	Unsatisfactory 1	Needs Improvement 2	Satisfactory 3	Exemplary 4	Score
Map Maker	Did not make attempt to follow map directions	Filled out half of the map directions	Filled out most of the map directions- missed only 1 section	Completed the map directions	
Understanding of Material	Did not demonstrate understanding of material	Limited understanding demonstrated	Demonstrated understanding of material	Added extra evidence to show understanding of material	
Grammar/ Punctuation	More than 8 errors	4-8 errors	1-3 errors	No errors	
Final Question	Did not demonstrate understanding of material	Limited understanding demonstrated	Demonstrated understanding of material	Added extra evidence to show understanding of material	
Score					

Alternative: Students who have access to the Internet at home may be assigned this for homework. Go through the steps in class prior to making the assignment so students know what to do. You may want to make copies of the numbered instructions and the ecosystem services key for their reference. If you take this alternative, have students print their maps at home. Hold a class discussion the following day and have students share their maps and their paragraphs.

Reflection Section Answer Guide

Toad-ally Awesome!

Introduction

What was the question the scientists wanted to answer? *How does flooding affect the reproduction of toads in the forests along the Rio Grande?*

How do you think flooding affects the reproduction of toads? *This is an individual question and students should back up their opinions with logic, evidence, and reason.*

Method

Why did the scientists also measure the amount of rainfall and the amount of water flow at each of the sites? *The scientists needed to measure these things because the amount of rainfall and the amount of water flow help the scientists determine whether the area flooded or not.*

Why do you think the scientists conducted their experiment from June through September of each year? *This is an individual question. Possible answers*

would be because it is reproduction season, rain season, and snow melt.

Findings

Look at figure 6. Do you think flooding affected the reproduction of toads? Why or why not? *It appears that flooding does affect the toad population because the scientists captured many more toads where there was flooding.*

What other living things do you think might be affected by flooding? Why? *This is an individual question. Possible answers include other amphibians and their reproduction cycles, insects, plants, and predator/prey relationships.*

Discussion

Do you think it would be a good idea to purposely flood the bosque periodically? Why or why not? *Yes, because small floods could be safely managed to protect both the people and the toad populations.*

Would people benefit from flooding that would enable the toads to reproduce? Why or why not? *This is an individual question and students should back up their opinions with logic, evidence, and reason.*

What Goes Around Comes Around

Introduction

What would happen to the Carolina bays if the directional model were correct? What would happen if the cyclical model were correct? *According to the directional model, the aquatic ecosystem might change into a marsh and then into a swamp (a forested wetland) because of prolonged drought that alters the vegetation to resemble more of a forested wetland than an aquatic wetland. According to the cyclical model, the bays always return to their aquatic ecosystem.*

What question did the scientists ask? *After a period of prolonged drought, do Carolina bays become more forested or do they always return to their aquatic ecosystem?*

Method

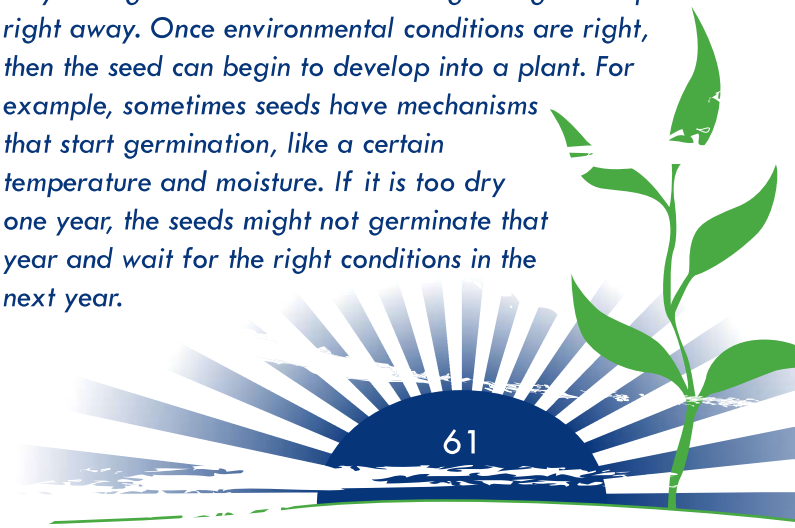
How do you think changes in rainfall affected the aquatic plants, marsh plants, and woody plants around the wetland? *Students may have different answers, which are encouraged as long as they can back up their answer with logic and evidence. Depending on which vegetation type the student focuses on, the amount of rainfall influences which plant can survive. If a lot of rain has fallen, then the bay should contain a lot of water that would encourage aquatic plants to grow, etc.*

An ecosystem is a very fragile system. When something disrupts the balance, the ecosystem may take years to recover. Do you think rainfall only affects vegetation in the current year or can rainfall affect how vegetation grows the next year? Explain. *Students may have different answers which are encouraged as long as they can back up their answer with logic and evidence. The scientists found that it can take more than a year for the bays' water levels to recover from a drought period. This means that vegetation patterns also take a while to change. The amount of water available will determine which plants grow in an area.*

Findings

How is the pattern of a person's development similar to or different from a Carolina bay? *Carolina bays are cyclical and people change in a directional pattern. Carolina bays can change back and forth from dry vegetation patterns, margin vegetation patterns, and aquatic vegetation patterns. People follow a directional model: baby, child, teenager, adult, etc.*

How do you think aquatic plants return to the bay after a drought period? *Plants put out seeds that are very strong and can survive without growing into a plant right away. Once environmental conditions are right, then the seed can begin to develop into a plant. For example, sometimes seeds have mechanisms that start germination, like a certain temperature and moisture. If it is too dry one year, the seeds might not germinate that year and wait for the right conditions in the next year.*



Discussion

How could climate change affect wetlands? *There are no right or wrong answers to this question. Scientists are still trying to understand this question. If climate change makes more rainfall, then more wetlands and aquatic systems may occur in an area. If less rain falls, then wetlands may become a lot drier and change to swamps or even to forests with upland trees. This would change the wetlands' job in the ecosystem.*

What would happen if all the Carolina bays dried up completely? How do you think this would affect the surrounding ecosystem? *Think about plants, animals, and humans. Refer to the "Thinking about the Environment" section. Wetlands provide a home to many unique plants and animals and perform many important roles to keep the environment healthy. For example, if the bays dried up, animals that feed on the aquatic plants would have to look somewhere else to get the right food sources.*

Think Outside the Box

Introduction

Think of one advantage of globalization for you or your community. Think of one disadvantage of globalization for you or your community. *There will be a variety of answers to this question. Encourage students to explain why they think their answer represents an advantage or disadvantage. Some examples of advantages include increased trade and access to a variety of products to buy. Some disadvantages include jobs being moved out of the community to other places and the increase in invasive species.*

In your own words, state the problem that the scientists wanted to study. *The problem scientists wanted to study is how to better predict the spread of invasive species.*

Method

After reading the Method Section, how do you think technology helps scientists to work together? *Scientists use technology to communicate, such as by the telephone and email. They also use the computer to examine different case studies, including the computer models that were used to make predictions.*

Why do you think scientists examined a lot of different case studies before they made a decision about the best way to track the spread of invasive species? *If the scientists had only used one or two case studies, they would not have much to compare. They needed to compare successful with unsuccessful predictions. For that they needed more than just one or two case studies.*

Findings

Think of a time when you benefited from a discussion with someone else. How did it help you? *This is an individual question and students will have many different experiences to share. In all cases, students should be able to identify how they benefited from having a discussion with someone else.*

Why do you think scientists want to more accurately predict the spread of invasive species? *Because when invasive species spread, they affect ecosystem services. This means they change the benefits provided to people by ecosystems.*

Discussion

How do you think sharing different opinions on a topic would help scientists better understand invasive species? Use an example from your own life to help you explain. *Because the scientists had different areas of expertise, their combined thoughts and ideas made for a much more complete understanding of how the spread of invasive species might be better predicted.*

Why do you think it is important for scientists to coordinate their efforts? *It is important for scientists to coordinate their efforts so that they do not waste time duplicating efforts and so that they work most efficiently.*

Fill Those Potholes!

Introduction

The United States Congress created two programs to help restore land to its natural state. By creating these programs, Congress recognized that some ecosystem services are at least as important as the services provided by agricultural crops or other uses of land. Review the list of ecosystem services in the first

paragraph of the "Introduction." You may also review "Thinking About the Environment" to learn about an important ecosystem service provided by prairie potholes. Do you agree that some of these services are as important as agricultural crops? Why or Why not? *This is an individual question and must be answered by each student individually. Students should be able to back up their reasoning with logic. You may use this question in a class discussion of the tradeoffs between agricultural and environmental (or ecosystem) services and benefits.*

What are the questions the scientists wanted to answer? *Do restored prairie potholes provide ecosystem services? If so, how what kind of services and how much benefit do they provide as compared to the natural prairie potholes that had never been drained? How do they compare in these services to nearby areas planted in crops?*

Method

Look at figures 7, 8, and 9. In 1997, the scientists collected information about potholes only. In 2004, they collected information about potholes and the land surrounding the pothole. Why do you think they expanded the study area around each pothole? *This is an individual question. Students will have to think of why it would be more advantageous to collect information from the land draining water into the pothole in addition to the pothole wetland itself. Students should be encouraged to explore the advantages of studying the larger area.*

Why did the scientists compare restored prairie potholes to natural prairie potholes? *The scientists' questions were: Do restored prairie potholes provide ecosystem services? If so, how much benefit do they provide as compared to the natural prairie potholes that had never been drained? The scientists could not answer the second question unless they compared restored potholes with natural potholes.*

Findings

Based on the findings reported by the scientists, do you think prairie potholes provide valuable ecosystem services to people? Why or why not? *Students should conclude that prairie potholes provide ecosystem services. These services include a higher variety of plants, help with addressing global climate change, protection from floods, and reduced soil erosion. Students will have to determine if they think these services are valuable. Students should support their determination with logic and sound reasons.*

The scientists reported on four ecosystem services. Based on your reading of this article, what is one other ecosystem service provided by prairie potholes and pothole areas? *Students should remember that potholes provide breeding habitat for waterfowl. If they do not remember this, urge them to reread "Thinking About the Environment." Students may also be encouraged to imagine other ecosystem services that may be provided by prairie potholes. An example is habitat for other animal species.*

Discussion

Based on the findings of this research, what is another research question the scientists could ask about prairie potholes and prairie pothole areas? (Hint: Reread the findings having to do with carbon and climate change.) *The scientists did not expect to find that the soil of restored prairie potholes did not hold as much carbon as natural potholes. This finding suggests a number of new questions, such as: What is the relationship between the age of a restored pothole and the amount of carbon its soil holds? What might happen if the study was done 10 years from now when the restored potholes are older? Does the soil of restored natural land in other areas of the country also hold less carbon than similar natural areas? Your students may come up with other ideas about comparing the amount of carbon being held by natural and restored prairie potholes, or other types of land. They may come up with other questions as well.*

Do you agree that the CRP and the WRP have helped to provide ecosystem services? Why or why not? *This is an individual question and students should back up their opinions with logic, evidence, and reason.*