

QUADRAT & TRANSECT ACTIVITIES

How, Where & Why Scientists Do Sampling!

Scientists often collect data “in the field” which could mean underwater, in a forest, in a cave, on a reef, or even the moon! Two essential methods to gather ecological information in a standardized way are:

Transect Sampling (using a single line) and **Quadrat Sampling** (counted within a grid). These sampling methods provide more accurate data than random sampling or simply guessing, but they take less time than counting every specimen in a certain area. Sampling helps us estimate & compare!



Image retrieved 10/27/08 from: <http://www.coml.org/edu/tech/count/quadrat-sampling-passive/2.jpg>

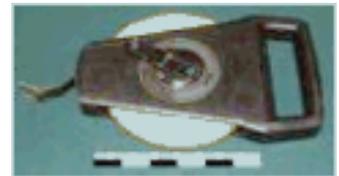
Make a Transect!



A transect is simply a line we stretch over an area we want to study. The line must have regular measurements marked off, like a tape measure, & is held straight & stationary. Scientists buy specialized transect tools (see photo below), but we can make our own simply by measuring a length of rope and using a pen with permanent ink to write the measurements (cm & m) at regular intervals along the line.

We will make our ropes _____ meters long & mark every _____ centimeters.

Images retrieved 10/27/08 from: <http://www.cmlr.uq.edu.au/images/measuringTransect.jpg>; http://www.marinenz.org.nz/documents/content_images/Neil_transect_P1020987_1.jpg; & <http://iodeweb5.vliz.be/oceanteacher/resources/other/AndersonBook/images/tape.jpg>



Practice with a Transect! (work with 2 partners)

1. Lay your transect line down straight across the floor & count the “population” of every thing you find under the line at each meter. Do not count anything on the floor that is not situated on a meter **transect point** even if it’s just an inch away.
 - *Question: If you only used this data to describe your classroom, would it be useful? Explain why or why not (in class discussion or write answer on a piece of paper).*
2. Plan with classmates, then hold several transect lines around the classroom to get a better picture of the “population” of different “species” or items in the classroom (i.e. text books, paper, pens, pencils, etc.). Record & share your data with the whole class. (Note: if it’s a nice day & you can work quietly, ask if you can do this outside with rocks, leaves, etc.)
 - *Question: What made this sampling activity more **reliable** than the 1st activity?*

Make a Quadrat! (work with 2 partners)

Supplies needed for each quadrat: 4 meters of $\frac{3}{4}$ " pvc pipe; 4 pvc elbows ($\frac{3}{4}$ "); pvc cement; hacksaw or pvc cutter; drill with $\frac{1}{4}$ " bit or smaller; string; tape measure.

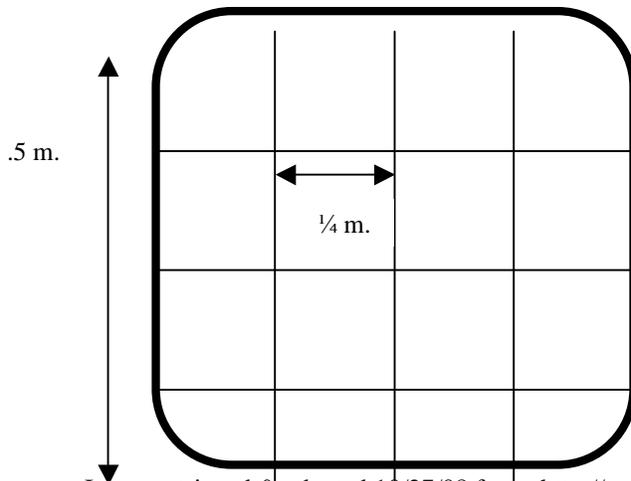


Image retrieved & adapted 10/27/08 from: <http://www.smast.umassd.edu/MHBNL/images/quad2.jpg>

The diagram above on the left shows a quadrat that is half a meter square. The photo on the right shows it can be made with pvc pipe and string or colored fishing line (this is good for use in most ecological areas, including under water if holes are drilled to submerge the pipes when needed – try find biodegradable monofilament to use instead of regular fishing line).

We will make our quadrats _____ m² square with line every _____ cm's.

Directions

1. **CUT:** Use a hacksaw or pvc cutter to cut the $\frac{3}{4}$ " pvc pipe into four _____ cm. pieces (cut on the edge of a flat surface, holding one end firmly in place; do not cut on top of the desk or directly towards your body!)
2. **GLUE:** Near an open door, window or outside, use pvc cement to attach 2 pvc pipe elbow pieces (90° angle) to both ends of 1 straight piece (work on a flat area & clean up glue spills immediately with rag or paper towel!). Glue all 4 straight sides and elbow pieces together.
3. **MEASURE:** find the halfway point, then $\frac{1}{4}$ and $\frac{3}{4}$ points on each side of the quadrat frame you created above. Double check your measurements! Use a drill with a $\frac{1}{4}$ inch bit to drill a hole at each of the points all the way through the pvc pipes (tie back hair & stabilize pipes!).
4. **TIE:** Thread the string or line through the holes you drilled to create a grid of straight lines across the frame. This will give you **9 intercept points** (note: the photo shows 16 points). Tie double knots or burn the ends of the strings to make sure your grid doesn't unravel.

Practice with a Quadrat!

Image retrieved 10/27/08 from:
www.georgiastrait.org/files/share/isopad-quadrat_JBurke.jpg

Our classroom or schoolyard is a good place to practice sampling diverse populations. Try the activities on the next page to find out how scientists use quadrats to learn **percent cover** and **point intercept, error, bias & randomization**.



Practice with a Quadrat! *cont'd* (work with 2 partners)

1. VISUAL ESTIMATION (this can be done in the classroom or outside) – First, estimate the number of different “species” (items) found within 2 feet on both sides of the transect line for its entire length just using your eyes, not your quadrat. Then estimate the number of each “species”. Note: Estimate means take your best guess – do not count everything!

<u>Species</u>	<u>Estimate Population</u>	<u>Actual Population</u>
• textbooks	3	3
• pencils	10	14
• floor tiles	40	42

Next, use your quadrat frame to estimate more accurately. Place your quadrat at the beginning of your transect line and estimate the number of each species. Write this down. Then re-position your quadrat at the middle and end of your transect line, estimating the number of species once more at each new position.

Finally, compare your estimations!

- *Question: Which visual estimation method – transect or quadrat – do you think is better to estimate percent cover of sample populations & why?*
- *Question: When you chose your transect line, did you look for a place where there was probably more interesting data to record? What does this tell you about **bias** in ecological sampling? What about **randomization**?*

2. POINT INTERCEPT – our class can work cooperatively just like a team of scientists.

- a) Select a large area to study (the entire classroom, or an outside area).
- b) In teams, place transect lines strategically to cover as much of the site as possible (i.e. place lines evenly apart, but not overlapping).
- c) Then lay quadrats at points along the transect lines at pre-agreed positions (if you have more time, do more than 3 position along each transect line).
- d) Each time you lay down the quadrat, write down exactly which species are found at every intercept point on your quadrat (including populations that “hide” under one another, or overlap, but do not move or touch anything!).
- e) When done, record each species, its population, and its **percent cover** of the area studied. Share your transect line info with the entire class.
- f) As a class, total all species, population and percent cover again, then analyze:
 - *Question: Did anyone see data outside the areas sampled by our transects & quadrats? If this activity were done on a reef, why would it be important to write **field notes** about this in a report? What does this tell you about **error** in sampling?*
 - *Question: Did anyone think some data we were looking for was hidden because we couldn't touch anything? How would our results change if we could move things that we find along transects or in quadrats? Do you think it's okay to change data because you think something is there, even though you didn't see it?*

TEACHER'S NOTES

Prepare for the Sampling Field Trip!

Additional, very useful information to study and practice ecological sampling with these tools can be found at: <http://www.hawaii.edu/gk-12/opihi/classroom/measuring.pdf> (see also Unit 9 Appendix on the *Ka Hana 'Imi Na'auao: Science Careers Curriculum* disk for handouts and a PowerPoint, plus activity tips).

Lesson Tips:

Making Quadrats – it is safest for you, or a student familiar with power tools, to drill all the holes in the pvc pipes that will be needed at one station. Since it takes only a few students at a time to work on making the quadrats, it may be best to have other students practicing with transect lines while quadrat-making is done by more trusted, mature students.

Using Quadrats – there are several ways to collect data using quadrats and transects; we have included instructions and handouts for three basic types. Methods can vary depending on the habitat, question of interest, and researcher, to provide the most accurate and repeatable data.

- **Transect Data** – Uses only a transect line. Easy and fast for large species. Hard to generalize results or compare across groups except if the habitat was similar for all.
- **Quadrat Data** – Randomly place quadrats for fast estimates. Good for substrate and large species estimates. Sample locations should be assigned before time for unbiased results.
- **Point-Intercept Data** – Detailed population and percent cover data. Good for substrate and small, rare species estimates. Time-consuming data collection but will give you lots of data to analyze and compare.

Teaming & Supplies – students work best in teams of 3 with a transect and quadrat (2 to position the tools, 1 to record the data). Also, when on the campus ground, or especially on a field trip, students will need clipboards (or firm lightweight notebooks) and paper to input data, plus a pencil.

Previewing Vocabulary – several words are written in bold on the student handout pages above. Point out and discuss these words and definitions with students before doing the activities and reading. The words are:

1. **Transect Sampling** – counted on points of a single line
2. **Quadrat Sampling** – counted on points of a grid
3. **Meter & Centimeter** (show students with meter stick & compare to leg length)
4. **Transect Point** – measured distance on a transect line
5. **Reliable** – yielding the same results in different experiments or studies
6. **Intercept Point or point intercept** – where 2 lines of a quadrat cross
7. **Percent cover** – portion of a total area 1 species covers at a specific site
8. **Error** – Statistical error is caused by random (unpredictable or unintentional) variation in making a measurement, whereas systematic error is caused by an unknown but

nonrandom fluctuation. If the cause of the systematic error can be identified, then it can usually be eliminated. Such errors can also be referred to as uncertainties
(Retrieved 10/28/08 from: <http://encyclopedia.thefreedictionary.com/error>)

9. **Bias** – a personal preference that causes unfair judgment. In science, a sampling error caused by systematically favoring some outcomes over others.
10. **Randomization** – the making of random arrangement in order to control the variables in an experiment (Retrieved 10/28/08 from: www.thefreedictionary.com)
11. **Field Notes** – additional information scientists record when doing observations at a study site

Field Trip – it is possible for students to enter the water on Hawaii DOE field trips if you:

- Plan the trip about 4 weeks in advance (see DOE Field Trip form in Unit 9 Appendix)
- If students do not go into the water above their knees ... having many, well-positioned chaperones make this simple.
- OR Hire a lifeguard to go on the trip for 15 or more students & have snorkel gear for all (local snorkel rental stores are often very happy to donate their gear, esp. if the class shares their thank you letter with a community newspaper!)

Feeling Hesitant? – students *love* these activities when actually doing them in nature. David Sobel, a current leader in place-based science education reminds us:

"What's important is that children have an opportunity to bond with the natural world, to learn to love it, before being asked to heal its wounds".