"What does it mean to be a fork?" Understanding the difficulty of defining species and classifying living things

INTRODUCTION

In Gen Bio III, you will integrate aspects from Gen Bio I and II to understand the complexity of living things at the organismal level. As an introduction to BI172, one of the first things that we want you to appreciate is the difficulty of categorizing living things.

Biological Classification System

It's been estimated that there are over 8 million species currently on earth. How do biologists organize and try to make sense of the incredible number and diversity of organisms? We use a classification system that reflects Darwin's idea that all living things are descended from a single common ancestor. The classification system consists of a series of nested categories that successively go from large to smaller groupings.   The largest highest taxonomic rank is domain. There are three domains: Archaea, Bacteria, and Eukarya. The second highest taxonomic rank is kingdom. How many kingdoms there are and how these divisions are made is controversial but the standard in the US is a six kingdom system. The following illustrates the classification of humans, dogs, and *E. coli* using this six kingdom system.

Humans:	**Dogs**	***Escherichia coli (E. coli)***
Kingdom: Animalia	**Kingdom:** Animalia	**Kingdom:** Eubacteria
Phylum: Chordata	**Phylum:** Chordata	**Phylum:** Proteobacteria
Class: Mammalia	**Class:** Mammalia	**Class:** Gammaproteobacteria
Order: Primates	**Order:** Carnivora	**Order:** Enterobacteriales
Family: Hominidae	**Family:** Canidae	**Family:** Enterobacteriaceae
Genus: *Homo*	**Genus:** *Canis*	**Genus:** *Escherichia*
Species: *sapiens*	**Species:** *lupus*	**Species***: coli*

The most basic unit of living things is a species. But what is a species? As you will see later in the course, biologists often have a difficult time defining what a species actually is. Why is it so difficult to come up with one single, clear-cut definition? One of the major problems is that by the very nature of evolution, the origin of species is often a gradual process influenced by a combination of evolutionary processes such as natural selection and genetic drift. In other words,

it isn't always so easy to say one organism is one species and one organism is another. This may seem confusing to you so we are going to use this activity to help you understand this difficulty.

Discuss: What is a fork? You probably have an idea of what a fork is but can you actually define it? In other words, what trait(s) makes something a fork?

What is your definition of a fork?

This may seem like a silly question but as you will see in lab, making such distinctions is not always as straight forward as you may think.

In today's lab, you will examine kitchen utensils as a substitute for organisms. You and your group will decide how to first identify your utensils and then organize or classify your kitchen utensils using a nested series of categories similar to the classification system above. How you define these categories will be up to you and your group.

OBJECTIVES

- Appreciate the difficulties associated with identifying what a species is

- Gain an understanding of the classification system using kitchen utensils as a proxy for living things.

MATERIALS
Each group will be given an identical collection of kitchen utensils. Each utensil is labeled with a unique number.

EXERCISE
Part 1: Identify the utensils. Done in Class – 20 minutes

- Take out all of your kitchen utensils.
- Give everyone a chance to look them over. You will see that each utensil is numbered.
- Each individual should identify each utensil WITHOUT DISCUSSING with the rest of the group. If you don't know, try to guess what it might be. Record the initial name and provide a brief description (size, material, shape etc.) on the data sheet provided at the end of this activity.
- Compare your initial identifications with the rest of your group.

- If there is any disagreement, discuss. Record the main points of the discussion. Your group must collectively decide the final ID through a majority vote or general consensus.
- Record the final name on the data sheet provided at the end of this activity.
- Make group observations of the "morphology" of each utensil noting color, shape, any special designs, material etc.

Part II: Classify your utensils. Done in Class – 60 minutes

- Organize your kitchen utensils. This may seem easy at first but you are being asked to organize these utensils into a series of nested categories like the biological classification system. For example, all of your utensils could be included into the Kingdom: Kitchen Utensilia. How would you subdivide this category into phyla (pl. of phylum)? How many phyla could you subdivide Kitchen Utensils into and which of these utensils will be included in which phyla?

- What criteria (trait) will you use to make these decisions? Will you base it on appearance, function, material? Why did you choose these particular traits?

Now, subdivide the categories again into classes, then again into order and so forth. At each subdivision, you and your group must justify your **classification by providing your reasoning. In other words, what specific traits did you use to make your distinctions? You should each strive to develop a classification system that goes to at least the FAMILY level.**

- Provide a final copy of your classification to your lab instructor **at the end of the lab**. Make sure that ALL group member names are on this classification.

- All group classifications will be posted on Blackboard for comparison.

Part III: Questions – This can be done in class (if you have time) or after class

1) Write down your original definition of a fork from page 2. Was your original definition an example of typological or population thinking? Explain.

2) Based on sources, the first utensil was likely to be the knife. The knife, which dates to paleolithic times, was originally used as a cutting/piercing tool but eventually changed into the standard table knife. A key change was the shift from a sharp to a rounded tip. When this occurred, the table knife came into more widespread use (hint: think

about a dinner surrounded by a group of warriors with sharp knives). Why do you think this change occurred?

3) The fork was a rather late arrival in Kingdom Utensilia. The original fork had two tines but now forks that you typically use at meal times have more than two. What could have caused this morphological shift (hint: think about trying to scoop up a forkful of small peas at dinner)? Why was this shift adaptive?

4) Not every single trait of an organism is necessarily adaptive. What aspects of your "organisms" might *not* be adaptive? List two examples and briefly explain why they are not adaptive.

5) Sieves or colanders are Members of Utensilia that have likely originated independently in different regions around the world. Every major civilization appears to have there own version of this utensil. Is this an example of homology or analogy? Explain your answer.

6) You may or may not have ever seen the utensil below. In any case, it is highly unlikely that you will ever use one in the future. This utensil originated in the late 1880's and remained very popular up until perhaps the 1970s.

Identify the utensil. What is the function? Why do you think has almost reached the point of "extinction."

7) In your classification of utensils, which particular utensils did you and your group find the hardest to place? Why?

8) What did you and your group find to be the most challenging aspect of this exercise?

WHAT YOU WILL SUBMIT:

- Introduction: A brief introduction, which gives the major points/objectives of this lab.

- Complete initial (individual) and final (group) utensil name and brief description. – Part I

- Summary of any key issues of the discussion if there are disagreements in identifications --- Part I

- Complete classification of utensils. Provide a through justification/reasoning of each group by providing the traits used to make that grouping. --- Part II

- Answers to the questions --- Part III

- Conclusions: By extrapolating from your experience during lab, what did you learn about defining species and the difficulties of classifying living things.