Lesson Plan Format for Science Teacher Education Candidates
Ithaca College School of Humanities and Sciences

Name	Caitlin Etri
Lesson Title or Topic	How do we classify invertebrates?
Grade Level	7
Course Name or Content Area	Life Science

Context

This is the introductory lesson to invertebrates. Students will understand how organisms can be classified based on comparative physiologies. As a result, evolutionary relationships can be inferred from classification schemes to create the tree of life. Students will be expected to use concepts learned from this lesson (i.e. classification, grouping, comparing) throughout the unit—eventually leading to an inquiry lab. This lesson has been designed for a class of 27 students who are from similar cultural backgrounds in a small, rural school.

Connections

Previous Lesson (unit)	Current Lesson	Next Lesson (unit)
Writing lab reports	Invertebrate classification	Biomimicry

Central Focus

Due to the fact that this is the first lesson of the unit, students will be introduced to the concept of classification for invertebrates. By the end of the lesson, students will be able to describe defining features of invertebrates, and identify shared characteristics between organisms. They will create their own classification scheme. This is reflective of what scientists do to group like organisms and infer evolutionary relationships. To mimic this, students will receive a "mystery organism" (trilobite). After receiving this card, they will have to make an educated decision as to which classification group it belongs to. This inquiry activity ties in relevant historical events (Linneaus), and current classification debates in the science community,

State/National Content Standards (Common Core State Standards, NSES, NSTA, and NGSS)

- **NYS Standard**: 1.1h *Living things are classified by shared characteristics on the cellular and organismal level. In classifying organisms, biologists consider details of internal and external structures. Biological classification systems are arranged from general (kingdom) to specific (species).*
- **NYS Standard Process Skills based on standard 4:** *Classify living things according to a student-generated scheme.*
- **NSES Life Science***: Millions of species of animals, plants, and microorganisms are alive today. Although different species might look dissimilar, the unity among organisms becomes apparent from an analysis of internal structures, the similarity of their chemical processes, and the evidence of common ancestry.*
- **NGSS LS4.A:** *Anatomical similarities and differences between various organisms living today and between them and organisms in the fossil record, enable the reconstruction of evolutionary history and the inference lines of evolutionary descent.*

COMMON CORE

- **RST.6-8.1 :** *Cite specific textual evidence to support analysis of science and technical texts, attending to the precise details of explanations or descriptions.*
- **SL.8.1:** *Engage effectively in a range of collaborative discussions (one-on-one, in groups, teacher-led) with diverse partners on topics, texts and issues, building on others' ideas and expressing*

their own clearly.

Objectives and Assessments

Learning Objectives The students will be able to …	**Formative Assessments**	**Summative Assessments**
1. Explain a student-generated classification system based on anatomical similarities and differences between invertebrates.	1. Students will share and explain their classification schemes to the class.	1. N/A
2. Classify a fossilized organism (trilobite) according to their classification scheme.	2. Classification scheme-students will write 2-3 sentences below their classification scheme explaining the trilobite's placement.	2. N/A
3. Identify invertebrates from vertebrates based on defining characteristics.	3. Science Starter probe—Think/Pair/Share	3. Lab report introduction
4. Explain how classification systems inform us about the history and evolution of species.	4. Homework Questions	4. Lab report discussion

Prior Knowledge

What knowledge, skills, and concepts must students already know to be successful with this lesson?	How will you know if your students have prior knowledge, etc.? Where will you teach/re-teach if necessary?
Students are expected to be able to classify organisms by identifying shared characteristics. This is the first lesson on invertebrates. Students should have an awareness of distinguishing characteristics of invertebrates.	The first round of classification will allow me to see which students are struggling with the concept of identifying shared characteristics. If many students are not finished and/or confused, I will allow extra time in my lesson to review how to separate organisms based on shared features. The Science Starter formative assessment probe will provide me with the animals that students commonly confuse as having an internal skeletal system. We will review the answers as a class after students have had sufficient time to discuss their answers with a partner. This will be done to clarify any confusion or preconceptions that students bring regarding invertebrates.

Academic Language

Academic language function

Students will be able to explain a student-generated classification system based on anatomical similarities and differences between invertebrates.

Language demands - Vocabulary	Language supports
Classification, hierarchal, quantitative, qualitative, Linnaean classification system, evolutionary relationships,	Charts, verbal explanations, cooperative groups, pictures, and picture graphs.
Language demands - Function *Analyze, Explain, Interpret, Justify with Evidence*	Language supports
Explain	Classification scheme
Language demands – Graphs, Figures, Symbols,	Language supports

Equations	
Classification scheme format	Examples, cooperative groups

Safety
N/A

Lesson Procedures: Instructional Strategies/ Learning Tasks		
Opening:		
5 min	**Distribute invert vs. vert. probe** as the Science Starter**.** Students will work independently. An envelope with the invertebrate cards will be placed between every two seats when the students walk in. Remind students not to open the envelope further instructions are given.	
Time-based Lesson Planning		
Time (in minutes)		
	What are students doing	What are you doing
2 min	Students will pair up with a neighbor to compare responses to the Science Starter. They will discuss, in partners, their thought process for the organisms they disagreed on.	Monitoring student progress by visiting groups. I will prompt them with further questioning if I notice differences between student responses.
5 min	Students will share their responses as I go through the science starter with the entire class. **Partners will share and comment on the animals that were of conflict.** We will discuss this as a whole. Collect science starters from every student.	Select a few groups to share their responses. Focus on the animals that students disagreed on. **Ask why they classified the organisms in the manner that they did**. Ask students to identify where bones are located in each of the animals (note: invertebrates will not have bones).
5 min	Students independently brainstorm ways classification systems can be important in our everyday lives. (Discussion question 1).	Review with students why we classify things (ie. Grocery stores, animals, books in a library, etc.) Have them reflect upon the teddy graham classification system they created in October. What happened to the specificity of the groups as they continued to sort out the teddy bears? **Ask students to brainstorm other ways classification systems can be important (i.e. what can they tell us about habitats, diets, and evolutionary relationships).**
3 min	Students will work with the same partner to organize the invertebrate cards into *two* distinct groups. **Students will share their classification system with the class.**	After students have categorized the cards into two groups, have a few partners share their classification system. If many students organized their cards in the same way, take a verbal poll and have students raise their hands. Ask students to look at other descriptive features that the cards display. Does this show further similarities between organisms that are grouped in the same category?
5 min	Students will work with a partner to analyze Linnaean Classification Chart—identifying similarities and differences	Refer to the Linnaean Classification System handout. Tell story about Linnaeus' garden in Sweden and his historical background as a

	between kingdoms.	scientist. Ask students to identify similarities that exist among organisms within particular kingdoms. What are the main distinguishing characteristics between the kingdoms? Project Brown Bear graphic—ask students what information the graphic is providing us with? How can we use this information to create our own classification system for invertebrates?
15 min	Students will work in pairs again to further classify their organisms into more categories. **Students will be responsible for writing down their classification scheme.** This will be handed in at the end of the period, or the next day if not finished.	Walk around the room and visit as many groups as possible to make sure everyone is on the right track. Students may work off of their original two classification groups, or may divide the organisms by a new feature.
2 min	Once students are finishing their scheme, distribute the "mystery organism." This is a trilobite. For homework, students must write 4-5 sentences underneath their classification scheme to explain how classification systems provide us with information about the history or evolution of species. Where did you place the mystery organism? Why?	Monitor student progress by visiting groups. Remind students to look at qualitative and quantitative features. After they have placed their "mystery organism", show students a real fossilized trilobite.
Closure: *How will you bring this lesson to closure? How will students reflect on what they learned today, and how will you prepare them for what's ahead?*		
40-End of Class	Select presenters from each group to share their classification schemes with the class. Read over the homework questions before class is dismissed.	

Differentiation			
Universal Design			
Inquiry, picture cards, visuals, and graphic images will accommodate a variety of learners. In addition, verbal explanations will be provided.			
Students with Specific Learning Needs			
Gifted, High Achiever	**Capable, but Disengaged**	**Difficulty Reading**	**IEP**
Students can get very elaborate in their classification scheme. This is dependent on how specific they want to be in classifying the invertebrate cards.	This lesson is not lecture based. As a result, students will be able to be creative in their classification and thinking schemes. The invertebrate cards can be moved around to reflect their thinking process. The real fossilized trilobite will also engage these learners.	This lesson does not rely heavily upon reading. Students will be moving around invertebrate cards to classify them into different categories. Student pairs will engage in a discussion about shared characteristics and traits.	Students will work in pairs for this activity. IEP students can be strategically paired up with a student that will scaffold the learning process. I will be available to assist these students as necessary.

Instructional Resources/Materials
✓ Invertebrate cards in envelope (1 set per 2 students) ✓ Kingdom table ✓ Classification handout ✓ Invertebrate/Vertebrate assessment probe ✓ Tree of life handout ✓ Trilobite

Theoretical Principles/ Research-Based Practices
Research conducted by Martin Braund identified the main organisms that students confuse between invertebrates and vertebrates. As a result, I have incorporated these organisms into my invertebrate/vertebrate probe to highlight student preconceptions. Students often hold the preconception that a flexible animal cannot possess a backbone (i.e. snake).

References
Braund, M. (1998). Trends in children's concepts of vertebrate and invertebrate. *Journal of Biological Education.* 32 (2) 112-127. Naz, A. & Nasreen, A. (2013). An Exploration of students' misconceptions about the concept 'classification of animals' at secondary level and effectiveness of inquiry method for conceptual change. *Journal of Faculty of Educational Sciences,* 46 (2) 195-214.

Classification of the Brown Bear

Taxonomic Group	Number of Species	Examples
Domain Eukarya	About 4–10 million	
Kingdom Animalia	About 2 million	
Phylum Chordata	About 50,000	
Class Mammalia	About 5,000	
Order Carnivora	About 270	
Family Ursidae	8	
Genus *Ursus*	4	
Species *Ursus arctos*	1