THE BARTON SPRINGS SALAMANDER: A PROBLEM-SOLVING TEST

PART ONE

There are two parts to the problem solving test. If you decide to use both parts, it is recommended that you administer part 1 one day and part 2 the following day. Each part should take less than 20 minutes to complete.

Part 1 of the problem solving test is presented in "Email Message From Mia Salerno." In this first part, students must list questions they need to have answered in order to make a decision about the best relocation site for an endangered species, the Barton Springs salamander. They are given information about the needs of the salamander, and some preliminary information about three possible locations. The following table provides a summary of the information given in the first email message:

The Needs of the Salamander	**Lake LBJ**	**Balmorhea Springs**	**Blue Hole Creek**
Deep water that moves quickly	Deep lake with fast water		Swift flowing creek
Spring –fed pools	Fed by springs		
Water temperature between 50 and 68 degrees Fahrenheit			
Earthworms and brine shrimp for food	Rich in aquatic life	Has brine shrimp	
Rocky and sandy river bottom			Has sandy bottom
No leaves or rotting debris to pollute the water		Clean water	

Appropriate Questions
Students should ask questions designed to fill in the gaps in this chart, namely questions about each of the three locations that would help them to determine which of the locales would be the best home for the salamander. Any of the following questions should be scored as correct:

Lake LBJ

- What is the temperature of Lake LBJ?
- Does Lake LBJ have earthworms and brine shrimp?
- What is the bottom of Lake LBJ made of?
- Are there any leaves or rotting debris that pollutes Lake LBJ?

Balmorhea Springs

- Is Balmorhea Springs deep?
- Does Balmorhea Springs have fast moving water?
- What is the temperature of Balmorhea Springs?
- What is the bottom of Balmorhea Springs made of?

Blue Hole Creek

- Is Blue Hole Creek spring-fed?
- What is the temperature of the waters in Blue Hole Creek?
- Does Blue Hole Creek have earthworms and brine shrimp?
- Are there any leaves or rotting debris that pollutes Blue Hole Creek?

Students will word their questions differently and will occasionally combine two questions into one. Accept any reasonable variations. They may also identify other issues as needs of the salamander; accept any reasonable questions about how these locales meet these needs.

Inappropriate Questions
There are several types of questions students should not ask, and if included in the list, they should be scored as incorrect. The following categories are examples of inappropriate questions:

Questions about the Salamander: Students are told to ask questions only about the locales, but they may overlook these instructions. If they do, you may decide not to mark as incorrect questions that are pertinent to the solution. For example, if a student asks, “Does the salamander have any natural predators?” you should not mark this as incorrect, since it is relevant to the solution. However, you should not accept questions that are unrelated to the needs of the salamander. The following are some examples of inappropriate questions:

- What color is the salamander? (appearance is irrelevant to the solution)
- How long do salamander live?

- How many salamanders are going to be moved there?
- Why is it important for the salamander to live in water with a rocky and sandy bottom? (Students do not need this information in order to determine the best locale for the salamander.)

Questions that Have Already Been Answered: Students should utilize the information already given, rather than wasting time collecting it again. Refer to the chart above to determine if information has already been given. A few examples of inappropriate questions in this category are

- Does Lake LBJ have fast moving water?
- Is Balmorhea Springs unpolluted?
- Does Blue Hole Creek have a sandy bottom?

Questions about the Locales that are Unrelated to the Needs of the Salamander: Only questions that help students to determine which locale can best meet the needs of the salamander are relevant to the development of a solution. The following are examples of questions about the locales that are inappropriate:

- What color is the water at Lake LBJ? (The salamander does not need a specific color of water.)
- Is it nice at Balmorhea Springs? (In addition to being vague, this does not address a specific need of the salamander.)
- Can the salamander live at Blue Hole Creek? (This is the problem students are supposed to solve. They need to collect data to determine the best location, not ask a character to solve the problem for them.)

Grading Part 1

You will need to determine the most appropriate way to score this measure. The following is one suggestion, but you will need to adjust it to fit your students.

Automatically give students 30 points. Then, add 10 points for every appropriate question they list, and deduct 5 points for every inappropriate question. For example, if a student records eleven questions, six of which are appropriate and five of which are not, that student's score would be 30 + 60 – 25 = 65. If another student records eight questions, seven of which are appropriate, that student's score would be 30 + 70 – 5 = 95. Cap scores at 100 points, so that even if a student records ten appropriate questions and no inappropriate questions, his/her score would be 100.

PART TWO

Part 2 of the problem-solving test provides students with the email from Daniel Chen offering answers/further information for students.

Once students have a chance to combine the new information with what they knew previously, they are required to recommend one of the three locations as a new home for the salamander. Each of the three locales has some advantages, so there is no wrong answer. This part should therefore be scored not for the correctness of students' choice but for their ability to present a rationale for their decision. It is recommended that you use a rubric to evaluate students' responses. The following are some items you may wish to include in your rubric, though you should adjust this to reflect whatever skills you have emphasized during Alien Rescue:

- Did the essay have a topic sentence?
- How many supporting details were given?
- Was the essay well written, convincing, and free of incorrect information?

The following two pages contain the reproducible emails for parts 1 **(Mia Salerno)** and 2 **(Daniel Chen)** of this problem-solving test.

THE EMAILS

EMAIL MESSAGE FROM MIA SALERNO

From: Mia Salerno, U.S Fish & Wildlife Service
To: Space Station Paloma Young Scientists

My name is Mia Salerno. I am a biologist studying the Barton Springs Salamander. As you may know, it is an endangered species. Data I have been collecting shows that the salamander is in danger of extinction because of water pollution and the many people who swim in the area where the salamanders live.

The Barton Springs salamander is an amphibian, and looks somewhat like a lizard. It has a long slender body about 2.5 inches long with gills on its neck for breathing in water. It has short legs and usually bends its body from side to side to give it as wide as possible a movement for its feet. These salamanders must live in deep water that moves quickly, and they like spring fed pools the best. Right now, they live only in pools fed by Barton Springs in Austin, Texas. The water temperature must be between 50F - 68F, and they cannot survive in water warmer than that. Salamanders tend to be shy, coming out at night to feed. They eat earthworms and brine shrimp. They need a rocky and sandy river bottom. Leaves and rotting debris can pollute the water, making it difficult for salamanders to survive. Salamander eggs usually hatch in November, March, and April.

Since the Barton Springs area is so small, we would like to try to introduce the salamander to a different location to see if it can survive there. We are considering the following three locations:

1. Lake LBJ: This lake is located about forty-five miles from Austin. Like Barton Springs, it is fed by springs from the Edwards Aquifer. It is a deep lake with fast moving currents, and is rich in aquatic life.

2. Balmorhea Springs: This large pool is located in west Texas and is known for its clean water. It is the home to many aquatic animals, including the brine shrimp eaten by the salamander.

3. Blue Hole Creek. This is an isolated creek in northwestern Texas seldom used by people. It is a swift flowing creek with a sandy bottom.

I heard that you have been working on a similar problem and I hoped you could help. I know you need more information before you can make your decision. **Please email the questions you must have answered about these three locations to my assistant, Daniel Chen.** He will gather as much information as he can and report back to you as soon as possible.

Thank you for your help.
Mia Salerno

EMAIL MESSAGE FROM DANIEL CHEN

From: Daniel Chen, U.S Fish & Wildlife Service
To: Space Station Paloma Young Scientists

Here is additional information about the three locations that we are considering for the salamander. I'm afraid I was not able to answer some of the questions you sent, but hopefully you have enough information here to make a decision.

Lake LBJ is located northwest of Austin, Texas, and was named after Lyndon B. Johnson, former president of the United States. It is a natural lake fed by underground springs. It is just over 21 miles long and has a maximum width of 10,800 feet. Tourists from all over Texas come here to take advantage of this beautiful lake. Water skiing and other sports are very popular here. The irregular shore line makes Lake LBJ attractive to boaters and fishermen. There is a rich variety of aquatic life, particularly bass, trout, and shrimp. The temperature of the lake ranges from 62° to 68° Fahrenheit. Lake LBJ is about 40 feet deep, and its bottom is covered with a variety of plant life. In the past, the lake suffered from pollution from Austin, though recent efforts have helped, and Lake LBJ is much cleaner than it was fifteen years ago. The most beautiful months for visiting the lake are March, April, May and June when the flowers are blooming.

Balmorhea Springs is located in west Texas at the foothills of the Davis Mountains. Water from the springs used to flow out into the desert, but during the Great Depression a huge L-shaped pool was dug. The water is exceptionally clean. It's clearer than the clearest Caribbean water and filled with aquatic life, including two endangered species. Turtles, frogs, crayfish, bass, and catfish are common. Balmorhea Springs is about 25 feet deep, and has a muddy, clay bottom. The slow moving water remains at a temperature around 72° Fahrenheit throughout the year. It is a popular swimming area, and the deepest areas are reserved for scuba divers interested in studying the aquatic life there. The marshland areas are ideal for bird watching.

Blue Hole Creek is located in northwestern Texas just south of the panhandle, about 50 miles from the Oklahoma border. It is far from any large towns. Because it is small and remote, it is rarely used for any water sports, even swimming. Blue Hole Creek is 16 feet deep at its deepest, and is much shallower in some places. The fast moving waters are fed by underground springs and are free of pollution. The water is kept cool by the shade of the trees that line its banks, and its temperature is generally between 60° and 65° Fahrenheit. The creek bottom is mostly sandy with small pebbles. Only small aquatic animals have been found in Blue Hole Creek, though the animals in the nearby woods depend on the creek as their source of water.