**Group Investigation**

**Introduction to the sample group investigation:**

Scientific investigation is a process that differs from one investigation to another and from one investigator to another. It is important for students to understand that a scientific investigation does not follow a set series of steps written in some manual. This is what makes teaching scientific inquiry so challenging.

Perhaps the best way to learn how to investigate is to begin investigating. As students complete each new investigation, they learn -- through feedback from peers, teachers, and scientists -- how to improve their next investigation. Students begin to develop a "feel" for what scientific investigation is all about.

In this classroom investigation, students first construct artificial habitats for animals. They then observe to develop questions about animal behavior, which they would like to investigate. Finally, they attempt to answer these questions by designing and carrying out original research using scientific inquiry.

Provide time for discussion as you progress through this activity. Possible discussion questions are provided which may help steer students toward analyzing the process they have completed.

**Preparation**

Before you begin this activity, you should collect a variety of containers for raising small animals. Small animals are best for this activity since relatively large populations can be kept and observed in a small space. Small aquariums are ideal, but can be expensive. You may find people with cracked or leaking aquariums that, while not good for fish, would work great for this activity. Gallon glass jars are good containers, too; you may be able to obtain these from your school cafeteria. Any clear plastic container with a lid will also work in most instances.

**Making observations and doing background research**

There are many animals that students may wish to observe in their homemade habitats. Some can be collected free and some can be purchased. Listed below are some animals that are easy to maintain and obtain:

- **Sow bugs** - These can be found in abundance under logs, boards, or rocks.
- **Crickets** - These can be purchased in pet stores or captured. Crickets have been known to eat through plastic containers.
- **Mealworms** - These can be purchased in pet stores where they are sold for food. They live very well in a bed of dry oatmeal.
- **Slugs** - Any gardener can find slugs and they will be grateful if you take some.
- **Garden snails** - Check for them in moist, wooded areas. Garden snails have a coiled shell.
- **Ant lions** - These are fascinating creatures. They make cone shaped pits in fine sandy soil. They are fast burrowers so you may need a fine sieve to capture them. They can be found at the
bottom of the pit they make.

**Ants** - Ants aren't difficult to find, but they are difficult to keep confined. Make sure you have a good seal with a fine mesh.

Making scientific observations is often the first step in an investigation. Sometimes, extensive observations are made before determining the question to be investigated. Not all observations will prove relevant to the question being investigated; sometimes they are simply recorded for future use. If you want students to collect their own animals, they should probably start by making observations of the animals' natural habitat. Remind students that the measuring and recording of data are important, so they need to plan what instruments they will use, what data they will collect, and how they will organize the data. Students should collect enough data to help them reconstruct the animal's habitat in the classroom.

Whether students collect their own animals or buy them, they need to learn as much as possible about the animals' natural habitat. They may need to do some background research to find out what other people have observed about their species of animal; scientists often make use of observations made by others.

Students should use their observations and background research to build a habitat that will support their animal species. They especially need to consider factors such as food, shelter, and water. They may also consider the best way to simulate conditions in the wild. For example, students may decide to put cardboard tents in a cricket habitat instead of rocks, because it would be easier to remove the tents in order to make observations. Only after the habitats have been constructed should animals be introduced.

Have students continue to observe their animals in the constructed habitat. They should observe behavior as well as conditions of the habitat. Make sure the animals continue to have a good supply of food, water, and shelter.

**Discussion Questions:**

- What kinds of observations are important to make in the wild?
- How could you have improved your observations?
- Were there any measurements you could have made that you didn't make?
- Why is it important to organize your observations?
- How could you improve your organization?
- What did background research tell you that you didn't know from your observations?
- Where else might you find information about your animal?
- How is your constructed habitat different from the natural habitat you observed?
- How is your constructed habitat the same as the natural habitat you observed?
- What kinds of questions do you already have about your animal?

**Developing a question (and possibly a hypothesis)**

As your students continue to observe their animals, they should record questions they have. You may wish to encourage this in several ways:
• Hang a large piece of paper in the room for students to record questions as they come up.
• Put a piece of paper with each habitat for recording questions.
• Have a questions page in an Investigator's Journal.
• Record your own questions for the class to see.

After students have made numerous observations, encourage them to narrow their questions. They may work either individually or in small groups. Before proceeding further, you may also wish to have them decide whether science can be used to answer their questions.

Each student (or group of students) may choose to further focus their investigation by formulating a hypothesis. A hypothesis is not always present in an investigation. In this case, students should have made sufficient observations to make a reasonable hypothesis. The hypothesis needs to be related to the student's question. In fact, the hypothesis is what the student thinks the answer to the question will be.

**Discussion Questions:**

- What did you observe that led you to this question?
- How could you improve your question?
- How might you find an answer to your question?
- What do you think the answer will be to your question? Why?

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**Writing a procedure to carry out original research**

In order to conduct their own original research, your students need to create a written procedure to keep them focused on the question to be answered (or the hypothesis to be checked). It is not uncommon at this point for inexperienced students to develop a procedure that has little to do with their original question. If this is the case, you might have them either reformulate a new question that they really want to answer, or design a new procedure.

For this activity, procedures will most likely follow one of two paths. First, students may choose to continue making observations of the animals in their constructed habitats, but focus their observations on just a few specific things. For example, a student might observe how crickets behave when they come in contact with one another to answer the question, "Do crickets behave in a certain manner when they come into contact with each other?" Another type of procedure involves changing the habitat in some way to answer a question. For example, if the students are asking, "Which foods do slugs prefer?" they might put different foods into the habitat and observe feeding behavior.

A procedure should clearly describe the way data are going to be gathered. Anyone reading a procedure should be able to repeat the experiment described. Students often write procedures that are either too detailed or not detailed enough. Have students share their procedure with others to get feedback. You may wish to use the Internet to have students share procedures with students in other schools. If you don't have access to e-mail, have other students in the class try to repeat a written procedure about which they have no prior knowledge.
Discussion Questions:

- What are the most important things for people to know about your procedure?
- How are you going to organize the data you gather when you carry out your procedure?
- What do you expect will happen when you carry out your procedure?
- How will you know when you have an answer to your question?

Forming a conclusion and reporting results

Once data has been collected, students need to analyze the data in order to draw a conclusion. Remind students to re-read their question (and hypothesis, if applicable) before coming up with a conclusion. Their conclusion should attempt to either answer their question or show their hypothesis to be true or false. It is not uncommon for inexperienced students to initially draw conclusions that have little or nothing to do with the original question or their original research.

Proper reporting of results tells others how a conclusion was reached. Students should find the best way to communicate their investigation. Use of graphs, tables, and even maps is useful here. This would be a good time to review how to make graphs or maps. It would also be a good time for students to share their results with others.

Discussion Questions:

- What is the best way to show your data?
- What do you want people to notice in your data?
- Does your conclusion answer your question?
- How would you change your investigation if you were to do it again?
- What other questions came up during your investigation?