumulative number of nonindigenous aquatic species that have been introduced in the United States and Virginia up to the last year listed. (2 points each question)

<p>How are the graphs alike?</p> <p>(Answers will vary.)</p>	<p>How are the graphs different?</p> <p>(Answers will vary)</p>
<p>What years showed the greatest increase in the numbers of species introduced into the United States and Virginia?</p> <p>(Up to 1950 compared to Up to 2000)</p>	<p>Tell two reasons that may have caused an increase in the number of new species.</p> <p>(Answers will vary; increased use of shipping as a means to transport goods; increase in bait release)</p>

Station 2: Ways that nonindigenous aquatic species are introduced into an ecosystem. (2 points each question)

<p>According to the chart, what are the top four pathways that aquatic species are introduced into the United States?</p> <p>(Shipping; Unknown; Stocked; Hitchhiker)</p>	<p>What are the top four pathways that aquatic species are introduced into Virginia waters?</p> <p>(Unknown; Stocked; Bait Release; Shipping)</p>
<p>Look at all the pathways shown. Name three pathways that could be prevented and tell why?</p> <p>(Answers will vary; any type of released species)</p>	<p>How does the data on these charts help you to better understand what could be happening to ecosystems in the United States?</p> <p>(Life forms change based on human intervention and adaptations of the life forms that live in those environments. Plants and animals not native to Virginia watershed habitats are introduced and subsequently adapt in ways that enable them to survive.)</p>

Station 3: Percent of nonindigenous aquatic species introduced into either freshwater or marine areas of the United States or Virginia. (2 points each question)

<p>What is brackish water?</p> <p>(Brackish water has lower salinity than seawater but higher salinity than fresh water.)</p>	<p>Where would you find brackish water?</p> <p>(Brackish water occurs naturally in areas where fresh water and saltwater mix, such as the point where rivers flow into oceans.)</p>
<p>How does brackish water affect the ecosystem?</p> <p>(All life forms that live in a particular ecological system are interdependent. These life forms are affected by changes to their ecological system.)</p>	<p>How many marine species were introduced into the United States? (546) How many marine species were introduced into Virginia? (6) Tell one reason why you think those numbers are so different?</p> <p>(Answers will vary; The US has more land that is adjacent to seawater marines areas than Virginia.)</p>

Station 4: Numbers of nonindigenous aquatic species introduced into the United States or Virginia. (2 points each question)

<p>What is a watershed?</p> <p>(A watershed is an area where rainfall naturally runs and either soaks into the ground or runs off in order to flow to a common water body like a stream or a river. Watersheds are important to wildlife, aquatic life and to humans because they provide habitat and clean water.)</p>	<p>How does watershed differ from brackish? Name some ways that species are introduced into freshwater waterways?</p> <p>(The watershed is where freshwater flows and mixes with brackish water; such as rivers flow into oceans.)</p>
<p>Tell two or more ways that can help to prevent the spread of land or aquatic species in an ecosystem.</p> <p>(Answers will vary.)</p>	<p>Based on the information you learned about the growth of invasive species, predict what may happen in the future.</p> <p>(Answers will vary.)</p>

Unit Assessment

Students are assessed based on state standards and learning objectives addressed. This project has two main components with a total value of 100 points.

Most Wanted Grade Sheet

Name _____ Date: _____

SOL	Activity	Grade
Most Wanted Poster <i>Virginia SOLs</i> <i>Science – 5.5b</i> <i>Oral Language – 5.1a,b,c</i> <i>Reading – 5.6 a, c, d, e, g</i>	Research Graphic Organizer (25 points) Most Wanted Poster (15 points) Presentation of Poster (10 points)	
Most Wanted Packet <i>Virginia SOLs</i> <i>Science – 5.1e</i> <i>Oral Language – 5.1a,b,c</i> <i>Reading – 5.6 a, c, d, e, g</i>	Station 1 (8 points) Station 2 (8 points) Station 3 (8 points) Station 4 (8 points) Station 5 (10 points) Group discussions (8 points) <i>(Group discussions must address how shipping and water recreation impacts the introduction of non-native species, tell about attempts to control or eliminate them, and predict what future trends may occur as a result of what they have learned.)</i>	
Total Points	100	