HOW RICH IS YOUR HABITAT?

Biology Practical—Biodiversity

Topics Covered:

- **Sampling the biodiversity in a habitat**
- **Measuring species in a habitat**
- **Using Simpson's Diversity Index**
- **Defining species richness**

Introduction

The purpose of this practical is to use a simple and convenient model of the real environment in order to understand the principles of random sampling and how to estimate biodiversity. You will use different coloured sugar balls to represent different species. A sheet of graph paper is used as a representative area of habitat.

Apparatus

You are provided with the following apparatus:

- one tray
- one pair of forceps
- a model quadrat consisting of one 3cm x 3cm square of plain paper with a 1cm x 1cm square hole in the middle (alternatively a 3cm x 3cm square of transparent acetate with a $1cm^2$ square marked in the middle). In each case the middle 1 cm^2 is the model quadrat.

In addition you have access to the following apparatus:

- a glue stick

Materials

You are provided with the following materials:

- three samples of sugar balls, labelled **A**, **B** and **C**.

Also required

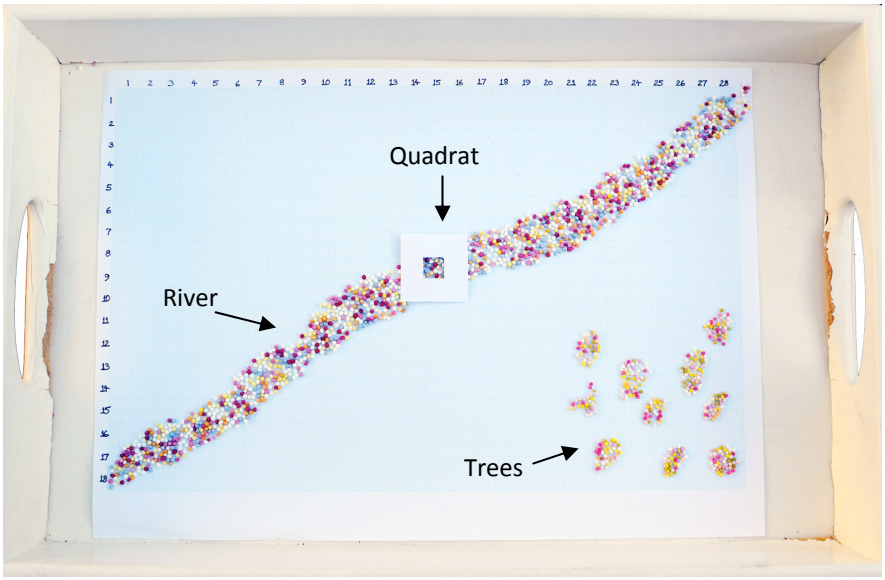
- calculator
- A4 sheet of graph paper

Procedure

Work in pairs.

STEP 1: Setting up habitats A and B

1. Lay the sheet of graph paper on a flat surface.
2. Identify the top left 1cm x 1cm square. Label this with a number 1 on the top (horizontal) axis and on the left (vertical) axis. Label the remaining 1cm^2 squares along the top and down the left hand side ready for sampling coordinates later.
3. Using a glue stick, create a 'model' freshwater habitat by covering a strip of graph paper with glue roughly diagonally across the sheet from bottom left to top right. The strip should be about 2cm wide. This will represent a stream or river and will be referred to as habitat **A**.
4. Lay the sheet of graph paper flat in the bottom of the tray provided.
5. Pour sugar ball sample **A** along the 'river' of glue so that the balls stick to it.
6. Remove the graph paper and let any loose balls fall back into the tray.
7. Roll the loose balls into a corner of the tray and pour them back into the sample container.
8. Replace the graph paper and repeat the process until the river of glue is completely covered in balls.
9. Next create 'model' trees or shrubs by applying about 10 blobs of glue, each about 1 cm^2, at locations of your choice in the remaining parts of the graph paper. These trees or shrubs will be referred to as habitat **B**.
10. Pour sugar ball sample **B** over the blobs of glue, tilting the tray until the blobs of glue are completely covered in balls.
11. Remove the graph paper, let loose balls fall back into the tray, pour spare balls back into the sample **B** container and replace the graph paper.



Q1 Does each sample of sugar balls represent:

- **A** a population
- **B** a community
- **C** a habitat
- **D** an ecosystem?

STEP 2 Sampling habitats A and B

1. Decide what species (colours) are present in each habitat. (*Hint: don't worry about tiny variations in colour – these could represent the variations normally present within species.)*

2. Prepare a Table for your results. Set out the Table as follows:

Sample	**Habitat A**			**Habitat B**			**Habitat C**		
	Species / number or % cover			Species / number or % cover			Species / number or % cover		
	white	pink	etc.	white	pink	etc.	white	pink	etc.
1									
2									
etc.									

In the following procedure, one member of the pair could sample habitat **A** while the other samples habitat **B**. Alternatively, one person could record the data while the other carries out the sampling.

3. **Sampling habitat A – freshwater stream or river**

In a real situation, the invertebrate animals in a freshwater stream or river could be sampled using a method known as kick sampling. This involves systematically kicking the river bed to dislodge animals and catching them in a net downstream. The kick samples can be examined at leisure in trays of freshwater.

In this model situation, you will randomly select 10 x 1cm^2 squares of graph paper along the glue 'river' to represent 10 kick samples.

(i) The 'river' is only about 2cm wide, so you will only need to select random coordinates along the horizontal axis of the graph paper. Select 10 random horizontal coordinates.
(ii) For each 1 cm^2 quadrat sample, locate the relevant coordinate. Use the forceps to help you place the paper or acetate quadrat in the middle of the river at the selected coordinate.
(iii) Count the number of each species present and record the results in your Table.

Q2 How will you ensure samples are taken at random?

4. **Sampling habitat B – trees or shrubs**

Q3 How could you sample the small animals, such as insects, in living trees?

Record the number of each species present in each of the glue trees. Note that no quadrats are needed. Each glue tree represents a random sample of small animals obtained from one tree – the tree would contain a much larger number of small animals.

STEP 3: Setting up and sampling habitat *C*

1. Pour sugar ball sample **C** gently over the remaining areas of graph paper. Try to get a more or less even spread of the balls. This could represent species in an area of meadow or grassland. It will be referred to as habitat **C**.

2. **Sampling habitat C – meadow or grassland**

Q4 In this model situation random sampling is better than using a line or belt transect. Briefly explain why.

(i) Depending on the time available, take between 10 to 30 random samples, using 1cm^2 quadrats. You may use the graph paper squares as quadrats or, if the density of balls is too high for ease of counting, the model quadrat used for habitat **A**.
Note that you can count the **number** of each species present in each quadrat **or** use **% cover**. Each sugar ball occupies about 4% of a 1cm^2 quadrat. Record the results in your Table.

Q5 In the model situation, the maximum % cover is 100% (25 balls in a 1 cm^2 quadrat). In a real situation a cover of more than 100% is possible. Explain the reason for this.

STEP 4: Simpson's Diversity Index (D)

Simpson's Diversity Index is a measure of the biodiversity of a habitat. It takes into account both **species richness** and **species evenness**.

Q6 Define species richness

The formula for Simpson's Diversity Index (D) is:

$$D = 1 - [\sum(n/N)^2]$$

n = number of individuals of a particular species
N = total number of individuals of all species

Calculate Simpson's Diversity Index for each of the three habitats, using a Table as shown below to help you. You may prepare a separate Table for each habitat or combine the three habitats in one Table.

species	n	n/N	$(n/N)^2$
white			
pink			
etc.			
	N =		$[\sum(n/N)^2]$ =
			$1 - [\sum(n/N)^2]$ =