# STREAM SCIENCE

What can we conclude from our investigation and how do we represent our findings?

## HAWAIʻI DOE STANDARD BENCHMARKS

**Science 1: The Scientific Process**
**SCIENTIFIC INVESTIGATION**
**SC.5.1.2** Formulate and defend conclusions based on evidence.

**Math 12: Data Analysis, Statistics, and Probability**
**STATISTICS**

- **MA.5.12.1** Determine the range, median, mode, and mean for a data set.
- **MA.5.12.2** Compare different representations of the same data and evaluate how well each representation shows important aspects of the data.

**Language Arts 6: Oral Communication**
**CONVENTIONS AND SKILLS**

- **LA.5.6.2** Give informal presentations or reports to inform.

## KEY CONCEPTS

- We can draw conclusions about the differences in stream life in forested vs. urban areas based on the evidence we collected during our stream study.
- We can interpret our data in different ways to analyze what it means and see if it validated our hypotheses.

## ACTIVITY AT A GLANCE

Students analyze and interpret the data from their stream investigation and work with their *hui* (group) to develop a presentation of their findings.

## ASSESSMENT

Students:

- Present findings and conclusions to classmates and answer questions using evidence from the investigation.
- Complete a summary data sheet showing the range, mode, median and mean of a data set.
- Display their data using two different representations and explain what both representations reveal about the data, and how one of the representations is more helpful in understanding the data than the other.
- Organize and give informal presentations or reports of information (for example, research information concerning a project and relate findings to class or group).

## TIME

4 – 5 class periods

## SKILLS

recording, organizing and interpreting data, graphing, analyzing, collaborating, presenting

## Materials

Provided in Lesson 3:

- ✓ Learning Log 3
- ✓ stream life data sheet
- ✓ *hui* data sheets

Provided in this lesson:

- ✓ Learning Logs 4 and 5
- ✓ Help Using Excel sheet

## Vocabulary

abundance – in this context, the total number of individual organisms in a given area

dissolved oxygen – oxygen dissolved in water

diversity – in this context, the total number of species in a given area

*mālama* – to care for

median – the middle number in a series arranged in order of size

mode – the number or range of numbers occurring most frequently in the data

mean – the average

range – the interval between the smallest and largest values or numbers

turbidity – the amount of suspended sediments in water; a measure of water clarity

variable – something that is likely to change

## Advance Preparation

- ☐ Create a large chart on the board like the one on Learning Log 5 for student groups to record their data during this activity.
- ☐ Copy the summary data sheets and the Help Using Excel sheet for each student.

## Teacher Background Information

Researchers have identified habitat characteristics that are associated with degraded stream sites. These characteristics include high levels of silt, warm water temperatures, reduced velocity, lack of stream bank vegetation, smaller substrate, and high nutrient concentrations (Brasher et al., 2004). Brasher and fellow researchers found that the most common freshwater molluscs are non-native, and that these were indicator species for degraded habitat conditions. For the crustaceans, the native *ʻōpae kalaʻole* (Atyid shrimp) was only found at sites with greater than 95 percent forested land use. The maximum water temperature in the urban section of the Kāneʻohe Stream exceeded the upper lethal limit (34°C) for *ʻōpae kalaʻole* (Brasher et al., 2004).

When students complete their investigation, they will have an opportunity to analyze their data and see how the different habitat characteristics are interrelated. Some of these connections are depicted below with arrows indicating an increase ↑ or a decrease ↓ in a particular factor.

When shade ↓ water temperatures ↑

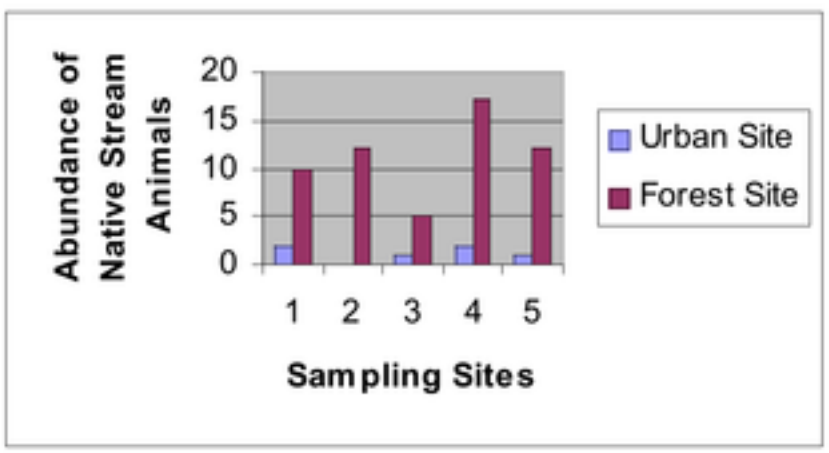
When water temperatures ↑ dissolved oxygen ↓

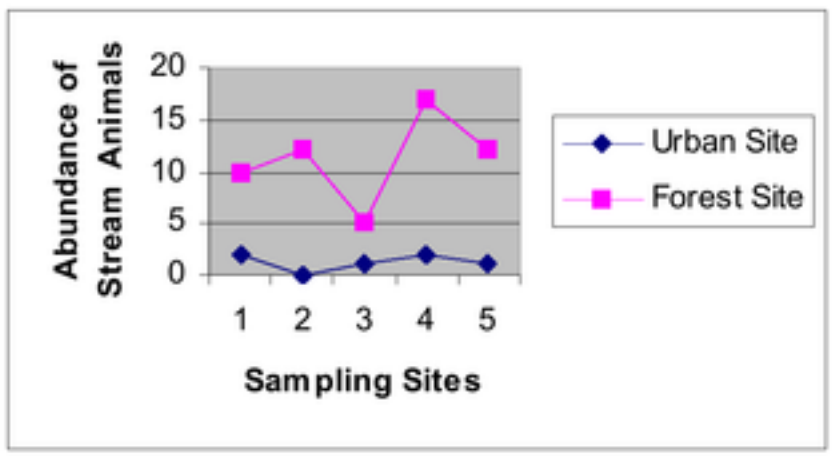
When velocity ↓ siltation (turbidity) ↑ water temperature ↑ dissolved oxygen ↓

Many urban and mixed land-use streams have high turbidity--high levels of suspended particles such as clay, silt or organic matter, which make the water cloudy or dirty. These particles absorb sunlight, resulting in increased water temperature. There is also a connection between water temperature and dissolved oxygen. Warm water holds less dissolved oxygen, which native stream animals need to survive.

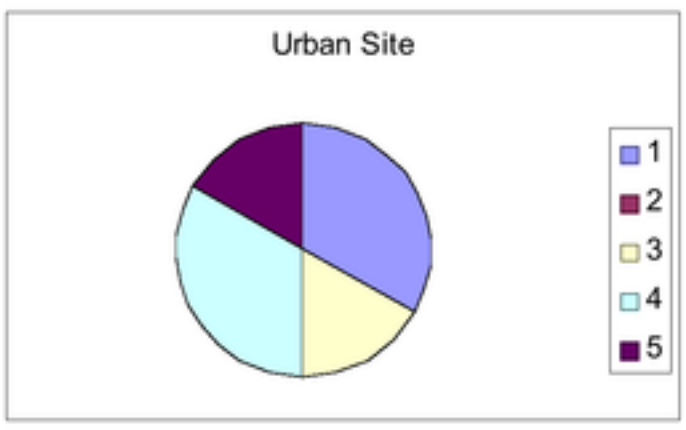
Your students probably found that there are few if any native species in the urban stream they studied. Native stream animals are adapted to the cooler, fast-moving, less turbid waters with riffles, runs and pools that are found in less disturbed stream sites. However, your students may have discovered, as Brasher et al. found, that there is a greater diversity (higher number of species) of invertebrates at the urban and mixed land-use sites (Brasher et al., 2004). This diversity is due to the fact that many non-native invertebrate species, such as Asiatic freshwater clams (*Corbicula fluminea*) are adapted to the degraded conditions found in channelized streams (Yamamoto and Tagawa, 2000).

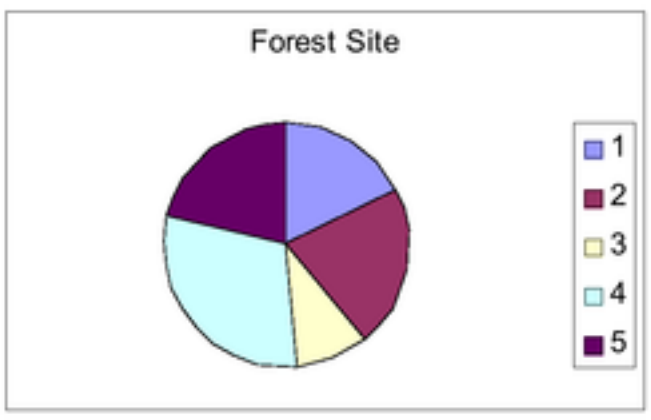
When students display their data, they will need to consider what types of graphs or charts are best to represent their results. The most common types of graphs are bar graphs, line graphs or pie charts. See samples below with notes about advantages of using each type.




Bar and line graphs are typically used to show results such as the abundance of stream animals along the y axis, and the variable such as sampling site along the x axis. The heights of the columns in the bar graph represent the data point for each site. The line graph is useful for analyzing trends and the relationship among data points.



Circle graphs or pie charts are useful for comparing categories of data to the whole data set. In the above example, these graphs are not as useful as the bar or line graphs for comparing the abundance of stream animals at each site.

## TEACHING SUGGESTIONS

1. **Discuss observations from the two different stream sites that students visited.**

- Ask students to sit with their *hui* (group) from the stream investigation activity and have their stream life data sheets and *hui* data sheets from Lesson 3 available.
- Discuss their general observations of the differences between the urban and forested stream sites.

2. **Summarize their observations of stream life on the large chart you prepared on the board.**

- Distribute **Learning Logs 4 and 5** and ask students to record the stream life data. If desired, add data on fish collected to the chart.

**Data Summary**

| Stream Life and Stream Characteristics | Urban Site  | Forest Site  |
|---|---|---|
| **Stream Life Diversity**<br>Number of invertebrate species<br>Number of native species<br>Number of non-native species | | |
| **Stream Life Abundance**<br>Number of invertebrate individuals<br>Number of native individuals<br>Number of non-native individuals | | |
| **Habitat Characteristics** (see Teaching Suggestion 7) | | |
| *Hui* 1: Percent shade cover | | |
| *Hui* 2: Water temperature | | |
| *Hui* 3: Dissolved oxygen | | |
| *Hui* 4: Turbidity | | |
| *Hui* 5: Velocity of streamflow | | |

3. **Ask students how they can draw conclusions about the impact of different habitat characteristics from the data they collected in the stream investigation.**

- Ask students how they will determine if their hypotheses were supported.
- Discuss their ideas.

4. **Show students how to calculate the range, median, mode and mean for simple data sets.**

- Explain that to understand what the data tells us, we need to analyze it.
- Write the sample data from the box below on the board.
- Discuss what the numbers mean and how they help to interpret the data.

Discussion Questions

- What is the difference between the median and the mode?
- Is there always a mode in a data set? Why or why not?
- How do you compute a median when you have an even number of data?
- Which numbers are most useful for interpreting the data? Why?

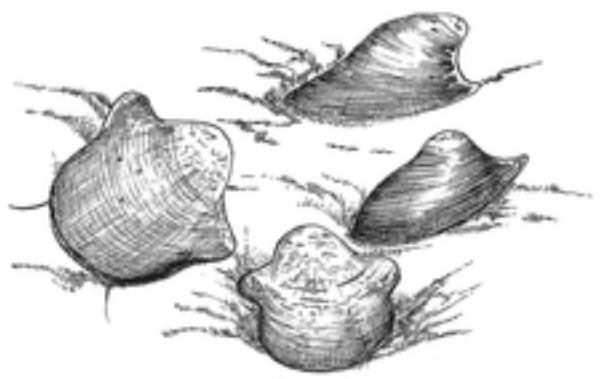
**Sample Data Sets**

Wave faces for a local surf spot over a 7-day period
7 feet, 4 feet, 2 feet, 2 feet, 3 feet, 6 feet, 4 feet
Arrange in numerical order: 2, 2, 3, 4, 4, 6, 7
**Median** (middle number): 4
**Mode** (most frequent): 2 and 4
**Range**: 2 – 7
**Mean** (average): 4
(Calculate by dividing the sum of all values by the number of values: 28 divided by 7 = 4)

Height of students on the first-string high school basketball team
66 inches, 72 inches, 76 inches, 64 inches, 77 inches, 65 inches
Arrange in numerical order: 64, 65, 66, 72, 76, and 77
**Median** (number halfway between 66 and 72): 69
**Mode**: none
**Range**: 64 – 77
**Mean**: 70

5. **Have groups interpret their data using at least two different representations.**

- Ask students to study the data their *hui* collected on a habitat characteristic.
- Challenge them to determine the range, median, mode and mean for their data and record this on **Learning Log 4**.
- As groups finish, check their work and ask students to help their peers as needed.
- Have groups prepare two different representations of their data, e.g., pie chart, line graph or bar graph.



- Challenge them to explain what each representation shows and which ways are best to display their data.

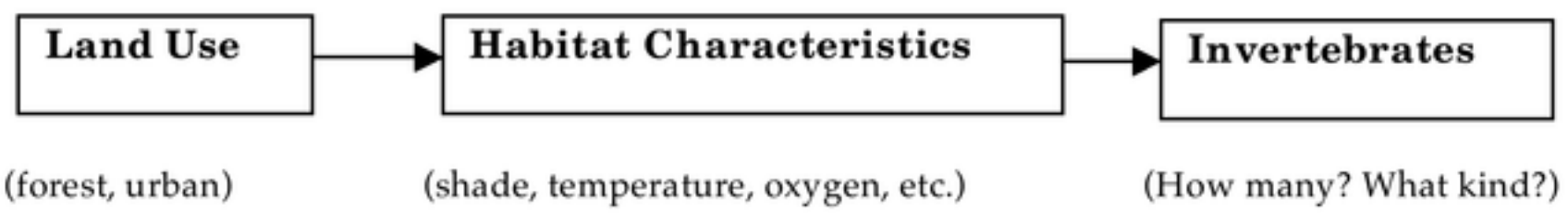
6. **Ask students from each *hui* to prepare an informal presentation of their data to the class.** Explain that this will be a practice for the *hōʻike* where students will summarize what they learned for a larger audience. Students should divide responsibilities to present their:
   - hypothesis
   - method
   - variables controlled
   - range, median, mode and mean for their data
   - chart or graph representation of data
   - conclusions – was the hypothesis supported?

7. **Have students from each group present the group's findings.**
- As students present, ask them to record the range and median for their data onto the large chart you created on the board.
- Ask all students to record this data on **Learning Log 5**.
- Discuss each group's presentation and allow time for students to record data on their summary sheets.
- Ask students to suggest ways that groups could improve their presentations for the *hōʻike*.

8. **Ask students to answer the questions on Learning Log 5.**
- As a homework assignment, challenge students to look for relationships in the data the class collected.
- Provide them with some examples (see Background) and challenge them to answer the questions.

9. **Discuss students' ideas about connections between the habitat characteristics and how the different characteristics influence stream life.**

**What are the connections?**




Discussion Questions
- How is shade related to temperature?
- How is dissolved oxygen related to temperature? (When temperature goes up, dissolved oxygen decreases.)

- Under which conditions is stream life most abundant? Why do you think this is true? (Note: It may be difficult to find native stream organisms in forested sites where habitat offers them many places to hide. In concrete stream channels, it is easier to see stream life.)
- Under which conditions is stream life most diverse? Why do you think this is true? (The urban site probably had more different species, but they were all non-native species that are able to survive in warmer, slow-moving water.)
- Revisit your predictions on the student activity sheet from the previous lesson. How many predictions were supported? How many were not supported? Which findings were most surprising? Why?
- How could we improve the accuracy of data collection if we repeated this investigation?
- What questions would we still like to answer with other investigations?

**10. Ask groups to think about projects that could help to restore *lōkahi* (harmony) to the stream community and explain that this will be the focus of the culminating activity.**

## References

Brasher, Anne M.D., Reuben H. Wolff and Corene D. Luton. 2004. *Associations Among Land Use, Habitat Characteristics and Invertebrate Community Structure in Nine Streams on the Island of Oahu, Hawaii, 1999-2001*. Water Resources Investigations Report 03-4256. U.S. Department of the Interior, U.S. Geological Survey. Honolulu, HI.

Yamamoto, Mike N. and Annette W. Tagawa. 2000. *Hawai'i's Native and Exotic Freshwater Animals*. Mutual Publishing. Honolulu, HI.