Biology – Quadrating and Soil Classification

Written by: Sarah Lacey

Number of lessons: **3-4**

Year Level(s): **Year 11**

Australian Curriculum content descriptions:

Science Understanding:

From Year 11 Biology ATAR syllabus

- Design investigations, including the procedure(s) to be followed, the materials required, and the type and amount of primary and/or secondary data to be collected; conduct risk assessments; and consider research ethics, including animal ethics
- Conduct investigations, including using ecosystem surveying techniques (quadrats, line transects and capture-recapture) safely, competently and methodically for the collection of valid and reliable data
- Ecosystems are diverse, composed of varied habitats, consisting of a range of biotic and abiotic factors, and can be described in terms of their component species, species interactions and the abiotic factors that make up the environment
- In addition to biotic factors, abiotic factors, including climate and substrate, can be used to describe and classify environments

Lesson 1 - Introduction to Quadrats

Context

This lesson introduces students to quadrating and the use of the formula to calculate approximate population size and density.

Materials and equipment

For each group:
2 x die
1 x pen
1 x worksheet instructions

Safety Advice

Nil

Objectives

Students to define quadrating
Students to estimate population size and density using the quadrat technique
Students to explain how quadrating can be used as a fieldwork technique

Introduction

Discuss with students how they might go about counting the number of trees in a forest or flowers in a meadow. This could be a think-pair-share.
Lead the students into thinking about how they would prevent double counting

Core

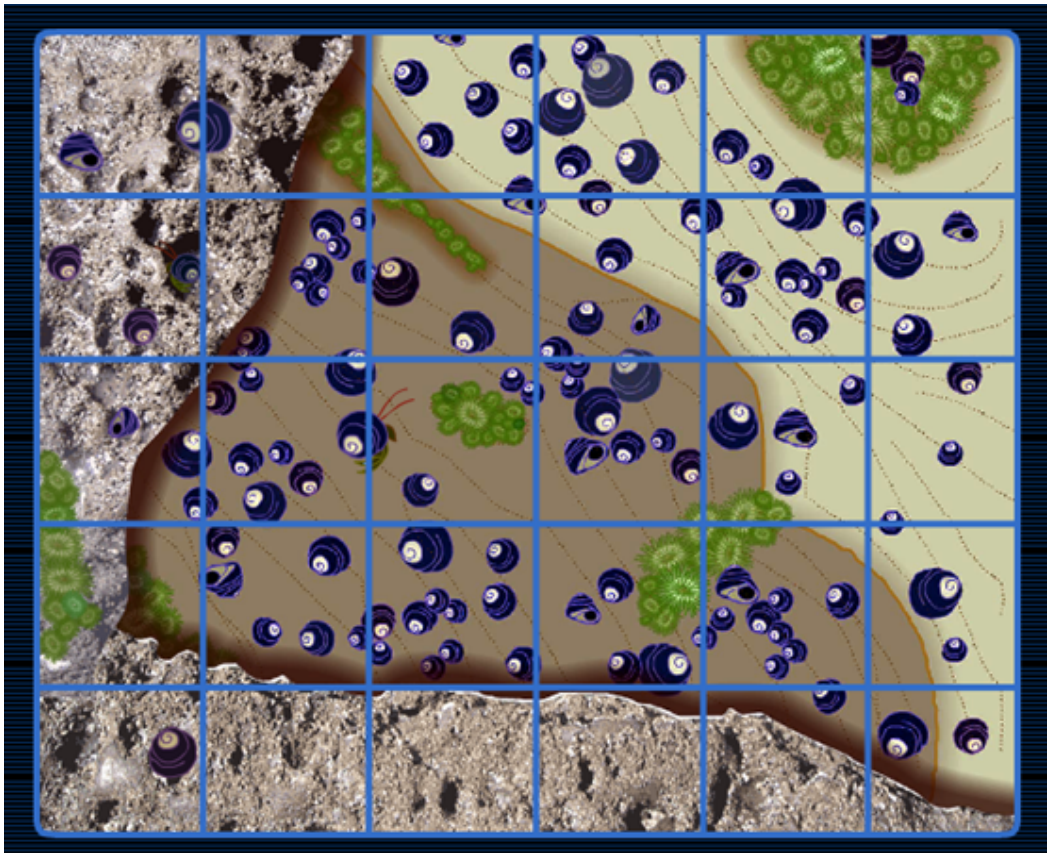
1.Discuss with students the concept of sample size to represent populations – students in a higher-level mathematics class may have discussed this previously.
2.Lead students through the process of quadrating including the use of the formula to calculate population size (Population size = number of individuals in quadrats / (number of quadrats sampled x total number of quadrats)) and density (Density = Total number / (number of quadrats sampled x area of quadrat))
3.Use the attached worksheet activity to solidify student understanding of the quadrating technique

Conclusion

Allow time for pack-up.
Class discussion of if all groups got the same answer for population size and population density.

Resources

Random Quadrat Sampling



Scientists cannot possibly count every organism in a population. One way to estimate the size of a population is to collect data by taking random samples. In this activity, you will look at how data obtained from random sampling compare with data obtained by an actual count.

Procedure:

The grid shown to the right represents a rockpool measuring 6 m on each side. Each grid segment is 1m2 x 1m2

Roll two die. One die indicates the horizontal axis and the second die the vertical axis to randomly select a quadrat from the grid.

Count the number of snails in that grid segment. Record this number on the data table

Repat until you have collected data from 10 quadrats

Calculate the estimated population size and population density using the formulas.
Then count the total number of snails actually shown

Random Sampling Data		Actual Data
Quadrat	Number of Snails	
Total Number of Snails		
Population size		
Population density		

Analysis:

1. Compare the total number of snails from the SAMPLING to the ACTUAL count. How close are they?

2. Why was the dice method used to select the quadrat?

3a. A lazy ecologist collects data from the same field, but he stops just on the side of the road and just counts the 10 segments near the road. Discuss how this would affect the data he collected.

4. Population Sampling is usually more effective when the population has an even dispersion pattern. Clumped dispersion patterns are the least effective. Explain why this would be the case.

Lesson 2 - Quadrating Practical

Context

This lesson will use the prior knowledge from last lesson to put the quadrating skill into practice on the school site.

Materials and equipment

Quadrating squares OR cones and tape
measure
Notebooks and pencils
Thermometer
Lux meter
Collection container for soil sample

Safety Advice

Hats and sunscreen

Objectives

Students to conduct an ecosystem survey on school grounds using the quadrat method.
Students to record the species observed on school grounds using a field journal.
Students to collect a soil sample to be examined in a later lesson.

Introduction

Remind students of the concepts covered last lesson, in particular the random sampling method.
Introduce students to the activity today. This will be easier if each group member stands at a corner of the quadrat and records counts – discourage students from walking over their sample area (the gardeners will thank you!). Ideally at this point students should be able to create their own method of random sampling and data collection.
In this practical students will also collect abiotic data for their field journal and a soil sample to observe later.

Core

Students are taken to a suitable place on school grounds to conduct their quadrats. Examples include, lawn with weeds growing in it, an undeveloped area with weeds, or a garden bed.

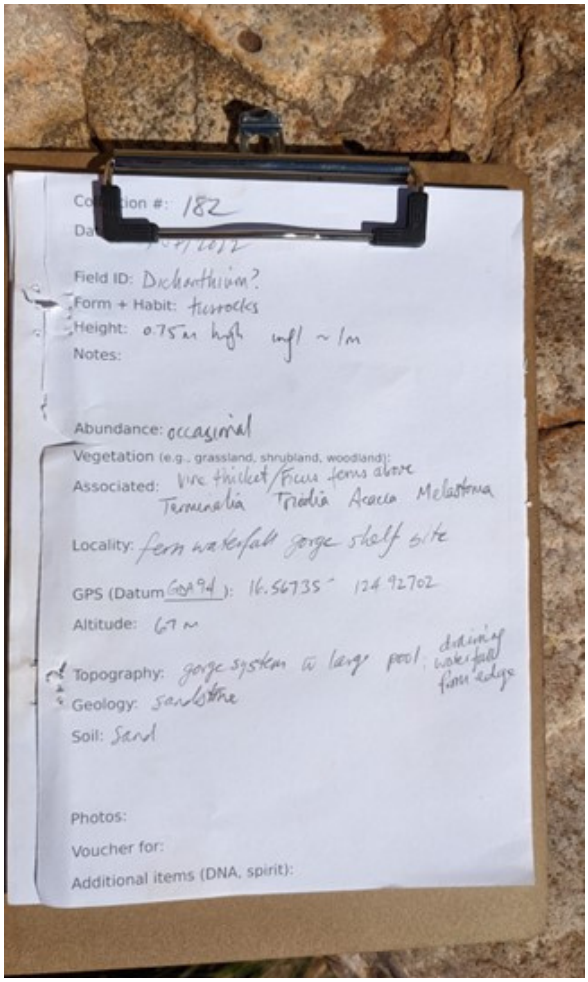
Students are to create a method for their investigation, they should think of key questions including – what is the percentage of total area they would need to sample to gain an adequate representation of the area? How will they ensure they have not double counted? After consideration of the method, students will collect their data, ensuring that enough quadrats have been sampled in the total area.

Students will also be asked to collect the ambient temperature, soil temperature and light levels as well as a soil sample for next lesson.

Conclusion

Allow time for returning to the classroom and packing of equipment.
Remind students that their field notes will be needed for next lesson

Example field notes:



Lesson 3 - Soil sample examination and writing report

Context

Students in this lesson will examine the soil sample taken and consolidate their field notes into a written report.

Materials and equipment

Dissecting microscopes

Safety Advice

Use gloves for handling soil samples incase of biting or stinging invertebrates or disease-causing microbes
Use safety glasses when using the universal indicator

Objectives

To determine the soil type from the sample site

Introduction

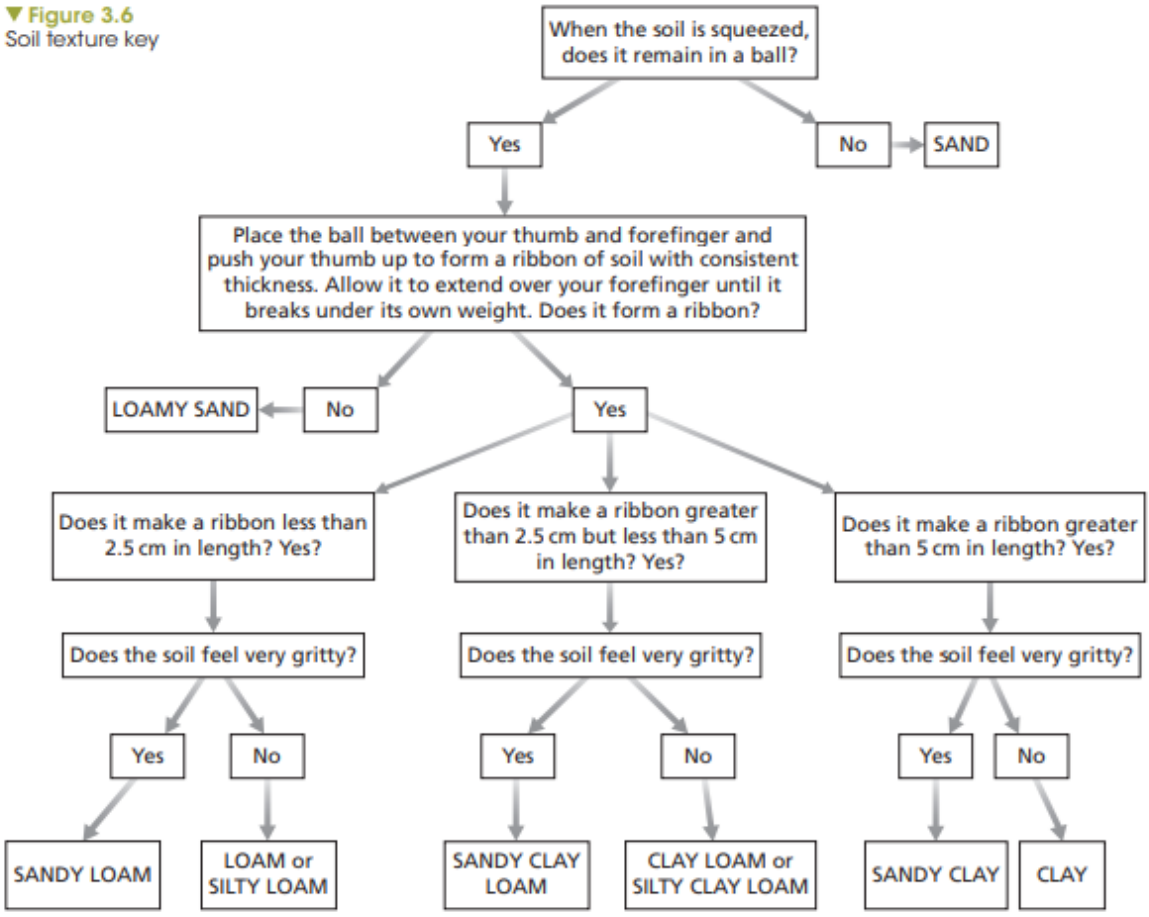
Remind students of the quadrating technique. Discuss why we might have also collected a soil sample – lead students to the type of soil can help to classify the environment and can greatly effect the types of plants.

Core

1. Soil Analysis (this has been adapted from the text:
   Bird, S., Borger, P., Evergreen, M., Martin, G., Pappas, Z. Walker, K., Woolnough, J., Wright, J. (2014). Nelson Biology Units 1 & 2 for the Australian Curriculum. (1st Ed). Cengage Learning Australia Pty Limited.

A. Classify the soil type.
Collect 1 teaspoon of soil and add a few drops of water, one at a time until it forms a "putty". Use the dichotomous key to classify the soil type.

▼ Figure 3.6
Soil texture key



Bird et al, 2014)

B. Add 20g of soil to a beaker with 40ml of distilled water. Stir and allow to settle. Then add a few drops of universal indicator to determine the pH of the soil.

C. Determine the soil porosity by measuring 20 g of soil, place in a funnel with filter paper. Add 20 ml of water to the funnel and allow the water to drain for 10 minutes. Measure the amount of water that had passed through after 10 minutes, indicating the porosity of the soil sample.

2. Students are to write a paragraph or two to consolidate the information collected into a report format. The bulk of the lesson. Provide core instructions for teachers delivering the lesson and what students need to do.

(Optional) if extra time
Allow students to look at the dry soil samples under a dissecting microscope. What are the invertebrates that can be seen? What type of soil/sand grains can be seen?

Conclusion

Discuss with the students the importance of understanding the properties of the soil for the diversity of the plants. Discuss the abundance and density of the plants, how was this effected by the soil?