Practical 4 - Q(a) Systematics and classification

This practical focuses on - **Drawing conclusions and evaluating evidence**. You will be developing other assessed skills throughout the practical.

Intended learning outcomes

By the end of this practical and its write-up you should be able to:

- Identify the main features used to classify organisms
- Be able to construct and use a simple dichotomous key
- Experience grouping organisms based on biological similarities.

Safety Information

There are no particular hazards in this practical, however you must follow your laboratory rules.

Background information

- The study of diversity in living organisms(biodiversity) is sytematics
- Living organisms are grouped according to morphological, physiological and biochemical similarities. These groups are called taxons.
- The most commonly used taxons are: Kingdom, Phylum, Class, Order, Family, Genus and Species
- Similarities exist due to evolution from a common ancestral stock.
- The more similarities shown by different organisms, the more closely related and the shorter the time since the organisms became separated by evolution.
- The more similarities, the fewer organisms belong to the taxon. Thus each kingdom contains many different types of organism with a few common features, while a genus contains only a few types of organism with many features in common.
- Nomenclature is the naming of organisms based on the taxons. International agreements exist for most taxa, in particular the binomial system used for genus and species. Rules apply to the correct use of grammar for the Latin names.
- Dichotomous keys are a universal means of classification that allows quick and reliable identification of unknown organisms.
- A key is a series of choices based on observable phenotypic characteristics. In a dichotomous key the choices are given in pairs. Correct choice at each pair gives the specific name of the organism.
- The information used in a key can be qualitative descriptions of physical features, for example, the colour, presence of spots. Alternatively information can be quantitative, for example the number of spots, number of spines, mass.
- There are two ways to set up a dichotomous key.

  1 Present the two choices together,

  2 Present by relationships, in which case the choices are widely separated.

  Examples of these types of key are in a student guide sheet.
- Type 1 keys are generally easier to follow, but may give less information about relationships than type 2.

You will investigate the taxonomic relationships between a number of organisms

- Read the information above.
- Group together the organisms in relation to shared features.
- Use the student guide to identify the kingdom to which each of the organisms belongs. List the evidence to support your groupings.
- Use a key to classify at least one organism into its complete taxonomic groupings.
- Use the guide sheet to construct a dichotomous key to identify a group of organisms

Method

Observing features used in classification

1 Observe each organism carefully.

2 Use the check list to identify the features that link the organism to a particular kingdom.

3 Put the organisms that belong to the same kingdom together.

4 Make further observations to group each organism into a phylum.

5 Using the organism labelled A, work through the key to identify the organism as far as you can.

6 Repeat step 5 for the organism labelled B.

Preparing to construct a dichotomous key

1 Look the organisms provided and sort them into groups based on observable feature.

2 There is no rule about which features are chosen, just that they are distinctive. A first grouping could be by size – longer than 2 cm or shorter than 2 cm. Put all the organisms that fit into one or other of the categories together.

3 Then look for another distinguishing feature – this might be colour and group the organisms accordingly

4 Continue to select a feature that separates the groups of organism until you have each in a separate group.

5 Use a piece of paper to lay out the groups like a spider chart and write down what feature you used to separate them. An example of a spider chart is on the guide sheet to constructing a key

Write-up

- Produce a table that shows the allocation of the organisms to specific kingdoms.
- This should include;
  - the correct names of the kingdoms,
  - One or two distinguishing features of each kingdom,
  - A list of the letters of the organisms provided
- Draw conclusions to complete the table considering:
  - Matching the description of the features of the organisms to the kingdom,
  - Grouping the organisms according to their kingdom,
  - Other features that may not be directly visible in the specimens that might be used to confirm identification
- Produce a table that shows the classification of organisms A and B
- Produce a dichotomous key to identify the organisms provided.
- Evaluate the key in relation to ease of use and accuracy of identification. You could do this your self, but it is more useful to ask another person to see if they can use your key.

Guide sheet to producing a key

These keys are based on imaginary flower petals from 7different organisms:

P.Q, R,S,T,U and V

Whichever key is used organism P should be identified as having red petals with a smooth edge.

1 Present the two choices together.

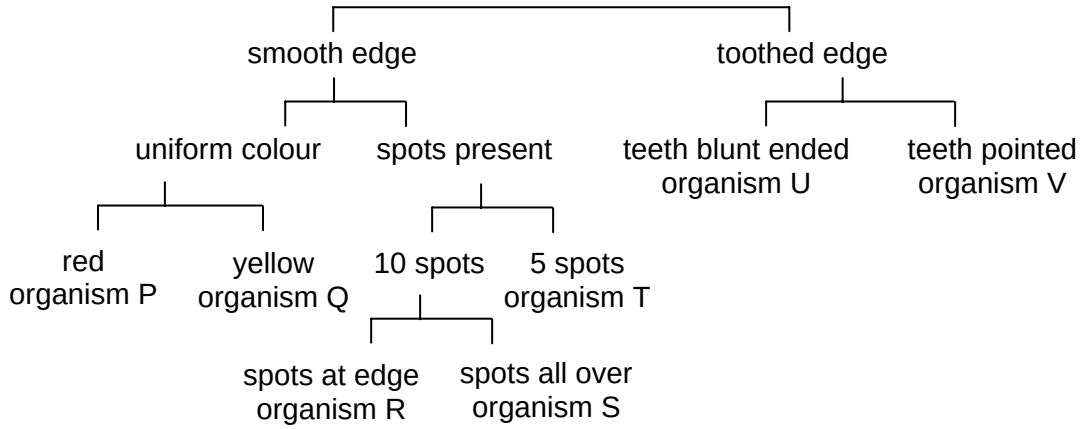
1	has smooth edge	2
	has toothed edge	3
2	uniform colour	4
	spots present	5
3	teeth blunt ended	organism U
	teeth pointed	organism V
4	colour red	organism P
	colour yellow	organism Q
5	ten spots	6
	five spots	organism T
6	spots at edges	organism R
	spots all over	organism S

If your specimen has a smooth edge you would then go to number 2 in the key and look at the next pair of choices. If it has spots then you go to number 5.

2 Present by relationships. In this case the choices are widely separated but are still given the same number.

1	Has a smooth edge		
	2	Colour uniform	
		3 colour red	organism P
		3 colour yellow	organism Q
	2	Spots present	
		4 ten spots	
			5 spots at edges organism R
			5 spots all over organism S
		4 five spots	organism T
1	Has a toothed edge		
	6	teeth blunt ended	organism U
	6	teeth pointed	organism V

Alternative presentation as a spider chart



Lesson Plan

Systematics and classification – Drawing conclusions and evaluating evidence

Context

A practical investigation set in the context of 9700 Syllabus Learning outcome (a) – biodiversity and the five kingdom classification.

It is anticipated that students will completed an AS practical course so that they will have good observational skills. It is also anticipated that they will have been given learning opportunities before this so that they will be familiar with the terminology used in classification.

Key aims of lesson

This practical is designed to develop the skills of: Drawing conclusions and evaluating evidence. Students will be developing other assessed skills throughout the practical.

Intended learning outcomes

By the end of this practical and its write-up the student should be able to:

- Identify the main features by which the five kingdoms are recognised
- Place an organism into the appropriate kingdom based on observable features
- Experience using a simple key to identify an organism
- Construct dichotomous key to identify a group of organisms
- Experience classifying an organism based on observable features

Resources required

White board or flipchart and suitable pens or blackboard and chalks

Practical materials specified on the Technical Information sheet

Some spare copies of the student worksheet

Planned activities (timings can be altered to suit shorter or longer lessons)

Timings/ minutes	**Teacher / Student Activities**
end of previous lesson	**Preparation** - 2 page student worksheet and guide to constructing a key given out for students to read in preparation for the practical lesson and to consider appropriate features that might be used in classifying organisms into taxons.
0-4	**Introduction** to the aims, intended outcomes and shape of the lesson - teacher led oral presentation
4-8	**Context** - review of classification, major taxons used in the five kingdom system. Teacher-led questioning, student responses / discussion, students building a framework for a suitable table to be used in identifying the organisms provided.

8-12	**Introduction to method** - teacher demonstration using a selected organism to indicate suitable features for assigning an organism to a kingdom.
12-22	**Assigning organisms to kingdoms.** Students use the table format worked out during context discussion to assign a variety of organisms to a kingdom. There should be at least 10 different organisms, with at least one from each of the major kingdoms. These can be arranged as a circus around the room and students move from one to the other. Every minute students move to the next organism. Teacher circulates, answering specific queries, praising students who are making a good effort and helping to guide students in the right direction.
23-25	Checking the allocations – teacher goes around the class asking each student to give the kingdom and the reasons for their choice. Students check their own answers.
26- 30 31 – 50 51 – 55	**Using and constructing a key** Optional – teacher / student interactive demonstration on constructing a key from everyday objects e.g. each students puts a writing implement on the table or a shoe. Alternatively the students themselves might be put into an identification key. Students construct a key to identify the organisms provided. Students evaluate the key by using another student's key to identify the organism. Comments are made on how easy the key was to use.
56- 60	**Drawing together the threads** – teacher-led class discussion on the skills that have been developed. Teacher led introduction to write-up, which should include the classification table and the key. Further practice at producing a key or using from teacher generated examples of organisms, using photocopies of actual organisms Students should also select two examples of organisms to generate a complete classification table for each.

Useful Information

- Taxons are based on similarities and differences that arise due to evolution.
- Some metabolic processes e.g. many of the respiratory reactions are the same in all organisms as they have been highly conserved by evolution. The indicate common ancestry of all organisms. Other processes shows differences due to adaptation to different environments e.g. sequence of digestion from large to small molecule is common but different enzymes may be present, which act in a number of different locations depending on how the organisms feed.
- Physiological and morphological differences due to evolution that can be observed or measured are used in classification. Technological advances have made it possible to measure molecular differences that are now also used in classification.
- Keys used to identify organisms are based on taxonomic groupings.

- Keys are usually hierarchical. The first part key is used to assign the organism to a phylum and/or class. Following sub-keys then allow further identification. This allows a faster process of identification
- The most commonly used keys are dichotomous. Simple field identification keys tend to use the paired choice or spider diagram method of presentation. More complex reference keys tend to be based on relationships.
- There is no one correct way of producing a key. The most important feature is that it works and is easy to use.
- There are classification and key construction websites that students could access via a search engine.
- A suitable table for identifying kingdoms might be:

	Feature of Kingdom.				
	Plantae	Animalia	Monera (Prokaryotae)	Protoctista	Fungi

Technical information

Systematics and classification – Drawing conclusions and evaluating evidence

The **apparatus and materials** required for this are listed below.

The amount of apparatus listed is for **one student or one group of students** if they are to work in groups.

1 A set of ten organisms, at least one example from of each of the five kingdoms. Photographs, photocopies and museum specimens may be used as well as live specimens

2 A set of at least 8 organisms from the same phylum or class. Photographs, photocopies, slides and museum specimens may be used as well as live specimens. Possibilities are: different types of flowering plants-either flowers or leaves or seeds, different types of arthropod, crustacea, arachnida or insecta, different types of mollusc shell, different types of fern – easier to use if spore cases are present, different types of fungi.

3 Access to standard keys of local flora and fauna or photocopies of parts of keys. Choice of organisms to use may be influenced by the keys available. Reference text books may also be suitable for the classification exercise.

4 websites

http://www.iit.edu/bi8611./~smilehtml
http://www.zoo.utoronto.ca/able/volumes/vol-12/7-timme/7-timme.html
http://regentsprep.org/Regents/biology/units/laboratory/dichotomous.cfm
http://www.park.edu/bhoffman/courses/bi225/labs/

Safety Precautions/Risks.

No specific hazards identified.

A risk assessment should be carried out as a matter of course.