Inquiry Based Field Science in the Schoolyard:
Investigation of Ground Invertebrate Density in Two Locations

Adapted from **Olympic Park Institute's** field science curriculum in the Old Growth Forest of the Olympic National Park

Overview and Objectives

This is a **guided inquiry** in which students will conduct a comparative field investigation focused on diversity (**responding/dependent variable**) in two locations (**manipulated/independent variable**) in the schoolyard. (At Olympic Park Institute, guided inquiries are used to prepare students for more complex open inquiries where *they* determine the investigative question.) Students will use a **quadrat**, a loop of rope that can be laid on the ground to define a square area to be studied. The objectives of the lesson are for students to:

- Gather data
- Develop descriptions, explanations and predictions related to a real world situation
- Think critically and logically to relate evidence and explanations
- Communicate scientific procedures and explanations.

Based on the **National Science Education Standards**, all students in grades K – 12 should develop abilities necessary to do scientific inquiry and understandings about scientific inquiry. This investigation complements the following curriculum topics: measurement, ecosystems, diversity of life, pollution and stewardship.

The Story behind the Investigation of Ground Invertebrates

A few years ago, the school's maintenance department decided to use pesticide free products to maintain the building and grounds at this site. Now, they are asking the **essential question**: Is the schoolyard a healthy habitat for living things? Evidence of a healthy habitat would include a diverse population of plants, animals, bacteria, fungi, and more.

Although the schoolyard has several different types of habitats--playground, garden, walking paths, lawn and mulched areas--we're only going to search in two different locations: the lawn and in a natural setting (teacher's choice). The investigation will be limited to only one type of animal that may live in the schoolyard, ground invertebrates, the "bugs" that live in the first few inches of soil near the surface. Evidence of a healthy habitat will include observation of a diverse population (many different kinds) of ground invertebrates.

Our **investigative question** will be: Is the diversity of ground invertebrates greater in the grass or in a natural area?

Materials

1 quadrat/small group (suggest 1-2 meter square)
1 ground invertebrate identification guide/small group
1 science notebook and pencil/student
2 hand lenses/small group
1 timer for the whole class
(may include a still or video camera)

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Safety and Management

All students will be going outdoors together and collecting data in two locations in the schoolyard near the school building. They will:

- Work respectfully within their assigned groups (3 or 4 students per group)
- Stay within the boundaries described by their teacher
- Refrain from engaging the attention of students in any other class
- Use science equipment only as instructed
- Wear appropriate clothing for an outdoor investigation
- Avoid horse play (pushing shoving, climbing, etc.)
- Follow all rules previously outlined for classroom behavior by the teacher

Procedure for Data Collection

1. *In the classroom*, introduce the **story** and the **questions**. Ask students how they would answer the **investigative question**. Each group can develop its own procedure or use the one provided by the teacher. Students should record the question, their **hypothesis** and the **procedure** in their notebook. Gather input from students to determine **variables** that should be held **constant**, e.g. amount of time to find ground invertebrates, size of area being investigated, etc.
2. Introduce the chaperone.
3. Describe safe behaviors for the investigation including how to carry and use the quadrats. Students should write at least three **safety rules** in their notebook.
4. Students will record **field notes** about the site (date, time, weather, location, nearby vegetation, animal activity) in their notebooks when they arrive outdoors. Ask students to create their own **data table** or use the one provided.
5. *Prepare to leave the classroom*. Students wear appropriate clothing and bring **quadrats**, hand lenses, notebooks, and pens/pencils.
6. Lead students to the first location and form a class circle. Identify boundaries for the data collection.
7. Groups select their test site for the first location and lay down the **quadrat**. Give a signal for counting to begin. After two minutes, signal for students to stop counting and record the number of different ground invertebrates found in that location. Students can use hand lenses to observe animals closely to make accurate drawings that include labels in their notebooks. They can use the identification guides to name the invertebrates they find.
8. Groups move the **quadrats** and determine **diversity** at two additional sites in this location.
9. Move to the second location and repeat steps 6, 7 and 8.
10. After the final measurement and recording of data are completed, students form a class circle to share their observations.
11. Return to the classroom.
12. Students meet with their groups so that every student has a completed data table.
13. Create a class data set for the quantitative values in the grassy and natural locations. Students copy class data in their notebooks.

Data Analysis

Students will:

1. Identify factors that could have influenced the data. Consider whether outliers should be included. Explain and determine whether **mean**, **median**, or **mode** best represents the class data.
2. Create a **line plot** or **bar graph** representing the data and highlight the single number (derived number) used to represent the data for each location on the graph.

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Comparative Investigation
Students identify:

1. Manipulated/independent variable
2. Responding/dependent variable
3. Controlled variable(s)
4. Number of trials completed

Conclusion
Students will:

1. Write a conclusive statement which answers the **investigative question**.
2. Include supporting data, **evidence**, for lowest and highest number of ground invertebrates.
3. Describe the difference in these two numbers.
4. Use explanatory language (explain how these data support your conclusion)
5. Include error analysis:
   - Identify two possible sources of error in the investigation.
   - Describe how each source of error could have affected the investigation results.
   - Explain how the investigation results could be made more reliable.
   - Discuss whether additional data collection is necessary to satisfactorily answer the **investigative question**. Describe a plan to complete further work if needed.
6. Identify new questions and plan a new investigation that would provide more evidence to answer the **essential question**.

Communication
Students will:

1. Prepare a presentation of final results for the maintenance department interested in the health of the schoolyard habitat in the form of a letter, oral presentation, poster or video.
2. Practice presentation to group or class. Use feedback from peers to improve presentation.
3. Deliver their presentation to the maintenance department.

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Data Table for Investigation of Ground Invertebrates in Two Locations

Student Name	Group Member	Group Member	Group Member

Date		**Time**	
Weather		**Location**	
Vegetation		**Animal Activity**	

Location 1 Number of Ground Invertebrates **Type of Habitat** _____

Trial 1	Trial 2	Trial 3

Drawings of Ground Invertebrates Found in Location 1

Location 2 Number of Ground Invertebrates **Type of Habitat** _____

Trial 1	Trial 2	Trial 3

Drawings of Ground Invertebrates Found in Location 2