One-day Lesson Plan Outline

*Lesson Title: \_\_Microbes are a BLAST\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_*

*Grade level = \_X* Middle or High *\_\_ Amount of time for this lesson =*

*\_\_50\_\_\_\_\_ minutes (Each Day) 1 days*

1. Standards and Safety and Materials:

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| A. Standards - (Both Wyoming and NGSS. Number and write it out) | **MS-LS1.A:** *Structure and Function*: All living things are made up of cells, which is the smallest unit that can be said to be alive. An organism may consist of one single cell (unicellular) or many different numbers and types of cells (multicellular). |
| B. Safety Concerns: If none – “minimal safety concerns with regular class activity” | Minimal safety concerns with regular class activity |
| C. Materials (List of all materials needed for class including **technology** – like probes, tools, computer use, etc…) | Microbe sort cards, internet access (activity can be completed if internet access or computers are not available), dichotomous key for microbes, projection screen, laptop for lecture and instructions. |

1. Objectives: (List them and make sure all are measurable! **Bold** the verbs. Three different levels!) Students will be able to…

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| A. SWBAT… ***use*** *a measurable verb* | **Determine** which characteristics are useful in sorting or classifying items. |
| B. SWBAT… | **Create and explain** a classification system using the microbe sorting cards. |
| C. SWBAT… | **Observe and record** information about microbes. |
| D. SWBAT… | **Draw conclusions** to **communicate** the various ecological roles that microbes play in the ocean. |

1. Connections, Misconceptions, and Crosscutting Concepts:

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| A. Real world connections: (List them; e.g. Careers, Societal issues, etc…) | Microbes play a role in the carbon and nitrogen cycles, vital to Earth functions, can be related to global warming. Microbes are used to create antibiotics and immunizations. The required use of vaccines in the public-school system is a hot topic in our society, which many relate to the increase of autism in our country. Microbiologists can have careers in pharmaceutical research companies, medical research, oceanic research and ecosystem research, to name just a few. |
| B. Student connections: (List them; With what do they connect? Music, food, etc…) | Microbes can be found in the yeast we used in baking and foods such as yogurt. Teacher can refer to the movie Holes and the creation of Sploosh for stinky feet and what causes the odor. The discoloration of oranges and how that relates to microbes. How the thickening of milk if it sours is related to microbes. |
| C. Misconceptions: (List those AAAS misconceptions related to your content) | **MOM002:** A model is always a three-dimensional object. Therefore, pictures, diagrams, graphs, written descriptions, abstract mathematical or conceptual models are not models. (Grosslight, et. Al., Penner et al., 1997; Treagust, et al. 2002; Schwartz & White, 2005). 36% grades 6-8; 43% grades 9-12.  **MOM007:** A model can only represent aspects of a phenomenon that are already known; it cannot be used to figure out new things (for example, make an accurate prediction) about what is being represented. This still allows one person to use a model to communicate things he or she already knows about something to other people, even if they do not already know it. (Grosslight et al., 1991; Schwartz & White, 2005). Grades 6-8 17%; Grades 9-12 14%.  **MOM006:** The more a model is similar to what is being modeled (particularly with respect to physical similarities), the better the model is (AAAS Project, 2061, n.d.). Grades 6-8 50%; Grades 9-12 41%.  **CEM001:** All cells are the same size and shape, i.e., there is a generic cell (AAAS Project 2061, n.d.). Grades 6-8 43%; Grades 9-12 37%.  **CEM005:** There are no single-celled organisms (AAAS Project 2061, n.d.). Grades 6-8 39%; Grades 9-12 30%.  **CEM003**: Some living parts of organisms are not made of cells (AAAS Project 2061, n.d.). Grades 6-8 36%; Grades 9-12 29%.  **CEM045**: Bacteria do not carry out essential life functions for themselves. Grades 6-8, 41%; Grades 9-12, 35%.  **ENM051**: Species that have no apparent, obvious, or superficial similarities have no similarities at all (see Shtulman, 2006). Grades 6-8, 39%; Grades 9-12, 32%.  ENM041: Species that are similar can share a common ancestor, but species that have no apparent, obvious, or superficial similarities cannot share a common ancestor (Poling & Evans, 2004; Stern & Hagay, 2005). Grades 6-8 47%; Grades 9-12 44%. |
| D. Crosscutting Concepts: (List them and explain how they are used – e.g. patterns, cause/effect, scale/proportion/quantity, systems/system models, energy/matter, structure/function, and/or stability/change) | **Middle School Science and Engineering practices**: *Planning and carrying out investigations.* To include investigations that use multiple variables and provide evidence to support explanations or solutions. Students are sorting microbes based upon several characteristics, discussing sorting options and researching sorting options of microbes. After deciding upon the sorting, students will be given a dichotomous key to compare their sorting with the key.  **Middle school crosscutting concepts**: *Scale, proportion, and quantity*. Phenomena that can be observed at one scale may not be observable at another scale. Through work with the sorting cards and research of the microbe, students will learn that microbes are not visible to the human eye but scaling up the microbe through the use of such tools as a microscope can make them observable to the human eye.  *Structure and Function*: Complex and microscopic structures and systems can be visualized, modeled, and used to describe how their function depends on the relationships among its parts. Use of the sorting cards, dichotomous key will aid in students learning how to visualize a system and relationships between structures and systems.  **Middle School Connections to Engineering, Technology, and Applications of Science**: Engineering advances have led to important discoveries in virtually every field of science, and scientific discoveries have led to the development of entire industries and engineered systems. Discussion about how scientists would sort the microbes leads to discussions of the use of such studies for the creation of medications, and understanding of terrestrial and marine ecosystems.  **Middle School Connections to Nature of Science**: *Science is a human endeavor*: Scientists and engineers are guided by habits of mind, such as intellectual honesty, tolerance of ambiguity, skepticism, and openness to new ideas. Each student/group will sort the microbes differently. Asking the students why they made the choices they did opens the discussion up to habits and experiences each person has that guides their thinking. |
| E. Academic Language: [List the words/prefixes/suffixes that are addressed (focus on science vocabulary as well as instructions such as analyze, compare/contrast, etc…). *What* will the teacher do? *How* does the teacher address the words/prefixes/suffixes? *How* does the teacher get students to use those words, prefixes, and/or suffixes?] | Microbe, dichotomous key, classification, characteristics, prokaryote, eukaryote, bacteria, microbiology, bacteria, viruses, fungi, protozoa  Teacher will ask class for definitions to see what the students know. Teacher will define all terms, giving visual examples. Students will apply these concepts to the sorting of the microbes and engage in a class discussion about what characteristics they used to sort their microbes and why they chose those microbes. Teacher will assist students by modeling the correct pronunciation and use of each term. Teacher will explain how diagramming a microbe on a larger scale aids in studying the microbe. |

1. Catch/*Engagement*: (Hook them quickly – use all 5 senses at different times – should be no longer than 5 minutes.)

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| Hook: How to get student/class attention | Show video defining microbes. Video length 2:12 minutes https://www.youtube.com/watch?v=\_Vj0cIgwpQI |

1. Pre-test: (Same as post-test and short – to the point… **Bold** the objectives you are using – same as above!)

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| Pre-test and Post-test question(s) Put the pre-test at the end of this day’s lesson plan (along with PowerPoint etc…)! | 1) **Determine** which characteristics were the most helpful in classifying the microbes.  2) **Create and explain** a classification system using the microbe sorting cards.  3) **Observe and record** information about microbes.  4) **Draw conclusions** to **communicate** the various ecological roles that microbes play in the ocean. |

1. Activity/*Exploration*: (**Bold** the verbs that match the objectives. Can have as many parts as needed – step by step directions.  
    *(Remember: Include at least 1 science writing activity and probe activity for the unit!)*

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| 1. Beginning of lesson | (total time for beginning lesson. 10:42 minutes).  1) Students view video (catch). <https://www.youtube.com/watch?v=_Vj0cIgwpQI> 2:12 minutes  2) Teacher will hold a review of the terms: dichotomous key, prokaryote, eukaryote through cold call (1:30 min.)  3) Teacher will use hands to ask students the definitions of classification and characteristics in general terms. Then ask students to apply these terms to scientific research. (3 min.)  4) Teacher will define microbiology, microbe, and the main types of microbes (bacteria, viruses, fungi, protozoa). (4 min.) |
| 1. Middle of lesson | (Total time for middle of lesson: 30:58 minutes).  5) Introduce the microbe sort card activity, hand out and go over instructions before handing out the microbe cards, otherwise students will focus on the cards and not the instructions.  6) Divide students into groups, hand out cards, direct students to sort or **create** a classification system of the microbe cards based upon characteristics the group thinks are important.  7) Have students **explain** the reasons for their groupings.  8) Have the students **record** their **observations** in their lab notebooks. |
| 1. End of lesson | (Total time for end of lesson 9 minutes).  9) Have students complete the questions on their lab handout.  10) Bring the class together and discuss the value and challenge to sorting organisms based on physical characteristics. If the students find the question confusing, give the students an example, such as, if the students were given pictures of other students in the classroom, they could sort the students by hair color, eye color, or other physical features, but not by talents or interests, which are functional traits. To classify an organism by functional traits, more information is needed than can be provided by a picture, such using DNA or observations of the organisms interacting in their natural ecosystem.  11) Review the terminology introduced at the beginning of the lesson, use show of hands.  12) Give a 5-question summative assessment.  13) Hand out homework assignment. Essay question: How does understanding the classification of microbes help us to understand the role of microbes in the ocean? |
| 1. Are lecture (<11 min), lab, etc… clearly explained? Are directions and student expectations explicit? *Did you do this? Yes or No* |  |
| 1. PowerPoints, lab sheets, notes, answer keys, etc… included? *Did you do this? Yes or No* |  |

1. Review/Essential Questions/*Explanation*: (Should be closely related to pre/post tests!)

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| A. Low Level Questions – (Knowledge/Remembering and/or Comprehension/Understanding) | What characteristics were most helpful in classifying the microbes? |
| B. Middle Level Questions – (Application/Applying and/or Analysis/Analyzing) | Why were these characteristics the most helpful?  What characteristics might scientists use to classify the microbes? |
| C. High Level Questions – (Synthesis/Evaluating and/or Evaluation/Creating) | Would scientists use the same process to sort/classify the microbes?  How does understanding the classification of microbes help us to understand their role in the ocean? |

1. Assessments (Post-test)/*Evaluation*: (**Bold** the verbs that match the objectives and are in the activity.)

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| A. Formative: (Check for learning in class?) e.g. Oral questions? | 1) At the beginning of the class, the teacher is completing a formative assessment, through cold call and show of hands, of the vocabulary terms.  2) During the activity part of the class, the teacher will be walking around, monitoring the students’ progress, asking questions about their choices.  3) At the end of the lesson a formative assessment will be made during the oral discussion and review of the terminology taught at the beginning of the class. |
| B. Post-test: ( “Same as pre-test”; Compare w/pre-test to inform teaching!) | 1) **Determine** which characteristics were the most helpful in classifying the microbes.  2) **Create and explain** a classification system using the microbe sorting cards.  3) **Observe and record** information about microbes.  4) **Draw conclusions** to **communicate** the various ecological roles that microbes play in the ocean |
| C. Summative: (Check for final learning/understanding) – e.g. Students turn in **constructed** project and **take** 20 question multiple choice test. | 1) Students will turn in their completed lab reports. If using groups, they will each still turn in a separate lab report.  2) Students will take a 5- question test at the end of class.  3) Students will complete an essay question for homework. |
| D. Explain how the data informs tomorrow’s teaching. For example, “The class post-test average must be a 80% or the next class begins with a 10 minute review/discussion of today’s material followed by another post-test of the same material.” | An overall average of 80% must be achieved before moving on to the next lesson. The data obtained from the assessments will inform the teacher of areas where the instruction must be revised, concepts students are struggling with.  The data will also be able to provide the teacher with information regarding which students find the material difficult or not challenging enough. |

1. Timeline for your lesson:

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| A. Catch 2 min  B. Pre-test 3 min  C. Instruction/lecture 6 min.  D. Activity – 4 parts 30 min  E. Review and Post-test 9 min  Add/change as needed |  |

1. Enrichment/*Elaboration*: (Include one enrichment activity for students that might finish early)

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| What enrichment activities are offered for students in this lesson (beyond what is taught)? | Students, using the internet or other resources, can look up the microbes from the cards, and give a brief description about them. Descriptors might include, type of microorganism, what part of the ocean they live in (deep, shallow, near shore, etc.), their food source, and/or the role they play in the environment |

1. IEP Accommodations/Differentiation/Diversity: What accommodations will you use to support struggling learners?

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| What accommodations are used to support struggling learners? | Depending upon the student’s needs, the student could be placed in the group of their choice, or decide to work separately. The would be permitted to choose where they wish to sit, be given more time to complete the assignment, be given oral and written instructions, and/or given extra assistance with completing the assignment. |

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