**Link to Standards:**

**HS-LS2-7** Design, evaluate, and refine a solution for reducing the impacts of human activities on the environment and biodiversity.\*

**Engage**: Read the comic below and then select the response that best matches your response.



Which of the following best matches how you would respond to releasing the crawdad (i.e. crayfish) into a non-native environment?

1. Releasing one crayfish into the creek will have no impact on the organisms that currently live there.
2. The crayfish will adapt to its environment or die because nature works on the rule of “survival of the fittest.”
3. Introducing the crayfish to a new environment could have a serious impact on the organisms that currently live there.

Why did you select your response? Please explain your logic in more detail.

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Watch the video: The 5 Worst Invasive Species in the Florida Everglades available at [http://time.com/2970094/florida-worst-invasive-species](http://time.com/2970094/florida-worst-invasive-species/)

Focus question:

1. How were the snails, iguanas, and pythons introduced to the Everglades?

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1. What effect do pythons have on the organisms that live in the Everglades?

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**Explore**: Read the article *Invasive Species National Wildlife Federation*. Available at: <http://www.nwf.org/Wildlife/Threats-to-Wildlife/Invasive-Species.aspx>

Answer the following questions:

1. Based on the information in the article, how would you define an "invasive species" in your own words?

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1. List direct and indirect threats of invasive species on the environment.

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1. How do invasive species spread?

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**Explain:**

Students will serve as consultants to the National Park Service and use their knowledge of invasive species and the practice of data interpretation to develop a claim for the best approach to manage the Burmese Python population in the Florida Everglades. Students will investigate the complex predator-prey relationships and learn why this invasive species could damage the ecosystem permanently. Students will analyze a set of data to determine which method of eradication would be best and most effective, considering factors such as cost, the amount of man-power necessary to implement it, the effect it would have on the python population, and its impact on other species. Students will need to take into consideration the initial cost, cost of yearly maintenance, the predicted effect on the python population, the amount of manpower it will take to implement it, and the affect it might have on other species in the Everglades.

**Read Client Letter 1 from the Everglades National Park**

1. What problem is the client facing? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
2. List the factors that the client is asking you to consider when developing your solution?

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**Read Data Set 1** and use the information to support your claim on the best method to eliminate the pythons.

|  |  |  |
| --- | --- | --- |
| **Method of Removal** | **Arguments For** | **Arguments Against** |
| Locate nesting sites and destroy eggs |  |  |
| Organized hunt for bounty for 30 days |  |  |
| Introduction of a new predator |  |  |
| Sterilization |  |  |
| Open hunting permits with no bounty |  |  |

Use the Claim-Evidence-Reasoning graphic organizer to link your claim and the evidence with your reasoning.

**Elaborate**

In the space below, craft a letter providing an explanation for the approach you recommend to eradicate the pythons from the Everglades. Include a clearly stated claim and explain your reasoning using evidence to support your argument.

Dear Ranger Marbury,

 Our team has determined the best approach to eradicate the pythons from the Everglades is

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Your client receives your recommendation, but counters with the following letter and presents additional information. **Read Client Letter #2 and Data Set 2**.

Use the additional information in Data Set 2 to complete the following graphic organizers with consideration to the environmental impact on the American Alligator.

|  |  |  |
| --- | --- | --- |
| **Method of Removal** | **Arguments For** | **Arguments Against** |
| Locate nesting sites and destroy eggs |  |  |
| Organized hunt for bounty for 30 days |  |  |
| Introduction of a new predator |  |  |
| Sterilization |  |  |
| Open hunting permits with no bounty |  |  |

Provide an updated eradication plan in the space below. If your eradication plan has not changed, then explain why your plan was not affected by the new data.

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1. How did your conclusion about the best method of eradication change when considering the new data?

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**Extend**

Consider the following: What would happen to the ecosystem if the pythons established themselves as a vital component of the ecosystem (e.g. replacing the alligator as the apex predator) and the eradication procedures were completely effective? Would the eradication of the pythons do more harm than good?

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*This lesson was adapted from the CPALMS Web Site and their bank of Model Eliciting Activities (MEA). Available at* [*http://www.cpalms.org/Public/PreviewResourceLesson/Preview/66237*](http://www.cpalms.org/Public/PreviewResourceLesson/Preview/66237)*.*

## Everglades National Park: Florida



Dear Students,

 As you may have heard, Florida’s most famous national park, the Everglades, has become overrun with an invasive species. Over the past few years, Burmese Pythons have begun to completely overtake this fragile ecosystem, and their numbers show no signs of declining. In fact, just the opposite is true: their numbers are actually on the increase. We worry that unless we do something very soon, the will become too established for us to completely eradicate them. The pythons present a challenge to us since they do not belong in our ecosystem. Because they have no natural predator, there is nothing to keep their numbers in check- based on our own population surveys; we’ve seen their numbers increase every single year. This is a significant problem, as the pythons are decimating the local mammal and bird populations that make up the majority of their diets. These populations have been on a steady decline, just as the python population has been on a stead incline.

 We are currently faced with a very serious problem, and we are turning to you for help. In the past, we have tried a number of different ways to eliminate the pythons: searching for nesting sites and destroying eggs, holding an annual hunt, sterilizing existing pythons, and attempting to introduce a new natural predator. Unfortunately, up to this point we have been completely unsuccessful. Therefore, we are turning to you. We have attached two sets of data for you to examine. The first is a bar graph that shows the number of pythons we removed from the park each year. We wanted you to see this so that you could have an accurate idea about the size of the problem we are facing. The second is a data table that lists all of the various eradication methods available to us. Also included in that table are a number of factors (both pro and con) for each eradication method.

We would like you to examine these two sets of data and come up with a detailed recommendation for us as to which method of eradication you believe would be the most successful for us in trying to remove the pythons from our ecosystem. While we have been unsuccessful in the past, we believe that is mostly because we did not make informed decisions. This is why we need your help. We are hoping that along with your recommendation, you could provide us with a detailed description of your reasoning and evidence to support your recommendation. In addition, please explain the predator-prey relationships within the Everglades and how the invasive species is affecting that delicate balance.

 Thank you for all of your help! We eagerly await your response.

 Sincerely,

 John Marbury

 Head Park Ranger

Everglades Nation Park

## CLIENT LETTER #1

## Everglades National Park: Florida



Dear Students,

 As you may have heard, Florida’s most famous national park, the Everglades, has become overrun with an invasive species. Over the past few years, Burmese Pythons have begun to completely overtake this fragile ecosystem, and their numbers show no signs of declining. In fact, just the opposite is true: their numbers are actually on the increase. We worry that unless we do something very soon, the will become too established for us to completely eradicate them. The pythons present a challenge to us since they do not belong in our ecosystem. Because they have no natural predator, there is nothing to keep their numbers in check- based on our own population surveys; we’ve seen their numbers increase every single year. This is a significant problem, as the pythons are decimating the local mammal and bird populations that make up the majority of their diets. These populations have been on a steady decline, just as the python population has been on a stead incline.

 We are currently faced with a very serious problem, and we are turning to you for help. In the past, we have tried a number of different ways to eliminate the pythons: searching for nesting sites and destroying eggs, holding an annual hunt, sterilizing existing pythons, and attempting to introduce a new natural predator. Unfortunately, up to this point we have been completely unsuccessful. Therefore, we are turning to you. We have attached two sets of data for you to examine. The first is a bar graph that shows the number of pythons we removed from the park each year. We wanted you to see this so that you could have an accurate idea about the size of the problem we are facing. The second is a data table that lists all of the various eradication methods available to us. Also included in that table are a number of factors (both pro and con) for each eradication method.

We would like you to examine these two sets of data and come up with a detailed recommendation for us as to which method of eradication you believe would be the most successful for us in trying to remove the pythons from our ecosystem. While we have been unsuccessful in the past, we believe that is mostly because we did not make informed decisions. This is why we need your help. We are hoping that along with your recommendation, you could provide us with a detailed description of your reasoning and evidence to support your recommendation. In addition, please explain the predator-prey relationships within the Everglades and how the invasive species is affecting that delicate balance.

 Thank you for all of your help! We eagerly await your response.

 Sincerely,

 John Marbury

 Head Park Ranger

Everglades Nation Park

**DATA SET #1**

The chart below shows the number of pythons removed from the park and neighboring areas between 1995 and 2010. Researchers say the slight decrease in the number of pythons captured in 2010 might be the result of a severe freeze in January of that year.



Source: National Public Radio- “Invasive Pythons Put Squeeze on Everglades’ Animals.” Article Written by Christopher Joyce. Article published on January 30, 2012. (<http://www.npr.org/2012/01/30/146088909/invasive-pythons-put-squeeze-on-everglades-animals> )

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Method of Removal | Initial Cost | Annual Cost for Maintenance | Predicted Effect on Python Population | Manpower (how many park rangers would be required) | Impact on Other Species |
| Locate nesting sites and destroy eggs | $500,000 | $500,000 | 20% decrease | 100 Rangers, 10 herpetologists, 5 veterinarians | Moderate, potentially high if nesting sites are misidentified |
| Organized hunt for 30 days with bounty | $150,000 (for bounties and advertising) | $150,000 | 5% decrease (a previous hunt yielded 68 pythons in 30 days) | 15 Rangers | Minimal |
| Introduction of a new predator | $4.5 million | $2.5 million | 45% decrease | 75 Rangers, at least 12 of which are wildlife biologists | Very high- could potentially destroy other species as well |
| Sterilization | $6.0 million | $2.0 million | 15% decrease (pythons are very elusive animals and difficult to locate) | 50 Rangers, plus at least 12 veterinarians | Minimal |
| Open hunting permits with no bounty | $1.0 million | $500,000 | 15% decrease | 15 Rangers, plus 2 full-time public relations/ media liaisons | Minimal |

## CLIENT LETTER #2http://www.wilderness.net/images/logos/NPSbw.gif

## Everglades National Park: Florida

Dear Students,

 We appreciate your thoughtful and careful analysis in response to our previous query. As you can imagine, this is an incredibly complex and challenging situation to deal with, as new evidence is always coming to light. In fact, since your response to us, a new variable has been brought to our attention that needs to be considered.

 One factor that we had not considered in our initial set of data about the pythons is the effect this all would have on the previous apex predator of the Everglades, the American Alligator. Alligators and Burmese Pythons share many of the same prey (small mammals and birds, typically). However, as these animals have decreased in number, the alligator population is decreasing as well. This is a concern for us because the alligator is both a native species and an important part of this ecosystem. Additionally, the American Alligator is quite synonymous with our state, and our local residents would be very disappointed if this population ever became endangered or worse yet, extinct.

 Additionally, we have also learned that the time of year we implement these strategies is also important. Certain strategies have very limited windows of effectiveness, while others are more open.

 It is with this in mind that we are once again asking for your help. We have another data table for you to examine. You will notice that it is similar to the first, with two additional columns added that address the alligator problem we are currently facing. We would like you to look at the data once again, this time with the new information in mind. We would like you to please make another recommendation to us after considering the new data. Please send your recommendation to us in the form of a response letter, once again explaining your procedure and how your group arrived at your recommendation. Also, please remember to include a discussion of all of the ecological implications of predator-prey relationships you were asked for in the first letter. We very much appreciate your thoughtfulness and perseverance when it comes to dealing with this issue.

Sincerely,

 John Marbury

 Head Park Ranger

Everglades Nation Park

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Method of Removal | Initial Cost | Annual Cost for Main- tenance | Predicted Effect on Python Population | Manpower | Impact on Other Species | Predicted Effect on American Alligator population | Time of Year the Method would be Most Effective |
| Locate nesting sites and destroy eggs | $500,000 | $500,000 | 20% decrease | 100 Rangers, 10 herpetologists, 5 veterinarians | Moderate, potentially high if nesting sites are misidentified | 20% increase in population size | Limited to immediately after breeding season; usually about 20-40 days in late spring |
| Organized hunt for 30 days with bounty | $150,000 (for bounties and advertising) | $150,000 | 5% decrease (a previous hunt yielded 68 pythons in 30 days) | 15 Rangers | Minimal | No change | Pythons most active in early spring during mating season, but also most aggressive; least active during winter months, but also much less aggressive |
| Introduction of a new predator | $4.5 million | $2.5 million | 45% decrease | 75 Rangers, at least 12 of which are wildlife biologists | Very high- could potentially destroy other species as well | Decrease of 15% | Anytime, though predators are most active in summer |
| Sterilization | $6.0 million | $2.0 million | 15% decrease (pythons are very elusive animals and difficult to locate) | 50 Rangers, plus at least 12 veterinarians | Minimal | 25% increase in population size | Anytime |
| Open hunting permits with no bounty. | $1.0 million | $500,000 | 15% decrease | 15 Rangers, plus 2 full-time public relations/ media liaisons | Minimal | 10% increase in population size | Pythons most active in early spring during mating season, but also most aggressive; least active during winter months, but also much less aggressive |

**DATA SET #2**