

## Developing Hypotheses

The following activity is designed to introduce students to the scientific process, which begins by formulating hypotheses based on observations. This activity provides students the opportunity to observe hermit crabs, which are amazing marine creatures that are sure to generate student interest. The teacher then guides a class discussion that takes students from observation to hypothesis development. This lesson is based on the Learning Cycle (Invitation, Exploration, Concept Invention and Application) and addresses the following Hawaii Content and Performance Standards:

Strand	The Scientific Process
<b>Standard 1: The Scientific Process: SCIENTIFIC INVESTIGATION: Discover, invent, and investigate using the skills necessary to engage in the scientific process</b>	
<b>Topic</b>	Scientific Inquiry
<b>Benchmark SC.BS.1.1</b>	Describe how a testable hypothesis may need to be revised to guide a scientific investigation
<b>Topic</b>	Scientific Inquiry
<b>Benchmark SC.BS.1.2</b>	Design and safely implement an experiment, including the appropriate use of tools and techniques to organize, analyze, and validate data
<b>Topic</b>	Scientific Inquiry
<b>Benchmark SC.BS.1.4</b>	Determine the connection(s) among hypotheses, scientific evidence, and conclusions
<b>Topic</b>	Scientific Inquiry
<b>Benchmark SC.BS.1.5</b>	Communicate the components of a scientific investigation, using appropriate techniques

### Invitation

Introduce the activity and hermit crabs by:

- Explaining that science is about discovery. This involves exploring new environments/organisms as well as developing a way to synthesize your observations in a way that helps you design experiments to test your ideas about what you observed. This is the process of hypothesis formation.
- Asking the class if they have ever heard the word hypothesis.
- Informing the class that they are going to take a closer look at organisms they might be familiar with-hermit crabs-and use these observations to help us in the process of learning about and developing hypotheses (Hermit crabs can be collected from most intertidal sites in Hawaii. The activity can also be modified by using almost any organism you think might generate student interest).

### Exploration

Divide the class into small groups of approximately 3-5 students. Provide each group with a container. Each container should include several hermit crabs, as well as enough salt water to

cover them. Invite the students to begin observing the hermit crabs, and to record their observations on the attached worksheet. During the observation period, you may supply each group with additional materials (such as coral rubble, algae, squid and/or empty shells) to guide their investigations. Instruct the students to formulate questions about the hermit crabs that arise from their observations. Have each group record at least three questions on the attached worksheet.

### **Concept Invention**

Take away the hermit crabs from each group, and reconvene the class for discussion. Invite each group to share at least one question that arose from their observations, and record these questions on the board.

Introduce the concept of hypotheses to the class by:

- Explaining that once scientists have a question or phenomena they are interested in, they need a tool to guide their investigations. Hypotheses serve this purpose.
- Ask the class if they can develop a definition of a hypothesis. After some discussion, provide the class with the following definition (This is also provided on the attached sheet, which can be copied and passed out to the class).
  - A hypothesis is a suggested explanation for an observed phenomenon. A hypothesis can be tested through experimentation.
    - Example: If skin cancer is related to sun exposure, then people who spend a lot of time in the sun will have a higher frequency of skin cancer.

### **Application**

Choose one of the class' questions, and work with the class to develop some possible explanations that would answer the question. Use these explanations to formulate testable hypotheses. Repeat this process with as many student-generated questions as you wish.

- For example, one group might wonder what the hermit crabs eat. Perhaps they saw the crab eating some of the squid, and this leads them to believe that hermit crabs might be carnivores. They might hypothesize that "If hermit crabs are carnivores, when presented with a variety of food options they will only eat meat products and will not eat any algae."

In the process of developing hypotheses, questions might arise about the difference between hypotheses, predictions and conclusions. The slight differences between these terms can be explained using the following examples:

- Hypothesis: If skin cancer is related to sun exposure, then people who spend a lot of time in the sun will have a higher frequency of skin cancer.
- Prediction: If you spend a lot of time in the sun you will get skin cancer.
- Conclusion: Sun exposure causes skin cancer.

At the end of the class, once again stress for the students the importance of hypotheses in science.

- Hypotheses are the building block of scientific discovery. Scientists use hypotheses to group their observations into testable ideas, and design experiments.



### **Developing a Hypothesis**

**Observe the hermit crabs with your group and record any observations you make. Feel free to use any of the additional materials available (coral rubble, food and empty shells). Things to consider: How do the hermit crabs look? What might they eat? How do they react to other crabs? Where do they spend most of their time?**

**Can you form any questions out of these observations? List at least three questions.**

**The following sheet can be photocopied to provide students with a written definition of a hypothesis, as well as some examples clarifying the subtle differences between hypotheses, predictions and conclusions.**

**A hypothesis is a suggested explanation for an observed phenomenon that can be tested through experimentation.**

- There are small but important differences between a hypothesis, a prediction and a conclusion.
  - Hypothesis: If skin cancer is related to sun exposure, then people who spend a lot of time in the sun will have a higher frequency of skin cancer.
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  - Conclusion: Sun exposure causes skin cancer.

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