

## EEB266: Invertebrate Diversity

### Group Presentation Assignment

For this project, you and your group will deliver a fifteen-minute presentation on one of the topics below. As research for your presentation, you are expected to cite at least three, peer-reviewed papers. (You will find that review papers are probably most helpful for this purpose.) Each presentation will be followed by a five-minute question period during which you are expected to participate actively, both as a presenter and as an audience member. More detailed instructions are available on the presentation rubric below.

Your group will need to **choose one of the following topics**. Each topic includes a brief introductory blurb, as well as a section, that outlines the **minimum requirements** for your presentation. You are expected to **elaborate on these topics, and synthesize information in a meaningful way**. Wherever possible, talk about any **trends or patterns you may notice across phyla**.

### Topics

#### I. Adaptations for a predatory lifestyle

Animals have been eating each other since the Cambrian Period, if not earlier. Other animals present a readily accessible source of energy, so in some ways, predation is more efficient than herbivory. Prey animals, however, have had hundreds of millions of years to develop morphological and behavioural techniques to avoid being eaten, and predators must overcome these defenses in order to fill their bellies.

**Requirements:** For this presentation, describe the challenges and benefits of a predatory lifestyle. Present examples of predatory taxa from at least 6 phyla, and describe how these taxa overcome the challenges of their lifestyles (such as finding and capturing prey, and overcoming prey defenses) with morphological traits, and behaviour. Describe common features of predators across phyla, paying special attention to structures used in locomotion and prey capture and feeding.

#### II. Adaptations for a terrestrial environment

Over the course of Earth's history, many organisms have made the dramatic transition from aquatic to terrestrial ways of life. By the time *Tiktaalik* poked its excessively-digitate limbs out of the sea, earth had already been colonized by countless other animals. Terrestrial ecosystems represent an incredible bounty of resources, but exploiting them requires organisms to first overcome many obstacles.

**Requirements:** For this presentation, you will need to outline the challenges of transitioning from aquatic to terrestrial habitats. You should describe examples of terrestrial taxa from at least 5 phyla, including at least one amphibious taxon; for one of these phyla, choose two taxa which represent independent transitions to land. How do each of these taxa overcome the particular challenges of terrestrial life using morphological, behavioural, or ecological traits? Do you see any similarities in these taxa across phyla?

#### III. Mimicry and crypsis

Sometimes, the best strategy is to hide in plain sight. Many animals – predators and prey alike – avoid detection by disguising themselves as other animals, or unassuming pieces of the scenery. Cryptic and mimetic animals may be so unrecognizable that they often represent some of the most bizarre forms in nature.

**Requirements:** For this presentation, define crypsis and mimicry; discuss the advantages of both strategies; and explain the difference between Batesian and Mullerian mimicry. Illustrate these

phenomena using examples from at least three phyla: as much as possible, your examples should highlight a diversity of ways in which crypsis and mimicry can be achieved. Discuss how behaviour can influence the effectiveness of both strategies.

#### **IV. Chemical vs. physical defenses**

Anti-predation defenses can often be broadly categorized as either chemical or physical. An example of a chemical defense are the toxins produced in the skin of a dart frog, while an example of a mechanical defense is the shell of a turtle. While this seems to be a simple dichotomy, each strategy brings with it a suite of different advantages and disadvantages, and often the line dividing them is blurry. And if it is so advantageous to develop defenses to avoid predation, why isn't every animal covered in armour, spines, and poisonous skin?

**Requirements:** For this presentation, you should summarize and clearly define what constitutes a chemical and a physical defense. You should describe the various costs and benefits of each strategy using real world examples from at least 3 different phyla. You should also provide at least 2 examples of defenses that have both a physical and chemical component, and explain how the two strategies complement each other.

#### **V. Form and function of shells**

Many structures in the animal kingdom play multiple roles. A giraffe's spots, for example, serve to camouflage the animal, but are also involved in thermoregulation. Although they are often thought of as protective structures, the shells of molluscs are another example of this phenomenon. Mollusc shells are incredibly diverse – having been prized by collectors for hundreds of years – and, unsurprisingly, this diversity of form is accompanied by a diversity of function.

**Requirements:** For this presentation, you should give an overview of the morphological diversity of shells within 7 classes of the phylum Mollusca. Describe the shells' composition and anatomy, and discuss the shells' shapes in relation to the ecology of the organisms. Your presentation should address at least four different uses for mollusc shells.

#### **VI. Diversity of armour**

From rhinos to horned lizards, armour is common in the animal kingdom. If one wants to appreciate the true diversity of armour, however, they must look outside Chordata. As primarily soft-bodied organisms, invertebrates make tempting targets for a variety of predators. To solve this problem, many taxa have evolved armour: plates, scales, shells, and skeletons have appeared many times in many forms throughout the course of evolution. While armour solves the problem of vulnerability, it creates a new set of challenges, and necessitates a trade-off between protection, and loss of some of the benefits of a soft body plan.

**Requirements:** For this presentation, describe examples of armour from at least 4 different phyla. Explain how each of your example taxa solves the problem of growing despite the confines of its rigid defenses. Compare and contrast these structures in terms of composition, form, and function, and explore how these defenses address the particular biological and ecological needs of the animals that possess them.

#### **VII. Reproductive behaviour (pre-copulatory)**

Pre-copulatory reproductive behaviour is some of the most elaborate behavior that can be observed in the natural world. It can serve a variety of functions, from mate guarding to competition to displays of fitness. While the images that often come to mind include rams butting horns or birds performing displays, pre-copulatory reproductive behaviour among the invertebrates is often complex, costly, and diverse. Not only that, but it often occurs in a wide variety of organisms that are difficult to observe.

**Requirements:** For this presentation, you should define what pre-copulatory reproductive behaviour is, and provide examples from at least 4 invertebrate phyla. You should also describe the various fitness benefits associated with your chosen examples. You should also describe what factors may inhibit the development of complex pre-copulatory behaviours.

### **VIII. Parental investment (post-copulatory)**

It is necessary for animals to ensure the survival of their offspring. Since reproduction requires an immense investment of resources, however, there is a tradeoff between the number of progeny produced, and the quality of any individual descendant. Organisms may produce as many offspring as possible, each with a relatively low probability of surviving to the age of reproductive maturity; they may produce relatively few offspring of higher quality, with a higher chance of surviving to old age; or they may strike a balance between the two.

**Requirements:** Drawing on examples from at least 5 different phyla, define “r selection”, “K selection”, parental care, and sperm sorting. Explain how each of these strategies relates to parental investment of resources, and the tradeoff between the number and the quality of offspring that survive to reproductive maturity.

### **IX. Sexual vs. asexual reproduction**

Life continues through mass extinctions and radical environmental change, sometimes in the unlikely places. In other words, “Life, uh... finds a way.” One of the most fundamental requirements for continued survival is reproduction. Organisms reproduce sexually and asexually, and within each of those categories is a startling diversity of strategies, each with its own suite of costs and benefits relating to an organism’s biology and ecology.

**Requirements:** For this presentation, you should outline the positive and negative aspects of sexual and asexual reproduction. Choose examples from at least 5 phyla, describe their lifecycles, and discuss why the form of reproduction they use complements the particular biology/ecology of that organism. Your examples should include the following: (i) at least one example of an animal that is facultatively sexual or asexual. Describe when and why this animal might reproduce in each fashion. (ii) At least two different types of asexual reproduction. (iii) At least one obligately and one facultatively hermaphroditic species. Discuss how hermaphroditism may alleviate some of the problems associated with sexual reproduction.

### **X. Filter feeding**

The ecological strategy of filter feeding can be found throughout the animal kingdom. It occurs among disparate phyla and in animals running a massive range of sizes, from sponges to vertebrates, from shrimp to whale sharks. It is often invoked as among the simplest feeding styles, and is frequently cited as the most likely ancestral feeding method among a variety of different taxa.

**Requirements:** For this presentation, you should describe the differences between active and passive filter feeding, as well as the differences between suction-filter feeding and tentaculate-filter feeding. Give benefits and pitfalls to each, as far as this is possible. You should give examples of filter feeding animals from at least 4 different phyla, with a description of how their approach to filter feeding differs.

### **XI. Sensory structures**

The ability of an animal to interact with its environment is almost entirely mediated by its ability to sense its environment. To that end, animals have developed a wide variety of mechanisms for sensing their surroundings. Eyes, antennae, and tentacles are just some of the most familiar examples of sensory structures found throughout the animal kingdom. Sensory structures are so important, in fact, that they often show considerable amount of morphological and functional convergence in very distantly related animals.

**Requirements:** For this presentation, you should cover the three major types of sensing: visual reception, chemosensation, and tactile. You should also cover at least 1 of the following topics: convergence in the morphology of sensory structures from distantly related groups; constraints on the development of sensory structures; possible drawbacks of developing sensory structures; relative advantages and disadvantages of the three major types of sensing.

## **XII. Symmetry in body plans**

Few characteristics are as fundamentally defining of a body plan as its type of symmetry. It is immediately recognizable, and brings with it a suite of physiological/developmental opportunities and constraints. Most animal life that you are probably familiar with are bilaterally symmetrical, including all vertebrates, arthropods, and molluscs. However, there are also radially symmetrical animals like jellyfish, and even some asymmetric ones like sponges. Some animal groups have even made transitions between different forms of symmetry over the course of hundreds of millions of years.

**Requirements:** For this presentation, you should briefly describe the three most common types of symmetry found in nature: asymmetry, radial symmetry, and bilateral symmetry. You should summarize the various advantages that each type of symmetry entails. You should also cover at least 2 of the following topics: ecological changes associated with transitioning from one form of symmetry to another; summarize the sponge-ctenophore sister group debate and how it is influenced by body plan symmetry; contrast the differences in motility structures between radially and bilaterally symmetrical animals; contrast how sensory structures are organized between radially and bilaterally symmetrical animals.

## **XIII. Coloniality**

A colony is composed of multiple individuals of the same species living either attached or in close association with each other. This is a very general description of what is possibly one of the most morphologically and behaviourally demanding adaptations found in the natural world. It involves the partitioning resources between its members (often, through connective tissue between individuals), the distribution of tasks between colonial units, the morphological specialization of individuals within the colony, and often the sacrifice of direct fitness of the individual to serve the needs of the colony. For the purpose of this course, we will use two general descriptors for colonial life history strategies. Eusocial colonies involve collective brood care, division of labour between reproductive and non-reproductive groups, and individuals that can move around and act semi-autonomously (*i.e.* ants, termites). Modular colonies involve obligate or at least facultative physical connection between individuals and a combination of sexual and asexual reproduction. For the purposes of this course, we are not considering animals that form colonies exclusively for nesting or breeding as colonial organisms (*i.e.* birds).

**Requirements:** For this presentation, you should summarize what characteristics are required for an animal to be considered “colonial,” and differentiate between eusocial colonies and modular animal colonies. Use examples from at least 3 phyla in order to demonstrate these differences. You should also cover at least 2 of the following topics: summarize the advantages and disadvantages of either a eusocial colonial lifestyle or a modular colonial lifestyle; compare and contrast the division of labour among two examples of colonial animals from different phyla; describe the life history similarities and differences of colonial animals from 2 different phyla.

## **XIV. Direct vs. Indirect Development**

The development of an individual from an egg to a sexually mature adult is a complicated process, and we can generally describe species as falling into one of two broad categories. Direct developers have a juvenile form that largely resembles a smaller version of the adult. Indirect developers have discrete morphological/anatomical forms differentiating adults from juveniles (often called larvae, although specialized terms exist for various groups). Both strategies are widespread across evolutionary groups and

environments, and each possesses its own unique suite of advantages, disadvantages, opportunities and constraints.

**Requirements:** For this presentation, you should summarize the differences between direct and indirect development using examples from at least two phyla. You should also cover at least two of the following topics: compare the possible advantages and disadvantages of each developmental style using examples from two phyla not used in your initial summary; comprehensively describe the life history of an indirect developer; compare and contrast the life cycle of indirect developers from three phyla that significantly change their niche between juvenile and adult forms.

## **XV. Parasites**

Gross as it may be, parasitism is a common strategy that has evolved multiple times throughout the history of life on earth. Parasites may be free-living, or may make their homes inside their hosts. They may draw sustenance from a multitude of different organisms, or may specialize on one particular host taxon. Some organisms are parasitic throughout their entire lives, while others may only be parasites for one or a few life stages. Although there are clear benefits to a parasitism, the parasitic lifestyle brings with it a whole “host” of problems.

**Requirements:** For this presentation, you will need to define parasitism and parasitoidism. Discuss the benefits and challenges or costs of a parasitic lifestyle, and describe at least four traits that are commonly found in parasitic taxa. Illustrate your discussion with examples of parasites from at least five different phyla, including at least one ectoparasite, one single-host parasite, one parasitoid, and one parasite that uses multiple hosts throughout its lifetime.

## Rubric

Topic:	Exemplary	Good	Satisfactory	Needs Improvement	Unsatisfactory	Score
Content						
Introduction Provided adequate background information to contextualize the topic & allow listeners to understand and appreciate its importance						/5
Assignment Description Addressed all aspects outlined in the topic description						/5
Understanding Demonstrated understanding of the topic during the presentation & question period						/10
Presentation						
Communication Spoke clearly and enthusiastically; did not read from notes or slides; equal participation from all group members; conforms to time limits						/5
Slides Visuals informative and legible; all images cited; at least three peer-reviewed publications cited						/5
Other						
Group member review sheet submitted						/1
PDF of slides submitted						/1
TOTAL						/32

Comments: