

# **Section One**

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## **Ecological Knowledge**

# Are You Me?

## Objective

Students will recognize various young stages of aquatic animals and match them with corresponding adult stages.

## Overall

Using Picture cards, students match pairs of juvenile and adult aquatic animals.

## Grade level: K-4

## Science

Students will demonstrate

- ❖ an increasing ability to recognize patterns and products of evolution, including genetic variation, specialization, adaptation and natural election.
- ❖ an increasing ability to understand how environmental factors affect all living systems (i.e. Individuals, community, biome, the biosphere) as well as species interactions.

## Evaluation

Choose two aquatic animals. Draw a picture of each animal as an adult and another picture of each animal as it looks when it is young.

# Fishy Who's Who

## Objectives

Students will: 1) recognize and identify the major species of freshwater or saltwater fish that live in their area; 2) describe various values of fish species in some aquatic communities; and 3) locate places where the fish species occur.

## Overall

Students complete an inventory of fish habitats that exist in their area, obtain information about the various fish species that occur in these habitats and locate the fish species on a map.

## Grade Level: 5-8

## Science

Students will demonstrate:

- ❖ an increasing ability to understand how environmental factors affect all living systems (i.e. Individuals, community, biome, the biosphere) as well as species interactions.
- ❖ an increasing ability to understand fundamental structures, functions, and mechanisms of inheritance found in microorganisms, fungi, protists, plants and animals.

## Language Arts

Students will demonstrate:

- ❖ competence in using the interactive language processes of reading, writing, speaking, listening, and viewing to gather and organize information in a variety of subject.

## Evaluation

1. Identify five species of fish that live your state.
2. Describe where in the state each of these fish is most apt to live and in what types of habitat.
3. List and describe a variety of reasons that fish are important.

# Whale Of A Tail

## Objective

Students will describe the sizes of different whales compared to their body size.

## Overall

Students use computational, graphing and measuring techniques to draw or sculpture life-size replicas of whales.

## Grade Level: 5-8

## Science

Students will demonstrate

- ❖ an increasing ability to use measuring instruments to gather accurate and/or precise information.
- ❖ an increasing ability to recognize patterns and products of evolution, including genetic variation, specialization, adaptation and natural election.
- ❖ an increasing ability to understand fundamental structures, functions, and mechanisms of inheritance found in microorganisms, fungi, protists, plants and animals.

## Language Arts

Students will demonstrate

- ❖ competence in using the interactive language processes of reading, writing, speaking, listening, and viewing to gather and organize information in a variety of subject.
- ❖ competence in using the interactive language processes of reading, writing, speaking, listing and viewing to communicate effectively.

## Mathematics

Students will

- ❖ compute.
- ❖ use mental computation and estimation skills and strategies and know when it is appropriate to do so.
- ❖ develop an understanding of measurement and systems of measurement through experiences which enable them to use a variety of techniques, tools and units of measurement to describe and analyze quantifiable phenomena.

## **Evaluation**

Draw the outline of a person and the outline of several whales researched in this activity. Draw the sketches according to scale. Place the sketches in order from smallest to largest.

# **Migration Headache**

## **Objective**

Students will: 1) list limiting factors affecting habitats and populations of migrating water birds; 2) predict the effects of such limiting factors; 3) describe the effects of habitat loss and degradation on populations of migrating water birds; and 4) make inferences about the importance of suitable habitat for migrating water birds.

## **Overall**

Students portray migrating water birds traveling between nesting habitats and wintering grounds.

## **Grade Level: 5-8**

## **Science**

Students will demonstrate:

- ❖ an increasing ability to recognize patterns and products of evolution, including genetic variation, specialization, adaptation and natural selection.
- ❖ an increasing ability to understand how environmental factors affect all living systems (i.e. Individuals, community, biome, the biosphere) as well as species interactions.

## **Language Arts**

Students will demonstrate:

- ❖ competence in using the interactive language processes of reading, writing, speaking, listening, and viewing to gather and organize information in a variety of subject.
- ❖ competence in using the interactive language processes of reading, writing, speaking, listening and viewing to communicate effectively.

## **Mathematics**

Students will:

- ❖ recognize patterns and describe and represent relations and functions with tables, graphs, equations and rules, and analyze how a change in one element results in a change in another.

## **Social Studies**

Students will demonstrate:

- ❖ an understanding of the connections between Earth's physical and human systems; the consequences of the interaction between human and physical systems; and changes in the meaning, use, distribution and importance of the resources.

## **Evaluation**

1. Name two human activities and two environmental factors that might interfere with water bird migration. For each activity and factor, describe the possible effects on the water birds.
2. Distinguish between effects on individual birds and effects on populations of birds. Indicate if an effect is short-term or long-term.
3. Why is suitable habitat important for migrating water birds? Include in your response a description of the different kinds of habitat that are needed by migrating water birds.
4. Is habitat loss a greater threat to the survival of migrating populations than for stationary populations of wildlife? Explain your answer.

# Designing A Habitat

## Objective

Students will identify the components of habitat that are essential for most aquatic animals to survive.

## Overall

Students design a habitat suitable for aquatic wildlife to survive in a zoo or an aquarium.

## Grade Level: 5-8

## Science

Students will demonstrate

- ❖ an increasing understanding of how the scientific enterprise operates.
- ❖ an increasing ability to recognize patterns and products of evolution, including genetic variation, specialization, adaptation and natural selection.
- ❖ an increasing ability to understand how environmental factors affect all living systems (i.e. Individuals, community, biome, the biosphere) as well as species interactions.
- ❖ an increasing ability to understand that organisms are linked to one another and to their physical setting by the transfer and transformation of matter and energy to maintain a dynamic equilibrium.
- ❖ an increasing ability to understand fundamental structures, functions, and mechanisms of inheritance found in microorganisms, fungi, protists, plants and animals.
- ❖ an increasing ability to understand that the Earth is a complex planet with five interacting systems, which consists of the solid Earth (lithosphere), air (atmosphere), water (hydrosphere), ice (cryosphere), and life (biosphere).

## Language Arts

Students will demonstrate

- ❖ competence in using the interactive language processes of reading, writing, speaking, listening, and viewing to gather and organize information in a variety of subject.
- ❖ competence in using the interactive language processes of reading, writing,

speaking, listing and viewing to communicate effectively.

## **Evaluation**

1. List the components of suitable habitat that are necessary for most aquatic animals to survive.
2. Choose an aquatic mammal, fish, amphibian or other aquatic animal. Describe the biological characteristics of the animal and the kind of habitat requirements it has in order to survive. Compare similarities and differences between this aquatic animal and another aquatic animal. What things, if any, must be different in their habitats in order for each kind of animal to survive?

# Where Does Water Run?

## Objective

Students will describe relationships between precipitation, runoff and aquatic habitats.

## Overall

Students will: 1) measure and calculate the area of a study site; 2) calculate the volume and weight of water falling on the study site; 3) determine specific and annual rainfall and runoff; and 4) trace the course of water to aquatic habitats.

## Grade Level: 5-8

## Science

Students will demonstrate:

- ❖ an increasing ability to use measuring instruments to gather accurate and/or precise information.
- ❖ an increasing ability to understand that the Earth contains a variety of renewable and nonrenewable resources.

## Mathematics

Students will:

- ❖ recognize, develop, and explore mathematical connections.
- ❖ compute.
- ❖ develop an understanding of measurement and systems of measurement through experiences which enable them to use a variety of techniques, tools and units of measurement to describe and analyze quantifiable phenomena.
- ❖ use algebraic concepts and processes to represent situations that involve variable quantities with expressions, equations, inequalities, matrices and graphs.

## Evaluation

1. Describe at least two relationships between aquatic habitats, precipitation, runoff and surface water.
2. Identify two human activities that have affected the quality of runoff.
3. Identify two human activities that have affected the quantity of runoff.
4. Identify two ways that runoff can affect humans.
5. Identify and describe two ways that runoff can affect aquatic wildlife.

6. Write a short list of steps to protect the quantity and quality of runoff water.

## Water Canaries

### Objectives

Students will: 1) identify several aquatic organisms; and 2) assess the relative environmental quality of a stream or pond based on indicators of pH, water temperature and the presence of a diversity of organisms.

### Overall

Students investigate a stream or pond using sampling techniques.

### Grade Level: 5-8

### Science

Students will demonstrate

- ❖ an increasing ability to use measuring instruments to gather accurate and/or precise information.
- ❖ an increasing ability to use technology to observe nature.
- ❖ an increasing ability to recognize patterns and products of evolution, including genetic variation, specialization, adaptation and natural selection.
- ❖ an increasing ability to understand how environmental factors affect all living systems (i.e. Individuals, community, biome, the biosphere) as well as species interactions.
- ❖ an increasing ability to understand that organisms are linked to one another and to their physical setting by the transfer and transformation of matter and energy to maintain a dynamic equilibrium.
- ❖ an increasing ability to understand fundamental structures, functions, and mechanisms of inheritance found in microorganisms, fungi, protists, plants and animals.

### Evaluation

1. Draw a simple illustration of one or more of the following organisms: Asellus(water sowbug), water strider, caddisfly larva, crayfish, scud, Daphnia, leech, mayfly nymph, midge larva, stonefly nymph, dragonfly nymph. Identify each organism by writing the correct name beside the picture.
2. You found a trout in a stream with a large variety of other organisms. Predict ranges you would expect to find for pH and water temperature.

# Aqua Words

## Objective

Students will describe a variety of ways and reasons why water is important to people and wildlife.

## Overall

Students brainstorm water words, make word trees with those words and write poetic statements about water.

## Grade Level: K-4

## Science

Students will demonstrate

- ❖ an increasing ability to understand how environmental factors affect all living systems (i.e. Individuals, community, biome, the biosphere) as well as species interactions.

## Language Arts

Students will demonstrate

- ❖ the interest and ability to write effectively for a variety of purposes and audiences.

## Evaluation

1. Explain three ways you use water.
2. Explain how plants use water.
3. Explain how animals use water.
4. Explain why water is important.
5. Write and illustrate a short story about the importance of water.
6. Use visual vocabulary techniques (see Evaluating and Assessing Student Learning in the Appendix) to demonstrate understanding of concepts and relationships from the activity.

# Water Plant Art

## Objective

Students will identify aquatic plants as an important component in aquatic habitats and for aquatic wildlife.

## Overall

Students create artwork showing aquatic habitats from their drawings and pressed aquatic plants.

## Grade Level: K-4

## Science

Students will demonstrate

- ❖ an increasing ability to recognize patterns and products of evolution, including genetic variation, specialization, adaptation and natural selection.
- ❖ an increasing ability to understand how environmental factors affect all living systems (i.e. Individuals, community, biome, the biosphere) as well as species interactions.
- ❖ an increasing ability to understand that organisms are linked to one another and to their physical setting by the transfer and transformation of matter and energy to maintain a dynamic equilibrium.

## Evaluation

1. Draw and identify two aquatic plants other than the plants pressed in the activity. What aquatic animals can be added to the pictures to show how these plants help aquatic animals?

# Marsh Munchers

## Objective

Students will: 1) identify components of a food web in a salt marsh; 2) identify their interconnectedness in the food web

## Overall

Students use body movement and pantomime to simulate the feeding motions of marsh animals.

## Grade Level: K-4

## Science

Students will demonstrate:

- ❖ an increasing ability to recognize patterns and products of evolution, including genetic variation, specialization, adaptation and natural selection.
- ❖ an increasing ability to understand how environmental factors affect all living systems (i.e. Individuals, community, biome, the biosphere) as well as species interactions.
- ❖ an increasing ability to understand that organisms are linked to one another and to their physical setting by the transfer and transformation of matter and energy to maintain a dynamic equilibrium.

## Evaluation

1. Give examples of two predators and two prey species that live in salt marshes.
2. Use some of the organisms listed below, and others of your choice, to construct a food web that might be found in a salt marsh: people, raccoons, marsh grass, bacteria, snails, oysters, detritus, young fish, egret.

# Wetland Metaphors

## Objectives

Students will: 1) describe the characteristics of wetlands and 2) evaluate the importance of wetlands to wildlife and humans.

## Overall

Students are presented with a selection of objects for investigation as metaphors for the natural functions wetlands.

## Grade Level: 5-8

## Science

Students will demonstrate:

- ❖ an increasing ability to recognize patterns and products of evolution, including genetic variation, specialization, adaptation and natural selection.
- ❖ an increasing ability to understand how environmental factors affect all living systems (i.e. Individuals, community, biome, the biosphere) as well as species interactions.

## Language Arts

Students will demonstrate:

- ❖ competence in using the interactive language processes of reading, writing, speaking, listening, and viewing to gather and organize information in a variety of subject.
- ❖ competence in using the interactive language processes of reading, writing, speaking, listening and viewing to communicate effectively.

## Evaluation

1. Explain why wetlands are called one of the world's most productive ecosystems.
2. Wetlands are important to a range of organisms in the animal kingdom, from zooplankton to humans. Select five species of animals and describe how wetlands are important to each.

# Hooks and Ladders

## Objective

Students will: 1) describe how some fish migrate as part of their life cycles; 2) identify the stages of the life cycle of one kind of fish; 3) describe limiting factors affecting Pacific salmon as they complete their life cycles; and 4) generalize that limiting factors affect all populations of animals.

## Overall

Students simulate the Pacific salmon and the hazards faced by salmon in an activity portraying the life cycle of these aquatic creatures.

## Grade Level: 5-8

## Science

Students will demonstrate:

- ❖ an increasing ability to recognize patterns and products of evolution, including genetic variation, specialization, adaptation and natural selection.
- ❖ an increasing ability to understand how environmental factors affect all living systems (i.e. Individuals, community, biome, the biosphere) as well as species interactions.
- ❖ an increasing ability to understand that organisms are linked to one another and to their physical setting by the transfer and transformation of matter and energy to maintain a dynamic equilibrium.
- ❖ an increasing ability to understand fundamental structures, functions, and mechanisms of inheritance found in microorganisms, fungi, protists, plants and animals.

## Social Studies

Students will demonstrate:

- ❖ an understanding of the connections between Earth's physical and human systems; the consequences of the interaction between human and physical systems; and changes in the meaning, use, distribution and importance of the resources.

## Evaluation

1. List, describe and illustrate the major stages in a Pacific salmon's life cycle.

2. Identify and describe some of the limiting factors that affect salmon as they complete their life cycles.
3. Identify and describe some limiting factors that might affect other animal populations.

## Micro Odyssey

### Objective

Students will: 1) identify forms of microscopic life that live in water; and 2) describe how various aquatic organisms are interrelated.

### Overall

Students will examine, draw, paint and identify microorganisms in pond water.

### Grade Level: 5-8

### Science

Students will demonstrate:

- ❖ an increasing ability to recognize patterns and products of evolution, including genetic variation, specialization, adaptation and natural selection.
- ❖ an increasing ability to understand how environmental factors affect all living systems (i.e. Individuals, community, biome, the biosphere) as well as species interactions.
- ❖ an increasing ability to understand that organisms are linked to one another and to their physical setting by the transfer and transformation of matter and energy to maintain a dynamic equilibrium.
- ❖ an increasing ability to use measuring instruments to gather accurate and/or precise information.
- ❖ an increasing ability to use technology to observe nature.

### Evaluation

1. Draw a simple illustration of one or more of the following pond organisms: Daphnia, Euglena, Hydra, Spirogyra, rotifer, water mite. Label your drawing and add information about the characteristics to the organisms and its habitat.
2. Identify each of the organisms in the list above, plus sulfur bacteria, as a producer (P), consumer (C) or decomposer (D).
3. Use at least three of the organisms listed above, and others, to construct an aquatic food web that might be found in a pond.

# Blue Ribbon Niche

## Objective

Students will: 1) identify different organisms that live in riparian areas; 2) describe the ecological role of some organisms in riparian zones; 3) describe some basic characteristics of riparian zones; and 4) evaluate potential positive and negative effects from changes in riparian zones.

## Overall

Students create a variety of representations of wildlife that can be found in riparian zones.

## Grade Level: 5-8

## Science

Students will demonstrate:

- ❖ an increasing ability to understand how environmental factors affect all living systems (i.e. Individuals, community, biome, the biosphere) as well as species interactions.
- ❖ an increasing ability to understand that organisms are linked to one another and to their physical setting by the transfer and transformation of matter and energy to maintain a dynamic equilibrium.
- ❖ an increasing ability to understand fundamental structures, functions, and mechanisms of inheritance found in microorganisms, fungi, protists, plants and animals.

## Language Arts

Students will demonstrate:

- ❖ competence in using the interactive language processes of reading, writing, speaking, listening and viewing to communicate effectively.

## Evaluation

1. Identify and describe the habitat and niche of each of these organisms: raccoon, frog, fish, heron and mosquito.
2. Identify three other animals that are common in riparian ecosystems in your area. What is the niche of each?
3. Describe two things that could have a positive effect on a riparian habitat.

4. A large stand of trees in a riparian zone is being evaluated for its economic potential. What other values would you ask the owners to consider before making a decision whether or not to harvest the trees? Explain.

## Fashion A Fish

### Objectives

*Grades K-2*

Students will classify fish according body shape and coloration.

*Grade 3-4*

Students will: 1) describe adaptations of fish to their environments; 2) describe how adaptations can help fish survive in their habitats; and 3) interpret the importance of adaptation in animals

### Overall

Students design a fish adapted for various aquatic habitats.

### Grade Level: K-4

### Science

Students will demonstrate:

- ❖ an increasing ability to understand how environmental factors affect all living systems (i.e. Individuals, community, biome, the biosphere) as well as species interactions.
- ❖ an increasing ability to understand fundamental structures, functions, and mechanisms of inheritance found in microorganisms, fungi, protists, plants and animals.

### Evaluation

*Grades K-2*

Circle the fish with vertical stripes. Circle the fish with the horizontal, flat shape. Circle the fish that would be difficult to see from above. (Use the masters provided on pages 59 and 60 for drawings of fish)

*Grades 3-4*

1. Name two fish adaptations in each of the following categories: mouth/feeding, shape, coloration and reproduction. Then describe the advantages of each of these adaptations to the survival of the fish in their habitats.

2. Invent an animal that would be adapted to live in your community. Consider mouth, shape, coloration, reproduction, food, shelter and other characteristics. Draw and describe your animal.

## Sockeye Scents

### Objectives

Students will: 1) trace and label the migratory route that sockeye salmon take from the ocean to an upstream lake; 2) describe on theory about how a salmon can find its birth stream; and 3) explain how adaptations enable some species to survive and maintain their population.

### Overall

Students participate in map and simulation exercises that help them understand the migration of the sockeye salmon.

### Grade Level: 3-4

### Science

Students will demonstrate:

- ❖ an increasing ability to understand how environmental factors affect all living systems (i.e. Individuals, community, biome, the biosphere) as well as species interactions.
- ❖ an increasing ability to understand that organisms are linked to one another and to their physical setting by the transfer and transformation of matter and energy to maintain a dynamic equilibrium

### Social Studies

Students will demonstrate:

- ❖ an understanding of the connections between Earth's physical and human systems; the consequences of the interaction between human and physical systems; and changes in the meaning, use, distribution and importance of the resources.

### Evaluation

1. Participation in the closing discussion can serve as an evaluation.
2. Have the groups collectively create a spawning migration map for sockeye salmon that shows obstacles they might encounter.
3. Invite another class to participate in the migration maze; have students lead the discussions and the migration.

# Pond Succession

## Objectives

Students will: 1) recognize that natural environments are involved in a process of continual change; 2) discuss the concept of succession; 3) describe success as an example of the process of change in natural environments; and 4) apply understanding of the concept of succession by drawing a series of pictures showing stages in pond succession.

## Overall

Students create murals showing three major stages of pond succession.

## Grade Level: 5-8

## Science

Students will demonstrate:

- ❖ an increasing ability to understand how environmental factors affect all living systems (i.e. Individuals, community, biome, the biosphere) as well as species interactions.
- ❖ an increasing ability to understand that organisms are linked to one another and to their physical setting by the transfer and transformation of matter and energy to maintain a dynamic equilibrium.

- ❖ an increasing ability to understand fundamental structures, functions, and mechanisms of inheritance found in microorganisms, fungi, protists, plants and animals.

## **Evaluation**

1. Draw a picture, with explanations, to show stages in pond succession.
2. Select a field, vacant lot, park or other area in your community. Make a sketch and write a paragraph to describe the area as it appears today. Make a sketch and write a paragraph to describe what the area might look like in 100 or 500 years from now if a gradual process of succession took place.

# **Eat and Glow**

## **Objectives**

Students will: 1) observe, demonstrate and describe how life forms are affected by changes in their habitats; 2) observe, demonstrate and describe how different species differ in their ability to adjust to changes in their habitat; and 3) observe demonstrate and describe how isolated ecosystems are more vulnerable to environmental changes.

## **Overall**

Students conduct an experiment using *Daphnia* and brine shrimp to demonstrate adaptations to environmental change by organisms.

**Grade Level:** 7-10

## **Science**

Students will demonstrate:

- ❖ an increasing ability to understand how environmental factors affect all living systems (i.e. Individuals, community, biome, the biosphere) as well as species interactions.
- ❖ an increasing ability to understand that organisms are linked to one another and to their physical setting by the transfer and transformation of matter and energy to maintain a dynamic equilibrium.
- ❖ an increasing ability to understand fundamental structures, functions, and mechanisms of inheritance found in microorganisms, fungi, protists, plants and animals.

## **Evaluation**

Use Activity #3 as a performance-based evaluation tool.

**The Edge of Home**

## **Objective**

Students will identify the characteristics of ecotones, or transitional zones, between two wildlife habitats.

## **Overall**

Students explore the concept of ecotones by visiting places where habitats overlap.

## **Grade Level:** 5-8

## **Science**

Students will demonstrate:

- ❖ an increasing ability to use measuring instruments to gather accurate and/or precise information.
- ❖ an increasing ability to use technology to observe nature.
- ❖ an increasing ability to understand how environmental factors affect all living systems (i.e. Individuals, community, biome, the biosphere) as well as species interactions.
- ❖ an increasing ability to understand that organisms are linked to one another and to their physical setting by the transfer and transformation of matter and energy to maintain a dynamic equilibrium.

## **Evaluation**

1. Write a paragraph about the characteristics of ecotones. Write two additional paragraphs to describe two ecosystems and an associated ecotone.
2. Choose a species of wildlife and write a story about its life as it roams through several different ecosystems and ecotones. Explain how the animal's experiences are different at each of the various locations.

# Section Two

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## Social and Political Knowledge

# Mermaids and Manatees

## Objectives

Students will: 1) describe how imaginary creatures may be inspired by actual animals; 2) distinguish between mythical and actual aquatic wildlife; and 3) give examples of how wildlife can inspire myth and art.

## Overall

Students describe aquatic animals using a narrative style of writing that in turn is the basis for a drawing or painting done by other students.

## Grade Level: 5-8

## Science

Students will demonstrate:

- ❖ an increasing ability to recognize patterns and products of evolution, including genetic variation, specialization, adaptation and natural selection.
- ❖ an increasing ability to understand how environmental factors affect all living systems (i.e. Individuals, community, biome, the biosphere) as well as species interactions.
- ❖ an increasing ability to understand that organisms are linked to one another and to their physical setting by the transfer and transformation of matter and energy to maintain a dynamic equilibrium.
- ❖ an increasing ability to understand fundamental structures, functions, and mechanisms of inheritance found in microorganisms, fungi, protists, plants and animals.

## Evaluation

1. Identify five specific foods derived directly from aquatic sources. List their country or region of origin.
2. Identify an aquatic plant or aquatic animal that you can find in a local store and that is also found growing or living in you state.
3. Identify an aquatic product that is used in food production but is not necessarily eaten directly. How is it used?
4. Describe three ways that aquatic habitats are important to humans as sources of food.

## Water We Eating

## Objectives

Students will: 1) identify foods derived from aquatic sources and their geographic origins, and 2) describe the importance of aquatic environments as food sources.

## Overall

Students visit a local supermarket and compile a list of products that originate in aquatic habitats.

## Grade Level: K-4

## Science

Students will demonstrate:

- an increasing ability to recognize patterns and products of evolution, including genetic variation, specialization, adaptation and natural selection.
- an increasing ability to understand how environmental factors affect all living systems (i.e. Individuals, community, biome, the biosphere) as well as species interactions.
- an increasing ability to understand that organisms are linked to one another and to their physical setting by the transfer and transformation of matter and energy to maintain a dynamic equilibrium.

## Social Studies

Students will:

- demonstrate an understanding of the patterns and results of international trade, including distribution of economic resources; imports and exports; specialization; interdependence; exchange of money; and trade policies.

## Evaluation

Identify five specific foods derived directly from aquatic sources. List their country or region of origin.

Identify an aquatic plant or aquatic animal that you can find in a local store and that is also found growing or living in your state.

Identify an aquatic product that is used in food production but is not necessarily eaten directly. How is it used?

Identify an aquatic product that is used in food production but is not necessarily eaten directly. How is it used?

Describe three ways that aquatic habitats are important to humans as sources of food.

## Net Gain, Net Effect

### Objectives

Students will: 1) describe the evolution of fishing techniques; and 2) interpret the changes in technology on fish populations.

### Overall

Students conduct a simulation to explore the evolution of fishing and the effects of changing technology on fish populations.

### Grade Level: 5-8

### Science

Students will demonstrate:

- ❖ an increasing ability to understand that science and technology affects individuals and that individuals in turn can affect science and technology.
- ❖ an increasing ability to recognize patterns and products of evolution, including genetic variation, specialization, adaptation and natural selection.

### Mathematics

Students will

- ❖ develop an understanding of measurement and systems of measurement through experiences which enable them to use a variety of techniques, tools and units of measurement to describe and analyze quantifiable phenomena.
- ❖ use data analysis, statistics and probability to analyze given situations and the outcomes of experiments.
- ❖ recognize patterns and describe and represent relations and functions with tables, graphs, equations and rules, and analyze how a change in one element results in a change in another.

### Evaluation

*For Younger Students*

Draw three pictures showing different ways that fish are caught. Mark the picture that shows the way most fish are caught.

*For Older Students*

Describe how fishing has changed from prehistoric times to the present. How have these changes affected fish populations?

# Watered Down History

## Objectives

Students will: 1) describe human, plant and animal life associated with a waterway over a period of time; 2) predict the future of the waterway; and 3) analyze cause-and effect relationships between events affecting the waterway.

## Overall

Students investigate the history of a chosen waterway through research methods, a taped personal interview and public records, and then display their findings on a mural.

## Grade Level: 5-8

## Social Studies

Students will demonstrate

- ❖ an understanding of physical and human geographic features that define places and regions.
- ❖ an understanding of landform patterns and water systems on Earth's surface; the physical processes that shape these patterns; and the characteristics and distribution of ecosystems.
- ❖ an understanding of the impact of human systems on Earth's surface including characteristics, distribution, and migration of human populations; the nature and complexity of patterns of cultural diffusion; patterns and networks of economic interdependence; processes, patterns, and functions of human settlement; and the forces of cooperation and conflict that shape human geographic divisions.

## Evaluation

1. Write at least two paragraphs describing how a waterway might have changed over a 100-year period of time-for example, from 1865 to 1965. Write another paragraph predicting what might happen between now and the year 2100.
2. Role-play the following scenario: each student is an elected official. Mr. Or Ms. Smith represents a group in favor of building a dam on a river to produce irrigation water and recreation opportunities in your area. Ms. Or Mr. Jones represents another group that thinks the dam will have a damaging effect on the animals and plants in and along the river. Pick on position to support and debate the topic.

# When a Whale is Right

## Objectives

Students will: 1) describe general characteristics and status of whales; 2) recognize that international alliances affect wildlife; and 3) evaluate the possible impact of wildlife issues on alliances and other relationships between and among nations.

## Overall

Students hold a hypothetical meeting of the International Whaling Commission.

## Grade Level: 9-12

## Social Studies

Students will demonstrate:

- ❖ an understanding of the meaning, rights, and responsibilities of citizenship as well as the ability to apply their knowledge of the ideals, principles, organization and operation of American government through the political process and citizen involvement.

## Evaluation

1. List four basic characteristics of two different species of whales.
2. Identify ten countries that are members of the International Whaling Commission. Indicate the countries that are whaling countries and list which species of whales they harvest. Explain how each country uses its harvested whales.
3. What is the purpose of the International Whaling Commission? Describe on action the Commission has taken to achieve its purpose. How are actions of the Commission enforced? What is your assessment of the Commission's importance and effectiveness?
4. Summarize your impressions of the impact of this issue-and other wildlife issues, if possible-on alliances and other relationships between and among nations.

# Sea Turtles International

## Objectives

Students will: 1) analyze the policies and philosophies that countries have relating to wildlife ownership and protection and to habitat management; 2) explain the importance of international agreements and organizations that manage species that cross national boundaries; and 3) define the difference between ownership of land and ownership of wildlife.

## Overall

Students portray the political interactions of citizens from different countries who have a variety of perspectives on the conservation of wildlife and habitat.

## Grade Level: 9-12

## Social Studies

Students will demonstrate:

- ❖ an understanding of the meaning, rights, and responsibilities of citizenship as well as the ability to apply their knowledge of the ideals, principles, organization and operation of American government through the political process and citizen involvement.

## Evaluation

Have students choose a current conflict in the world dealing with the protection of wildlife species and international borders. Have students research the topography; natural features; economic; cultural; and political structures of the countries involved, and what, if anything, is being done internationally or locally to help the migrating wildlife. Students should specifically address how culture, economics and politics of the selected countries determine the fate of wildlife species that cross international borders.

# **Section Three**

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## **Sustaining Fish and Wildlife Resources**

# Water Wings

## Objectives

Students will: 1) illustrate the water cycle; 2) describe the interrelatedness of the world's waters; and 3) state the importance of water to people, plants and animals.

## Overall

Students will visualize a simulated field trip and then create artwork and poetry.

## Grade Level: 5-8

## Science

Students will demonstrate

- ❖ an increasing ability to understand how environmental factors affect all living systems (i.e. Individuals, community, biome, the biosphere) as well as species interactions.
- ❖ an increasing ability to understand that organisms are linked to one another and to their physical setting by the transfer and transformation of matter and energy to maintain a dynamic equilibrium.

## Language Arts

Students will demonstrate

- ❖ competence in using the interactive language processes of reading, writing, speaking, listening, and viewing to gather and organize information in a variety of subject.

## Evaluation

1. Describe the water cycle. Illustrate your description.
2. Describe how all of the earth's water is connected and interrelated.
3. List at least 10 ways that you use water every day.
4. List as many examples as you can of why water is important to plants and animals.
5. Draw a picture showing how one drop of water can connect with a whale, a school and a cactus.

# Puddle Wonders

## Objectives

Students will: 1) predict where puddles will form and how they will change; 2) observe and describe organisms that live in or near puddles; 3) measure and record the amount of water in puddles; and 4) make inferences about what types of organisms occupy puddles.

## Overall

Students will observe water that accumulates in puddles and will measure the depth, area and volume of the puddle.

## Grade Level: 5-8

## Science

Students will demonstrate

- ❖ an increasing ability to use measuring instruments to gather accurate and/or precise information.
- ❖ an increasing ability to understand how environmental factors affect all living systems (i.e. Individuals, community, biome, the biosphere) as well as species interactions.

## Mathematics

Students will

- ❖ compute.

- ❖ develop an understanding of measurement and systems of measurement through experiences which enable them to use a variety of techniques, tools and units of measurement to describe and analyze quantifiable phenomena.

## Evaluation

1. Describe common characteristics of animals that use puddles. Explain the value of puddles to these animals.
2. How would you determine the amount of water in a puddle? Explain your method.

# Riparian Retreat

## Objectives

Students will: 1) describe habitat characteristics of riparian areas; 2) identify animals that inhabit them; and 3) state the importance of riparian areas to wildlife and humans.

## Overall

Awareness of a riparian zone is created through the use of a simulated field trip and art work.

## Grade Level: 5-8

## Science

Students will demonstrate

- ❖ an increasing ability to recognize patterns and products of evolution, including genetic variation, specialization, adaptation and natural selection.
- ❖ an increasing ability to understand how environmental factors affect all living systems (i.e. Individuals, community, biome, the biosphere) as well as species interactions.
- ❖ an increasing ability to understand that organisms are linked to one another and to their physical setting by the transfer and transformation of matter and energy to maintain a dynamic equilibrium.

## Language Arts

Students will demonstrate

- ❖ competence in using the interactive language processes of reading, writing, speaking, listening, and viewing to gather and organize information in a variety of subject.
- ❖ competence in using the interactive language processes of reading, writing, speaking, listening and viewing to communicate effectively.

## Evaluation

1. What is a riparian zone?
2. Identify four animals found in a riparian zone.
3. Why are riparian zones important to wildlife? To humans? Why are riparian zones intrinsically valuable? Write a poem to explain your response.
4. Describe your position on a plan to develop a riparian habitat for recreational use by hikers, birdwatchers and other “low-impact” users. A parking area, restrooms, walkways, garbage removal and other needs must be considered.

# How Wet Is Our Planet?

## Objectives

Students will: 1) describe the amount and distribution of water on the earth in Oceans, rivers, lakes, groundwater, icecaps and the atmosphere; and 2) make inferences about the importance of responsible water use.

## Overall

Students Calculate water volumes using percentages.

## Grade Level: 5-8

## Science

Students will demonstrate

- ❖ an increasing ability to understand how environmental factors affect all living systems (i.e. Individuals, community, biome, the biosphere) as well as species interactions.
- ❖ an increasing ability to understand that the Earth is a complex planet with five interacting systems, which consists of the solid Earth (lithosphere), air (atmosphere), water ( hydrosphere), ice ( cryosphere), and life ( biosphere).
- ❖ an increasing ability to understand that the Earth contains a variety of renewable and nonrenewable resources.

## **Mathematics**

Students will

- ❖ compute.
- ❖ recognize patterns and describe and represent relations and functions with tables, graphs, equations and rules, and analyze how a change in one element results in a change in another.

## **Evaluation**

1. Estimate the percentage of water that is distributed in each of the following areas of our planet: oceans, rivers, freshwater lakes, inland seas and saltwater lakes, groundwater, icecaps and glaciers and the atmosphere.
2. Explain why it is important that humans use water responsibly.

# **Facts and Falsehoods**

## **Objectives**

Students will: 1) develop criteria for evaluating the quality, balance and fairness of a presentation; and 2) evaluate the balance and fairness of presentations designed to represent specific points of view about an environmental topic.

## **Overall**

Students analyze and evaluate print material according to criteria they establish for quality, balance and fairness, and then develop their own presentations using the same criteria.

**Grade Level:** 9-12

## **Science**

Students will demonstrate:

- ❖ an increasing ability to recognize patterns and products of evolution, including genetic variation, specialization, adaptation and natural selection.
- ❖ an increasing ability to understand how environmental factors affect all living systems (i.e. Individuals, community, biome, the biosphere) as well as species interactions.

- ❖ an increasing ability to understand that organisms are linked to one another and to their physical setting by the transfer and transformation of matter and energy to maintain a dynamic equilibrium.
- ❖ an increasing ability to understand fundamental structures, functions, and mechanisms of inheritance found in microorganisms, fungi, protists, plants and animals.

## **Language Arts**

Students will demonstrate:

- ❖ competence in using the interactive language processes of reading, writing, speaking, listening, and viewing to gather and organize information in a variety of subject.
- ❖ competence in using the interactive language processes of reading, writing, speaking, listening and viewing to communicate effectively.

## **Social Studies**

Students will demonstrate:

- ❖ an understanding of the meaning, rights, and responsibilities of citizenship as well as the ability to apply their knowledge of the ideals, principles, organization and operation of American government through the political process and citizen involvement.

## **Evaluation**

1. Select one of the following topics and describe the types of information that could be included in an informal presentation designed for students: recreation area, sewage treatment plant, whaling museum.
2. Why is it, or is it not, important for informational presentations to be accurate, balanced, fair and of quality?
3. The Big City Dam Visitor Center has two informational displays. One display explains how water is taken from the basin and used for irrigation for agriculture and for city water supplies. The second shows property damage from floods before the dam was constructed. What other information, if any, could be provided for visitors?

# Watershed

## Objectives

Students will: 1) describe the characteristics of watersheds; 2) discuss the role of watersheds in providing wildlife habitat as well as human habitats; and 3) give examples of watershed conservation.

## Overall

Students measure the area of a local watershed, calculate the amount of water it receives each year, and discuss the varied roles the watershed plays in human and wildlife habitat.

## Grade Level: 5-8

## Science

Students will demonstrate:

- ❖ an increasing ability to understand how environmental factors affect all living systems (i.e. Individuals, community, biome, the biosphere) as well as species interactions.
- ❖ an increasing ability to understand that the Earth is a complex planet with five

interacting systems, which consists of the solid Earth (lithosphere), air (atmosphere), water (hydrosphere), ice (cryosphere), and life (biosphere).

- ❖ an increasing ability to understand that the Earth contains a variety of renewable and nonrenewable resources.

## **Mathematics**

Students will:

- ❖ develop an understanding of measurement and systems of measurement through experiences which enable them to use a variety of techniques, tools and units of measurement to describe and analyze quantifiable phenomena.
- ❖ know the basic concepts of trigonometry and apply these concepts to real world problems.
- ❖ use data analysis, statistics and probability to analyze given situations and the outcomes of experiments.

## **Social Studies**

Students will demonstrate:

- ❖ an understanding of the connections between Earth's physical and human systems; the consequences of the interaction between human and physical systems; and changes in the meaning, use, distribution and importance of the resources.

## **Evaluation**

1. Describe and draw a watershed.
2. How are wildlife habitats related to watersheds? Why are watersheds important to people? Write a short essay in response to these questions.
3. Develop a plan on how to protect, conserve or restore a watershed.

# What's in the Air

## Objectives

Students will: 1) describe acidic precipitation; 2) generate and test hypotheses concerning effects of acidic precipitation; and 3) make inferences about the potential effects of acidic precipitation on aquatic life.

## Overall

Through simulations and direct measurement the students experience differing conditions acidity in aquatic habitats and explore the consequences of acidic conditions on aquatic life.

**Grade Level:** 5-8

## Science

Students will demonstrate:

- an increasing ability to understand how environmental factors affect all living systems (i.e. Individuals, community, biome, the biosphere) as well as species interactions.
- an increasing ability to understand that the Earth is a complex planet with five interacting systems, which consists of the solid Earth (lithosphere), air

(atmosphere)

- an increasing ability to understand that the Earth contains a variety of renewable and nonrenewable resources.

## **Social Studies**

Students will demonstrate:

- an understanding of the connections between Earth's physical and human systems; the consequences of the interaction between human and physical systems; and changes in the meaning, use, distribution and importance of the resources.

## **Evaluation**

1. What is acidic precipitation? What are some of the causes of acidic precipitation? What are some of the effects of acidic precipitation? Write at least three paragraphs to respond.
2. Indicate true (T) or false (F) for each of the statements:
  - ❖ Acidic precipitation decreases pH.
  - ❖ Acidic precipitation kills some fish populations.
  - ❖ Acidic precipitation increases sulfate in some lakes and streams.
  - ❖ Acidic precipitation increases alkalinity in rivers and lakes.
  - ❖ Acidic precipitation causes toxins, like aluminum, to be released into waters.
3. Predict what might happen to each of the following as a result of acidic precipitation: Plants, fish, soil, cars, building, aquatic insects, aquatic birds and mammals, aquatic habitats, human.

## **Plastic Jellyfish**

## Objectives

Students will: 1) describe the potential effects of plastic waste on aquatic wildlife and habitat; and 2) identify specific actions they can take to help remedy the problem.

## Overall

Students monitor the plastic waste production in their own households, research the effects of plastic waste on freshwater and marine life and propose various ways to lessen the problem.

## Grade Level: K-4

## Science

Students will demonstrate

- ❖ an increasing ability to understand how technology is used to synthesize new products.
- ❖ an increasing ability to understand that science and technology affects individuals and that individuals in turn can affect science and technology.
- ❖ an increasing ability to understand that progress in science and technology is controlled by societal attitudes and beliefs.
- ❖ an increasing ability to recognize patterns and products of evolution, including genetic variation, specialization, adaptation and natural selection.
- ❖ an increasing ability to understand how environmental factors affect all living systems (i.e. Individuals, community, biome, the biosphere) as well as species interactions.

## Social Studies

Students will demonstrate:

- ❖ an understanding of the connections between Earth's physical and human systems; the consequences of the interaction between human and physical systems; and changes in the meaning, use, distribution and importance of the resources.

## Evaluation

1. Give three examples of ways that plastics could enter an aquatic food chain.
2. Describe the effects of plastic waste on aquatic animals.
3. List two things you can do to prevent harm to wildlife from plastic litter.
4. What are two ways that governments or industries can reduce the number of plastic pellets that enter aquatic environments?

# What's in the Water?

## Objectives

Students will 1) identify major sources of aquatic pollution; and 2) make inferences about the potential effects of a variety of aquatic pollutants on wildlife and wildlife habitats.

## Overall

Students analyze the pollutants found in a hypothetical river. They graph the quantities of pollutants and make recommendations about actions that could be taken to improve the habitat.

## Grade Level: 5-8

## Science

Students will demonstrate:

- an increasing ability to understand how environmental factors affect all living systems (i.e. Individuals, community, biome, the biosphere) as well as species interactions.
- an increasing ability to understand that the Earth is a complex planet with five interacting systems, which consists of the solid Earth (lithosphere), air (atmosphere)
- an increasing ability to understand that the Earth contains a variety of renewable and nonrenewable resources.

## Social Studies

Students will demonstrate:

- an understanding of the connections between Earth's physical and human systems; the consequences of the interaction between human and physical systems; and changes in the meaning, use, distribution and importance of the resources.

## Evaluation

1. Describe the effects that large quantities of the following things might have on an aquatic environment. Consider short-term and long-term effects of hot water, fertilizer, soil (silt), heavy metals, etc.
2. Water is taken from a river, treated, used by people of a community, sent to a city sewage treatment plant and put back into the river. Is this aquatic pollution? Defend your response.

# Something's Fishy Here

## Objectives

Students will: 1) identify potential cause-and-effect relationships involving aquatic-related pollution; 2) generate and evaluate alternative solutions to problems of aquatic pollution; and 3) outline a plan to reduce the consequences of possible aquatic pollution in their communities.

## Overall

Students read and discuss a story, inventing their own endings that lead to environmental action in their community.

## Grade Level: 5-8

## Science

Students will demonstrate:

- ❖ an increasing ability to understand how environmental factors affect all living systems (i.e. Individuals, community, biome, the biosphere) as well as species interactions.

## Language Arts

Students will demonstrate:

- ❖ competence in using the interactive language processes of reading, writing, speaking, listening, and viewing to gather and organize information in a variety of subject.
- ❖ competence in using the interactive language processes of reading, writing, speaking, listening and viewing to communicate effectively.

- ❖ competence in applying the interactive language processes of reading, writing, speaking, listening and viewing to succeed in educational, occupational, civic, social and everyday settings.

## **Social Studies**

Students will demonstrate:

- ❖ an understanding of the meaning, rights, and responsibilities of citizenship as well as the ability to apply their knowledge of the ideals, principles, organization and operation of American government through the political process and citizen involvement.

## **Evaluation**

1. Identify potential types of aquatic pollution in the students' community. Identify the pollution source. Describe some of the issues associated with pollution.
2. Water is taken from a river, treated, used by people of community, sent to a city sewage treatment plant and put back into the river. Is this aquatic pollution? Defend your response.
3. Sam Smith and Jill Jones each caught their fishing line on a dead tree in a stream. They couldn't get their line loose, so they cut off about 15 feet of line. Is this aquatic pollution? Defend your response.

# The Glass Menagerie

## Objectives

Students will describe the characteristics of oligotrophic and eutrophic aquatic habitats, emphasizing the effects of nutrient loading.

## Overall

Students observe and describe changes in physical characteristics of several different experimental aquatic habitats that they create.

**Grade Level:** 9-12

## Science

Students will demonstrate:

- ❖ an increasing ability to understand how environmental factors affect all living systems (i.e. Individuals, community, biome, the biosphere) as well as species interactions.
- ❖ an increasing ability to understand that organisms are linked to one another and to their physical setting by the transfer and transformation of matter and energy to maintain a dynamic equilibrium.

## Evaluation

Code each of the following as a characteristic of eutrophic lakes (E), oligotrophic lakes (O), both kinds of lakes (B), or neither type of lakes (N) by writing one letter beside each statement.

\_\_\_ Deep, greater than 60 feet (18 meters).

- \_\_\_ Have many species of plankton (both zooplankton and phytoplankton), but low number of each species.
- \_\_\_ High transparency (can see a long way down into the water).
- \_\_\_ Large number of fish that many people consider desirable.
- \_\_\_ Large amount of decaying organic matter.
- \_\_\_ Little oxygen available.
- \_\_\_ Large amount of algae.
- \_\_\_ Taste and odor problems.
- \_\_\_ Bacteria mostly aerobic (oxygen using).
- \_\_\_ A result of natural or human-caused erosion.
- \_\_\_ High total productivity.
- \_\_\_ Few plant nutrients (nitrates, phosphates, manure).
- \_\_\_ Considered an old lake, in terms of succession.
- \_\_\_ High rate of nutrient cycling.

# Water's Going On?

## Objectives

Students will: 1) record and interpret daily water consumption; and 2) make recommendations as to how to conserve water.

## Overall

Students estimate and calculate water consumption and then design and try ways to conserve water.

## Grade Level: 5-8

### Science

Students will demonstrate:

- ❖ an increasing ability to understand how environmental factors affect all living systems (i.e. Individuals, community, biome, the biosphere) as well as species interactions.

### Mathematics

Students will

- ❖ compute.
- ❖ develop an understanding of measurement and systems of measurement through experiences which enable them to use a variety of techniques, tools and units of measurement to describe and analyze quantifiable phenomena

### Social Studies

Students will demonstrate:

- ❖ an understanding of the meaning, rights, and responsibilities of citizenship as well as the ability to apply their knowledge of the ideals, principles, organization

and operation of American government through the political process and citizen involvement.

## **Evaluation**

1. Estimate the number of gallons of water you personally use each day. Divide that usage into major categories. Present the data portraying your water use in the form of a graph.
2. What daily activity requires the most water per year?
3. Describe and explain three ways you can decrease your water consumption.
4. How do water conservation efforts effect people and wildlife now, and in the future?

# **Alice In Waterland**

## **Objectives**

Students will: 1) trace domestic water to its source prior to human use and to its destination after use; 2) identify potential effects from human water use on terrestrial and aquatic wildlife; and 3) develop and practice responsible water conservation behaviors.

## **Overall**

Students use a simulated field trip, lecture-discussion and student-gathered data to explore water use and its effects on wildlife habitat.

## **Grade Level:** 5-8

### **Science**

Students will demonstrate:

- ❖ an increasing ability to analyze, synthesize and communicate scientific information using technology
- ❖ an increasing ability to understand how environmental factors affect all living systems (i.e. Individuals, community, biome, the biosphere) as well as species interactions.
- ❖ an increasing ability to understand that the Earth is a complex planet with five interacting systems, which consists of the solid Earth (lithosphere), air (atmosphere), water ( hydrosphere), ice ( cryosphere), and life ( biosphere).
- ❖ an increasing ability to understand that the Earth contains a variety of renewable and nonrenewable resources.

### **Mathematics**

Students will:

- ❖ use problem solving strategies to investigate and understand increasingly complex mathematical content.

### **Evaluation**

1. Draw and label a flow chart tracing water in your community from where it comes—to your home—to where it goes after it leaves your home.
2. Estimate the number of gallons of water you use each day for personal use. What do you do that uses the greatest amount of water in a year?
3. Name three ways you might conserve water. How much water could you conserve using each method for a year? How might wildlife be affected by your water conservation actions? How might plants be affected?
4. Rank the following water uses from those that use the most water to those that use the least in the United States: domestic, industrial, agricultural/irrigation, recreational (1=most).
5. What effect, if any, does human water consumption have on animals that live on the land? What effect, if any, does human water use have on animals that live in or around water?
6. Give examples of ways that water quality can be negatively affected by human consumption. Give examples of actions people can take to protect the quality of water.

# **Turtle Hurdles**

## **Objectives**

Students will: 1) describe the life cycle of sea turtles; 2) identify specific mortality factors related to sea turtles; 3) make inferences about the effects of limiting factors on sea turtle populations; and 4) make recommendations to minimize the factors that might lead to the extinction of sea turtles.

## **Overall**

Students become sea turtles and limiting factors in a highly active simulation game.

**Grade Level:** 5-8

## **Science**

Students will demonstrate:

- ❖ an increasing ability to recognize patterns and products of evolution, including genetic variation, specialization, adaptation and natural selection.
- ❖ an increasing ability to understand how environmental factors affect all living systems (i.e. Individuals, community, biome, the biosphere) as well as species interactions.

## **Social Studies**

Students will demonstrate:

- ❖ an understanding of the connections between Earth's physical and human systems; the consequences of the interaction between human and physical systems; and changes in the meaning, use, distribution and importance of the resources.

## **Evaluation**

1. Describe and illustrated the major states of sea turtles' life cycle, beginning with the egg.
2. Name at least four limiting factors that prevent sea turtles from reaching the adult breeding stage.
3. Write a law that would help protect sea turtles. What would the law include? Who would enforce it?

# **Aquatic Roots**

## **Objectives**

Students will: 1) trace the origins of various species of local aquatic animals and/or aquatic plants; 2) categorize them into native and exotic species; and 3) evaluate the appropriateness of introducing new species.

## Overall

Students use reference materials to research various local aquatic plants and/or animals to find out whether they are natives or exotics and to investigate their impacts on people, other animals and the environment.

## Grade Level: 5-8

## Science

Students will demonstrate:

- ❖ an increasing ability to recognize patterns and products of evolution, including genetic variation, specialization, adaptation and natural selection.
- ❖ an increasing ability to understand how environmental factors affect all living systems (i.e. Individuals, community, biome, the biosphere) as well as species interactions.
- ❖ an increasing ability to understand fundamental structures, functions, and mechanisms of inheritance found in microorganisms, fungi, protists, plants and animals.

## Social Studies

Students will demonstrate:

- ❖ an understanding of the impact of human systems on Earth's surface including characteristics, distribution, and migration of human populations; the nature and complexity of patterns of cultural diffusion; patterns and networks of economic interdependence; processes, patterns, and functions of human settlement; and the forces of cooperation and conflict that shape human geographic divisions.

## Evaluation

1. Identify three native aquatic plants and animals in your area. Identify three exotic aquatic plants and animals that exist in your area.
2. Give four reasons why an aquatic plant or animal might be introduced in an area. Are these reasons appropriate? Why or why not?
3. A local organization has proposed that a new fish be introduced into a state's rivers or lakes. List at least five questions that could be answered about the fish and its impact on the state's watercourses before the proposal is approved or rejected.

# Where Have all The Salmon Gone?

## Objectives

Students will: 1) interpret and make inferences about fluctuations in fish populations from actual data; and 2) analyze the effects of human use and habitat changes on a fish population.

## Overall

Students graph and interpret actual fish population data in relation to historical events.

## Grade Level: 5-8

## Science

Students will demonstrate:

- ❖ an increasing ability to understand that science and technology affects individuals and that individuals in turn can affect science and technology.
- ❖ an increasing ability to recognize patterns and products of evolution, including genetic variation, specialization, adaptation and natural selection.

## Mathematics

Students will

- ❖ develop an understanding of measurement and systems of measurement through experiences which enable them to use a variety of techniques, tools and units of measurement to describe and analyze quantifiable phenomena.
- ❖ use data analysis, statistics and probability to analyze given situations and the outcomes of experiments.
- ❖ recognize patterns and describe and represent relations and functions with tables, graphs, equations and rules, and analyze how a change in one element results in a change in another.

## Evaluation

Study the graph below to answer these questions:

- ❖ Which fish population appears to be the most stable?
- ❖ Fish #3 appears to be a prey species for which fish?
- ❖ What would think is the primary diet of Fish #1? Fish#2? Fish #3? Why?
- ❖ What natural and human events may have accounted for the decrease in Fish #2's size between year two and four, and between years 16 and 18?
- ❖ What effect did the introduction of Fish #4 appear to have on the other fish species?
- ❖ What actions might the state fish agency have taken to maintain the populations of Fish #2?
- ❖ What natural and human events may have caused all the fish species to die in year 20?

# To Dam Or Not To Dam

## **Objectives**

Students will evaluate potential positive and negative effects from constructing a dam on a river.

## **Overall**

Students portray individuals representing differing perspectives and concerns related to a complex issue.

## **Grade Level:** 5-8

## **Science**

Students will demonstrate:

- ❖ an increasing ability to understand that progress in science and technology is controlled by societal attitudes and beliefs.
- ❖ an increasing ability to understand how environmental factors affect all living systems (i.e. Individuals, community, biome, the biosphere) as well as species interactions.

## **Social Studies**

Students will demonstrate:

- ❖ an understanding of the meaning, rights, and responsibilities of citizenship as well as the ability to apply their knowledge of the ideals, principles, organization and operation of American government through the political process and citizen involvement.

## **Evaluation**

1. If a dam were constructed on a river, what would be the benefits to wildlife?
2. If a dam were constructed on a river, what would be the challenges to wildlife?

# **Aquatic Times**

## **Objectives**

Students will: 1) identify a diversity of issues related to aquatic organisms and habitats: and 2) develop their own opinions concerning some issues involving aquatic life and habitats.

## **Overall**

Students investigate, write and produce a newspaper that features aquatic information and issues.

**Grade Level:** 5-8

## **Language Arts**

Students will demonstrate:

- ❖ competence in using the interactive language processes of reading, writing, speaking, listening, and viewing to gather and organize information in a variety of subject.
- ❖ competence in using the interactive language processes of reading, writing, speaking, listening and viewing to communicate effectively.
- ❖ competence in applying the interactive language processes of reading, writing, speaking, listening and viewing to succeed in educational, occupational, civic, social and everyday settings.

## **Evaluation**

1. Identify three issues involving aquatic animals, aquatic plants or aquatic habitats.
2. Explain why it is important accurately report environmental information to others.
3. What are the characteristics of a good environmental reporter?

# **Silt: A Dirty Word**

## **Objectives**

Students will: 1) describe how sand and/or silt affects water flow; and 2) identify human activities that add sand and/or silt to surface water.

## **Overall**

Students create a model to simulate changes to a stream and its water flow when silt and/or sand are added to the system.

## **Grade Level:** 3-4

## **Science**

Students will demonstrate:

- ❖ an increasing ability to understand how environmental factors affect all living systems (i.e. Individuals, community, biome, the biosphere) as well as species interactions

## **Evaluation**

1. Write on a chart or blackboard all the observations and ideas generated by the students; engage them in a discussion about the meaning of these results.
2. Ask each group to create two illustrations:
  - 1) a healthy stream that could support a variety of aquatic life; and 2) a human activity that causes siltation in that stream.

\* Adapted from "Wild About Salmon, An Educators Guide", Idaho Department of Fish and Game, 1999.

# Dam Design

## Objectives

Students will: 1) identify problems experienced by salmon in migration; 2) evaluate the social, political, economic and ethical consequences of an environmental concern; 3) identify mitigation projects that have worked and those that have not; and 4) identify and propose strategies and technologies to address an environmental concern.

## Overall

Students will design and draw a dam appropriate for salmon survival.

## Grade Level: 9-12

## Evaluation

1. Each presentation needs to include a diagram/model of the dam and its migration features.
2. Encourage students to question the design and conclusions of each group, and remind them that constructive criticism demonstrates understanding of the problems.

\* Adapted from "Wild About Salmon, An Educators Guide", Idaho Department of Fish and Game, 1999.

# Kelp Help

## Objectives

Students will list and describe different ways that kelp can be beneficial to humans, wildlife and the environment.

## Overall

Students research kelp, create a mural and report to the class about their findings.

## Grade Level: 5-8

## Science

Students will demonstrate:

- ❖ an increasing ability to understand how environmental factors affect all living systems (i.e. Individuals, community, biome, the biosphere) as well as species interactions.
- ❖ an increasing ability to understand that organisms are linked to one another and to their physical setting by the transfer and transformation of matter and energy to maintain a dynamic equilibrium.
- ❖ an increasing ability to understand fundamental structures, functions, and mechanisms of inheritance found in microorganisms, fungi, protists, plants and animals.

## Language Arts

Students will

- ❖ demonstrate the interest and ability to write effectively for a variety of purposes and audiences.
- ❖ competence in using the interactive language processes of reading, writing, speaking, listening, and viewing to gather and organize information in a variety of subject.
- ❖ competence in using the interactive language processes of reading, writing, speaking, listening and viewing to communicate effectively.

## Evaluation

1. What is kelp? Write a paragraph and draw a picture to illustrate your response.
2. Describe two ways that kelp is helpful to each of the following: humans, wildlife, aquatic habitats.

# Dragonfly Pond

## Objectives

Students will: 1) evaluate the effects of different kinds of land use on wetland habitats; and 2) discuss and evaluate lifestyle changes to minimize damaging effects on wetlands.

## Overall

Students create a collage of human land use activities around an image of a pond.

## Grade Level: 5-8

## Science

Students will demonstrate:

- ❖ an increasing ability to understand how environmental factors affect all living systems (i.e. Individuals, community, biome, the biosphere) as well as species interactions.
- ❖ an increasing ability to understand that the Earth is a complex planet with five interacting systems, which consists of the solid Earth (lithosphere), air (atmosphere), water ( hydrosphere), ice ( cryosphere), and life ( biosphere).
- ❖ an increasing ability to understand that the Earth contains a variety of renewable and nonrenewable resources.

## Social Studies

Students will demonstrate:

- ❖ an understanding of the connections between Earth's physical and human systems; the consequences of the interaction between human and physical systems; and changes in the meaning, use, distribution and importance of the resources.

## Evaluation

1. Identify three actions that people can take to reduce or prevent damage to wetlands.
2. Under what conditions, if any, do you think these actions to reduce damage to wetlands would be appropriate? Inappropriate? Select any action that you personally think would be appropriate and that you could take to reduce or prevent damage to wetlands. Write a one-page paper on your plan.

# Living Research: Aquatic Heroes and Heroines

## Objectives

Students will describe the importance of the accomplishments of local people who have contributed to conserving or preserving aquatic environments.

## Overall

Students identify people—through news media, personal contacts or other means—who have made contributions to conserving or preserving aquatic environments; research their contribution, including a personal interview; and then write a biography of the person.

## Grade Level: 9-12

## Social Studies

Students will demonstrate:

- ❖ an understanding of the meaning, rights, and responsibilities of citizenship as well as the ability to apply their knowledge of the ideals, principles, organization and operation of American government through the political process and citizen involvement.

## Language Arts

Students will demonstrate:

- ❖ competence in using the interactive language processes of reading, writing, speaking, listening, and viewing to gather and organize information in a variety of subject.
- ❖ competence in using the interactive language processes of reading, writing, speaking, listening and viewing to communicate effectively.
- ❖ competence in applying the interactive language processes of reading, writing, speaking, listening and viewing to succeed in educational, occupational, civic, social and everyday settings.

## Evaluation

1. Identify two people who have helped protect a local aquatic area and describe what each did. Why are their actions important?
2. What can you do—working alone or with others—to conserve or protect an area of aquatic habitat in your community?

# Water We Eating?

## Science

Students will demonstrate:

- an increasing ability to recognize patterns and products of evolution, including genetic variation, specialization, adaptation and natural selection.
- an increasing ability to understand how environmental factors affect all living systems (i.e. Individuals, community, biome, the biosphere) as well as species interactions.
- an increasing ability to understand that organisms are linked to one another and to their physical setting by the transfer and transformation of matter and energy to maintain a dynamic equilibrium.

## Social Studies

Students will:

- demonstrate an understanding of the patterns and results of international trade, including distribution of economic resources; imports and exports; specialization; interdependence; exchange of money; and trade policies.

# **NH Science Curriculum Framework**

**1 a; (Science as Inquiry)**

**Students will demonstrate an increasing understanding of how the scientific enterprise operates.**

Designing A Habitat

**2a; (Science and Technology)**

**Students will demonstrate an increasing ability to use measuring instruments to gather accurate and/or precise information.**

Puddle Wonders

Water Canaries

Where Does Water Run Off After School

Micro Odyssey

**2 b;(Science and Technology)**

**Students will demonstrate an increasing ability to use technology to observe nature.**

Water Canaries

The Edge of Home

Micro Odyssey

**2 c; (Science and Technology)**

**Students will demonstrate an increasing ability to analyze, synthesize and communicate scientific information using technology**

Alice in Waterland

**2 d; (Science and Technology)**

**Students will demonstrate an increasing ability to understand how technology is used to synthesize new products.**

Plastic Jellyfish

**2 e;( Science and Technology)**

**Students will demonstrate an increasing ability to understand that science and technology affects individuals and that individuals in turn can affect science and technology.**

Net Gain, Net Effect

Where Have All the Salmon Gone

Plastic Jellyfish

**2f; (Science and Technology)**

**Students will demonstrate an increasing ability to understand that progress in science and technology is controlled by societal attitudes and beliefs.**

To Dam or Not To Dam  
Plastic Jellyfish

### **3a;( Life Science)**

**Students will demonstrate an increasing ability to recognize patterns and products of evolution, including genetic variation, specialization, adaptation and natural selection.**

Water Plant Art  
Are You Me?  
Designing A Habitat  
Whale of A Tail  
Riparian Retreat  
Water Canaries  
Mermaids and Manatees  
Wetland Metaphors  
Marsh Munchers  
Micro Odyssey  
Hooks and Ladders  
Migration Headache  
Aquatic Roots  
Net Gain, Net Effect  
Where Have All the Salmon Gone?  
Water We Eating?  
Facts and Falsehoods  
Turtle Hurdles  
Plastic Jellyfish  
Pond Succession  
Eat and Glow

### **3b;(Life Science)**

**Students will demonstrate an increasing ability to understand how environmental factors affect all living systems (i.e. Individuals, community, biome, the biosphere) as well as species interactions.**

Aqua Words  
Water Wings  
How Wet Is Our Planet?  
Water Plant Art  
Are You Me?  
Designing A Habitat  
Puddle Wonders  
Riparian Retreat  
Water Canaries  
Mermaids and Manatees  
Kelp Help  
Wetland Metaphors

Marsh Munchers  
Micro Odyssey  
The Edge of Home  
Blue Ribbon Niche  
Hooks and Ladders  
Fishy Who's Who  
Fashion a Fish  
Aquatic Roots  
Water We Eating?  
The Glass Menagerie  
To Dam or Not To Dam  
Facts and Falsehoods  
What 's in the Air?  
What's in the Water?  
Dragonfly Pond  
Turtle Hurdles  
Plastic Jellyfish  
Watershed  
Something's Fishy Here  
Alice In Waterland  
Silt: A Dirty Word  
Sockeye Scents  
Pond Succession  
Eat and Glow

### **3c;( Life Science)**

**Students will demonstrate an increasing ability to understand that organisms are linked to one another and to their physical setting by the transfer and transformation of matter and energy to maintain a dynamic equilibrium.**

Water Wings  
Water Plant Art  
Designing A Habitat  
Riparian Retreat  
Water Canaries  
Mermaids and Manatees  
Kelp Help  
Micro Odyssey  
The Edge of Home  
Blue Ribbon Niche  
Hooks and Ladders  
Water We Eating?  
The Glass Menagerie  
Facts and Falsehoods

### **3d;(Life Science)**

**Students will demonstrate an increasing ability to understand fundamental structures, functions, and mechanisms of inheritance found in microorganisms, fungi, protists, plants and animals.**

Whale of a Tail  
Water Canaries  
Mermaids and Manatees  
Kelp Help  
Blue Ribbon Niche  
Hooks and Ladders  
Fishy Who's Who  
Fashion A Fish  
Aquatic Roots  
Facts and Falsehoods  
Pond Succession  
Eat and Glow

### **4a;(Earth/Space Science)**

**Students will demonstrate an increasing ability to understand that the Earth is a unique member of our solar system, located in the galaxy, within the universe.**

No correlation

### **4b; (Earth/Space Science)**

**Students will demonstrate an increasing ability to understand that the Earth is a complex planet with five interacting systems, which consists of the solid Earth (lithosphere), air (atmosphere), water ( hydrosphere), ice ( cryosphere), and life ( biosphere).**

How Wet Is Our Planet?  
Deadly Skies  
Deadly Waters  
Dragonfly Pond  
Watershed  
Alice in Waterland

### **4c;(Earth/Space Science)**

**Students will demonstrate an increasing ability to understand that the Earth contains a variety of renewable and nonrenewable resources.**

How Wet Is Our Planet?  
Where Does Water Run Off After School?  
What's in the Air?  
What's in the Water?

Dragonfly Pond  
Watershed  
Alice in Waterland

**5a;(Physical Science)**

**Students will demonstrate an increasing ability to distinguish among materials by utilizing observable properties.**

No Correlation

**5b;(Physical Science)**

**Students will demonstrate an increasing ability to understand that matter is composed of dynamic interactive units or particles, that all the properties and changes in matter can be explained in terms of the forces involved in the interactions of these units, and that mass is conserved in these changes and interactions.**

No Correlation

**5c; (Physical Science)**

**Students will demonstrate an increasing ability to understand the relationships among different types and forms of energy.**

No Correlation

**5d;(Physical Science)**

**Students will demonstrate an increasing understanding of how electrical and magnetic systems interact with matter and energy.**

No Correlation

**5e; (Physical Science)**

**Students will demonstrate an increasing understanding of how an unbalanced force exerted on an object causes a change in the state of rest or motion of that object in the direction of the unbalanced force.**

No Correlation

**5f;(Physical Science)**

**Students will demonstrate an increasing understanding that energy can be transmitted by waves, using light and sound as examples.**

No Correlation

**5g; (Physical Science)**

**Students will demonstrate an increasing understanding that heat is the product of many natural processes.**

No Correlation

**6a;**

**Students will demonstrate an increasing ability to recognize parts of any object or system and understand how the parts interrelate in the operation of that object or system.**

No Correlation

**6b;**

**Students will demonstrate their understanding of the meaning of stability and change and will be able to identify and explain change in terms of cause and effect.**

No Correlation

**6c;**

**Students will understand the meaning of models, their appropriate use and limitations, and how models can help them in understanding the natural world.**

No Correlation

**6d;**

**Students will increasingly quantify their interactions with phenomena in the natural world, use these results to understand differences of scale in objects and systems and determine how changes in scale affect various properties of these objects and systems.**

No Correlation

# NH English Language Arts Curriculum Frameworks

**1. Students will demonstrate the interest and ability to read age-appropriate materials fluently, with understanding and appreciation.**

No Correlation

**2. Students will demonstrate the interest and ability to write effectively for a variety of purposes and audiences.**

Aqua Words  
Kelp Help

**3. Students will demonstrate the interest and ability to speak purposefully and articulately, as well as listen and view attentively and critically.**

No Correlation

**4. Students will demonstrate competence in understanding, appreciating, interpreting and critically analyzing classical and contemporary American and British literature as well as literary works translated into English.**

No Correlation

**5. Students will demonstrate competence in using the interactive language processes of reading, writing, speaking, listening, and viewing to gather and organize information in a variety of subject.**

Wetland Metaphors  
Migration Headache  
Aquatic Times  
Living Research: Aquatic Heroes and Heroines  
Water Wings  
Designing A Habitat  
Riparian Retreat  
Something's Fishy Here  
Whale of a Tail  
Kelp Help  
Fishy Who's Who  
Facts and Falsehoods

**6. Students will demonstrate competence in using the interactive language processes of reading, writing, speaking, listening and viewing to communicate effectively.**

Wetland Metaphors  
Migration Headache  
Aquatic Times  
Living Research: Aquatic Heroes and Heroines  
Designing A Habitat  
Something's Fishy Here  
Riparian Retreat  
Whale of a Tail  
Kelp Help  
Blue Ribbon Niche  
Facts and Falsehoods

**7. Students will demonstrate competence in applying the interactive language processes of reading, writing, speaking, listening and viewing to succeed in educational, occupational, civic, social and everyday settings.**

Aquatic Times  
Living Research: Aquatic Heroes and Heroines  
Something's Fishy Here

# NH Mathematics Curriculum Frameworks

**1a; Students will use problem solving strategies to investigate and understand increasingly complex mathematical content.**

Alice in Waterland

**1b; Students will use mathematical reasoning.**

No correlation

**2a; Students will communicate their understanding of mathematics.**

No correlation

**2b; Students will recognize, develop, and explore mathematical connections.**

Where Does Water Run Off After School

**3a; Students will develop number sense and an understanding of our numeration system.**

No correlation

**3b; Students will understand the concepts of number operations.**

No correlation

**3c; Students will compute.**

Whale of A Tail  
Puddle Wonders  
How Wet Is Our Planet?  
Where Does Water Run Off After School

**3d; Students will use mental computation and estimation skills and strategies and know when it is appropriate to do so.**

Whale of A Tail

**4a; Students will name, describe, model, classify and compare geometric shapes and their properties with an emphasis on their wide applicability in human activity.**

No correlation

**4b; Students will develop spatial sense.**

No correlation

**4 c; Students will develop an understanding of measurement and systems of measurement through experiences which enable them to use a variety of techniques, tools and units of measurement to describe and analyze quantifiable phenomena.**

Puddle Wonders  
Net Gain, Net Effect  
Where Have All The Salmon Gone?  
Where Does Water Run Off After School  
Watersheds  
Whale of A Tail

**4d; Students will know the basic concepts of trigonometry and apply these concepts to real world problems.**

Watersheds

**5a; Students will use data analysis, statistics and probability to analyze given situations and the outcomes of experiments.**

Net Gain, Net Effect  
Where Have All The Salmon Gone?  
Watersheds

**6a; Students will recognize patterns and describe and represent relations and functions with tables, graphs, equations and rules, and analyze how a change in one element results in a change in another.**

Net Gain, Net Effect  
Where Have All The Salmon Gone?  
How Wet Is Our Planet?  
Migration Headache

**6b; Students will use algebraic concepts and processes to represent situations that involve variable quantities with expressions, equations, inequalities, matrices and graphs.**

Where Does Water Run Off After School

**7a; Students will be able to use concepts about mathematical change in analyzing patterns, graphs and applied situations.**

No correlation

**8a; Students will use a variety of tools from discrete mathematics to explore and model real-world situations.**

No correlation

## **NH Social Studies Curriculum Frameworks**

**1; Students will demonstrate an understanding of the purpose of government and how government is established and organized.**

No correlation

**2; Students will demonstrate an understanding of the fundamental ideals and principles of American democracy; the major provisions of the United States and New Hampshire Constitutions; and the organization and operation of government at all levels including the legislative, executive and judicial branches.**

No correlation

**3; Students will demonstrate an understanding of the relationship of the United States to other nations and the role of the United States in world affairs.**

No correlation

**4; Students will demonstrate an understanding of the meaning, rights, and responsibilities of citizenship as well as the ability to apply their knowledge of the ideals, principles, organization and operation of American government through the political process and citizen involvement.**

To Dam or Not To Dam  
Living Research: Aquatic Heroes and Heroines  
Something's Fishy Here  
Facts and Falsehoods  
When A Whale is Right  
Sea Turtle International

**5; Students will demonstrate the ability to analyze the potential costs and benefits of economic choices in market economies including want and needs; scarcity; tradeoffs; and the role of supply and demand, incentives, and prices.**

No correlation

**6; Students will demonstrate the ability to examine the interaction of individuals, households, communities, businesses, and governments in market economies including competition; specialization; productivity; traditional forms of enterprise; and the role of money and financial institutions.**

No correlation

**7; Students will demonstrate an understanding of different types of economic systems, their advantages and disadvantages, and how the economic systems used in particular countries may change over time.**

No correlation

**8; Students will demonstrate an understanding of the patterns and results of international trade, including distribution of economic resources; imports and exports; specialization; interdependence; exchange of money; and trade policies.**

Water We Eating?

**9; Students will demonstrate the ability and willingness to apply economic concepts in the examination and resolution of problems and issues in educational, occupational, civic and everyday settings.**

No correlation

**10; Students will demonstrate the ability to use maps, mental maps, globes and other graphic tools and technologies to acquire, process, report and analyze geographic information.**

No correlation

**11; Students will demonstrate an understanding of physical and human geographic features that define places and regions.**

Water Down History

**12; Students will demonstrate an understanding of landform patterns and water systems on Earth's surface; the physical processes that shape these patterns; and the characteristics and distribution of ecosystems.**

Water Down History

**13; Students will demonstrate an understanding of the impact of human systems on Earth's surface including characteristics, distribution, and migration of human populations; the nature and complexity of patterns of cultural diffusion; patterns and networks of economic interdependence; processes, patterns, and functions of human settlement; and the forces of cooperation and conflict that shape human geographic divisions.**

Aquatic Roots

Water Down History

**14; Students will demonstrate an understanding of the connections between Earth's physical and human systems; the consequences of the interaction between human and physical systems; and changes in the meaning, use, distribution and importance of the resources.**

To Dam or Not to Dam

Plastic Jellyfish

Hooks and Ladders

What's in the Air?

What's in the Water?

Dragonfly Pond

Watershed

Migration Headache

**15; Students will demonstrate the ability to apply their knowledge of geographic concepts, skills, and technology to interpret the past and present and to plan for the future.**

No correlation

**16; Students will demonstrate the ability to employ historical analysis, interpretation, and comprehension to make reasoned judgements and to gain an understanding, perspective and appreciation of history and its uses in contemporary situations.**

No correlation

**17; Students will demonstrate a knowledge of the chronology and significance of the unfolding story of America including the history of their community, New Hampshire and the United States.**

No correlation

**18; Students will demonstrate a knowledge of the chronology and significant developments of world history including the study of ancient, medieval and modern Europe (Western civilization) with particular emphasis on those developments that have shaped the experience of the entire globe over the last 500 years and those ideas, institutions and cultural legacies that have directly influenced American thought, culture and politics.**

No correlation