2015

# Microbe Hunters: Pioneers of the Microscopic World [7th grade]

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**UNDERSTANDING BY DESIGN**

# Microbe Hunters: Pioneers of the Microscopic World

**Grade:** Seventh Grade

**Subject Areas:** Science and Reading

**Designed by:** Joy Brush and Jaime Jaen

**Time Frame:** About 15 days each for Reading and Science Class (spread throughout several weeks)

**School District:** KIPP San Antonio

**School:** KIPP Camino Academy

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**Abstract:** This unit integrates reading and science as students follow the contributions of Leeuwenhoek, Spallanzani, and other influential scientists depicted in Paul de Kruif's *Microbe Hunters*. Students first read and discuss the investigations conducted by these scientists in reading class. In science class, students design and implement their own versions of these experiments to build on their understanding of the microscopic world and the importance of perseverance.

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Note: The learning activities in this unit do not have to be taught in 15 consecutive days, nor must students read *Microbe Hunters* from cover to cover. Our intention was to have students delve into a particular section of *Microbe Hunters* in reading class as it coincided with the information being presented in science. For example, in reading class students will begin by reading about Leeuwenhoek's experimentation with different methods of magnification. After reading this passage the students will design and implement their own related experiment in science class (see performance assessments). Students might read the next passage in *Microbe Hunters* consecutively or a certain amount of time later – depending when it coincides with the curriculum in science.

## Stage 1 – Desired Results

### Established Goals (Standards)

Reading:

**RL.7.1:** Cite several pieces of textual evidence to support analysis of what the text says explicitly as well as inferences drawn from the text.

**RL.7.2:** Determine a theme or central idea of a text and analyze its development over the course of the text; provide an objective summary of the text.

**RL.7.4*** Determine the meaning of words and phrases as they are used in a text, including figurative language and connotative meanings; analyze the impact of rhymes and other repetitions of sounds (e.g. alliteration) on a specific verse or stanza of a poem or section of a story or drama.

**RI.7.6:** Determine an author's point of view or purpose in a text and analyze how the author distinguishes his or her position from that of others.

Science:

**6.12A** – understand that all organisms are composed of one or more cells.

### Transfer

*Students will independently use their learning to…*

- Identify and explain the importance of perseverance and its impact on self and others.
- Decode a difficult text to create meaning by making personal connections to the text.
- Articulate how scientific advances and inventions change the world and affect the future.

### Meaning

Understandings

*Students will understand that….*

- In the human experience, perseverance has been essential to an individual's ability to reach goals and impact the world around them.
- Books that are written by a member of a different culture or written many years ago can be hard to understand. Masterful readers can use the context in which the text was written to create meaning.
- Successful scientists and inventors do not always rely on the same approach or method to accomplish their goals.
- Perseverance and problem solving are

Essential Questions

- What role can (and should) perseverance play in my life? When I persevere, how does it impact my life and others?
- What universal struggles transcend time and place, bringing meaning to our own lives?
- How do scientific inventions fundamentally change the human experience?
- How is problem solving related to perseverance?
- What are cells, where are they found, and how do we know

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<table>
<tr>
<td rowspan="4">7.12C – recognize levels of organization in plants and animals, including cells, tissues, organs, organ systems, and organisms.<br>7.12F – Recognize that according to cell theory all organisms are composed of cells and cells carry on similar functions such as extracting energy from food to sustain life.<br>7.14B – Compare the results of uniform or diverse offspring from sexual reproduction or asexual reproduction<br><u>Process Skills:</u><br>7.3D – relate the impact of research on scientific thought and society, including the history of science and contributions of scientists as related to the content.<br>7.4A – Use appropriate tools to collect, record, and analyze information, including life science models, hand lens, microscopes, microscope slides… journals/ notebooks, and other equipment as needed to teach the curriculum</td>
<td colspan="2">inevitably intertwined.<br><br>Science:<ul><li>All living things are made of cells. All cells come from other cells. Cells are the smallest units of life in organisms.</li><li>Scientific discoveries and inventions can radically change our perspective on the world and what we assumed to be true.</li></ul></td>
<td>they exist?<ul><li>Why are cells important to living things?</li><li>How and why do microscopes magnify specimens?</li></ul></td>
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<tr>
<td colspan="2">Acquisition</td>
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<td>Knowledge<br>Students will know…<ul><li>the scientific contributions of Leeuwenhoek, Spallanzani, Pasteur, Koch and Walter Reed.</li><li>How Leeuwenhoek, Spallanzani, Pasteur, Koch and Walter Reed used perseverance to accomplish their goals</li><li>how major scientists and events contributed to the discovery of cells and the development of microscopes.</li><li>The development of the microscope played a crucial role in the discovery of cells and development of modern medicine.</li><li>Examine and compare the methods used by Leeuwenheuk, Spallanzani and other scientists that resulted in their contributions to the scientific community</li><li>observe and illustrate how all organisms are composed of one or more cells</li><li>recognize that the presence of a nucleus determines whether a cell is prokaryotic or eukaryotic.</li></ul></td>
<td>Skills<br>Students will be able to…<ul><li>identify specific words or phrases to determine the author’s point of view</li><li>Draw inferences from the text about perseverance.</li><li>Paraphrase a quotation about perseverance.</li><li>Identify and explain examples of figurative language and describe the impact they have on the reader.</li><li>Compare an author’s embellished/exaggerated account with a purely objective presentation of facts.</li><li>Analyze the author’s point of view and support this analysis by citing examples from the text</li><li>Use figurative language to demonstrate understanding of a complicated topic.</li><li>refine a definition to include opposing ideas</li></ul></td>
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| | • differentiate between the structure and function of plant and animal cell organelles, including the organelles common to all cells: cell membrane, nucleus, and cytoplasm cell wall, mitochondrion, chloroplast, and vacuole.<br>• depict levels of organization in plants and animals: Cells are the smallest unit of life; cells form tissues, tissues form organs, organs form systems, and systems form organisms.<br>• compare and contrast how and why cells reproduce (including the process and results of asexual and sexual reproduction) | • identify the parts of a microscope and their functions<br>• prepare a microscope slide and properly use a microscope |

| **Stage 2 – Evidence** | |
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| **Evaluative Criteria**<br><br>Criteria for Success for Reading Performance Tasks – See Appendix<br><br>Criteria for Success for Science Performance Tasks – See Appendix | Performance Task(s)<br>*Students will demonstrate meaning-making and transfer by…*<br>1. Participate in a Socratic Seminar with the framing question: How does the perseverance of individuals impact their lives and the lives of others?<br>2. Create a storyboard that illustrates the scientific achievements of each of the microbe hunters and a moment in which they demonstrated perseverance.<br>3. Write a 5 paragraph essay using the following prompt: Many times when biographical authors write about individuals they fall in love with their subjects. Did Paul De Kruif idolize his subjects? Explain…<br>4. Students will explore with glass, water, lenses and other objects of choice to ponder the question: How and why do microscopes magnify specimens? In this investigation, students will explore how Leeuwenhoek and other scientists developed the compound microscope by attempting to create their own magnification devices. (See appendix for student materials)<br>5. Design and conduct an experiment based on Leeuwenhoek's process to test the essential question: What are cells? Where are they found and how do we know they exist? Students will choose a variety of specimens (living, once-living or nonliving) and observe them under the microscope. |

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| | 6. Design an investigation to test the question: How do cells reproduce? Students will use Spallanzani's scientific process to observe and experiment with the growth rates of yeast. They may opt to change a variable of their choice (environment, nutrient availability, etc.).<br>---<br>Other Evidence (e.g., formative)<br>Formative assessments:<br>1. Create a flow-chart that presents a step-by-step model of Leeuwenhoek's scientific method.<br>2. Create a T-chart listing at least two positive qualities and two negative qualities of Spallanzani's personality according to the text<br>3. Students will write a brief summary comparing the experimental process used by Spallanzani and Leeuwenhoek.<br>4. Students will write a brief paragraph describing the relationship between perseverance and problem solving reflected in the work of Spallanzani<br>5. Students will list a sequence of events that outline Koch's development from a romantic dreamer to a disciplined scientist.<br>6. Students will list at least four examples of figurative language in this chapter and write a short paragraph explaining how they create a less formal tone.<br>7. Students will record factual details from a video to compare to the exaggerated portrayal of Pasteur in the book.<br>8. Students will create a graphic organizer that depicts the pressure on Pasteur as he sought a vaccine for rabies.<br>9. Students will sort images of plants, humans and other various organisms into the proper sequence of organization using a graphic organizer: cells, tissues, organs, systems and organisms.<br>10. Students will use a microscope and provided resources to observe and identify the names and functions of various microscope parts.<br>11. Students will prepare a specimen on a microscope slide and use a compound microscope without assistance to accurately focus on a particular area of the specimen at low, medium and high power magnification.<br>12. Students will complete a Venn diagram to compare and contrast asexual and sexual reproduction. |

## Stage 3 – Learning Plan

Pre-Assessment

*How will you check students' prior knowledge, skill levels, and potential misconceptions?*

Pre-Assessments may be introduced at the beginning of the unit, or immediately prior to introducing each topic/skill.

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- Open response Pre-Assessment (scored using the Rubric for Open-Ended Questions in Science -see appendix)
  - What role can (and should) perseverance play in my life? When I persevere, how does it impact my life and others?
  - What universal struggles transcend time and place, bringing meaning to our own lives?
  - How do scientific inventions fundamentally change the human experience?
  - How is problem solving related to perseverance?
  - What are cells, where are they found, and how do we know they exist?
  - Why are cells important to living things?
  - How and why do microscopes magnify specimens?

- Microscope Pre-Assessment: provide students with a list of microscope parts (ex: Ocular lens, diaphragm, stage). Have students write each term on a separate post it note and place the label on the microscope where they think that part is located. Remind students not to place the post it notes directly on the lenses.

**Learning Activities**: Each sequence of activities below may take multiple days. In total, the lessons are anticipated to take about 15-20 days for 60 minute classes. The learning activities in this unit do not have to be taught consecutively, nor must students read *Microbe Hunters* from cover to cover. The learning activities below are separated by reading and science, although they are intended to be taught as topics coincide. The activities in Science should be performed as students read the related passage in *Microbe Hunters*.

**Reading**

1. Students will read the first two sections of Leeuwenhoek's chapter and answer 12 text dependent questions. Students will summarize the author's view of Leeuwenhoek by choosing three words.
2. Students will read section three of the Leeuwenhoek chapter and answer text dependent questions to identify his process through the scientific method.
3. Students will read the beginning of the Spallanzani chapter and answer text dependent questions in order to identify two positive attributes and two negative attributes about Spallanzani.
4. Students will engage in a discussion by moving to different sections of the room depending on if they think Spallanzani was prejudiced or not prejudiced when he approached the Needham Experiment. They will then compare the process used by Leeuwenhoek to study rain water and the process used by Spallanzani to disprove Needham.
5. Students will read section 6 of the Spallanzani chapter in search of figurative language that makes the text come alive. They will also chronicle the events that

**Formative Assessment**

1. Create a flow-chart that presents a step-by-step model of Leeuwenhoek's scientific method.
2. Create a T-chart listing at least two positive qualities and two negative qualities of Spallanzani's personality according to the text
3. Students will write a brief summary comparing the experimental process used by Spallanzani and Leeuwenhoek.
4. Students will write a brief paragraph describing the relationship between perseverance and problem solving reflected in the work of Spallanzani

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| Spallanzani went through and how he used perseverance to make his way through these events.<br>6. Student will watch a brief clip from Old Yeller to better relate to the disease of Rabies. Students will identify and explain foreshadowing and answer text dependent questions. Students will summarize the letter to Pasteur's sister.<br>7. After reading and discussing that both Leeuwenhoek and Spallanzani built perseverance into their scientific procedures, students will read chapter 3 independently and will apply the same process to identify Pasteur's perseverance.<br>8. Student will read the Koch chapter and answer 15 text dependent questions. They will then list a sequence of events that outline Koch's path to the medical field<br>9. Students will read the next section of the Koch chapter, answer text dependent questions and identify and explain examples of figurative language and the effect they have on the reader.<br>10. Students will watch an informational video about Pasteur and compare it to the exaggerated portrayal of him in the book. They will answer several text dependent questions as they read and identify three examples of figurative language.<br>11. Students will split into 4 teams and read on in four sections. They will write notes about the section related to how Pasteur had to show perseverance in his search for the rabies cure. They will then complete a graphic organizer that depicts the pressures bearing down on Pasteur as he sought a vaccine for rabies | 5. Students will list a sequence of events that outline Koch's development from a romantic dreamer to a disciplined scientist.<br>6. Students will list at least four examples of figurative language in this chapter and write a short paragraph explaining how they create a less formal tone.<br>7. Students will record factual details from a video to compare to the exaggerated portrayal of Pasteur in the book.<br>8. Students will create a graphic organizer that depicts the pressure on Pasteur as he sought a vaccine for rabies. |
| **Science**<br>1. Students will explore the question: "How and why do microscopes work to magnify a specimens" Students discuss how they think a microscope works and make predictions as to which everyday items will work best for magnification. Next, students investigate, compare and record data on different methods used for magnification (ex: glass, increasing drops of water on a glass slide, lenses and combinations of magnifying lenses). See appendix for a sample student handout.<br>2. Students will use their data from this experiment to investigate the structure and function of Leeuwenhoek's microscope in comparison to modern compound microscopes. Which item worked the best for magnification? How is this similar or different from Leeuwenhoek's invention? How are modern microscopes different from Leeuwenhoek's original microscope?<br>3. Students will place labels on a microscope according to their predictions for the name and function of each part. First provide students with a list of microscope parts (ex: Ocular lens, diaphragm, stage). Have students write each term on a separate post it note and place the label on the microscope where they think that part is located. Remind students not to | **Formative Assessment**<br>1. After completing the magnification investigation, students will write a letter addressed to Leeuwenhoek (imagining that they are living during his time). In this letter, they should include a diagram of the setup that best magnified their specimen, as well as a defense of their design, articulating why it was the best option for optimal magnification.<br>(Possibility: Leeuwenhoek was a "commoner" and wrote his letters in an informal vernacular. This assignment could be used in a writing class to |

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| place the post it notes directly on the lenses. (See pre-assessment section above). Students then depict and label the name and function of each microscope part on a printed diagram after receiving feedback as to whether their pre-assessment predictions were correct. See appendix for handouts.<br>4. Students will practice using a compound microscope by focusing in on the left eye of a smiley face (printed and taped on a glass slide) at low, medium and high power magnification. Students will complete the focusing quiz in order to demonstrate mastery of this skill and receive authorization to use the microscope independently. See appendix. After mastering this skill, students will practice preparing a wet mount using a specimen of choice.<br>5. Design an experiment based on Leeuwenhoek's process (based purely on curiosity) to test the essential question: What are cells? Where are they found and how do we know they exist? Students will choose a variety of specimens (living, once-living or nonliving) and observe them under the microscope. All questions, observations and conclusions should be documented in a lab report, to be assessed by the attached rubric. Through discovery and experimentation, students should come to the conclusion that all living (and once-living) things are made of cells. Cells are not found in abiotic substances. (This may take several days, depending how many specimens are used and how easily students are able to focus the microscope)<br>6. After the experiment, reinforce the concept that all living things are made of cells using a concept attainment model. Examples (YES column) should include images or descriptions of living and once-living substances. Non-Examples (NO column) should include abiotic substances (never alive). After sorting each example into the YES or NO column during the activity, students discuss and justify what the labels should be for each column (Example: yes= alive/once-alive/biotic/made of cells. No= abiotic/not made of cells). Do not provide the answer, but do help lead students to the realization that YES = made of cells (as needed). See the following sample of a concept attainment model in use: http://www.ascd.org/ascd-express/vol4/420-silver.aspx<br>7. Students will depict how living things are organized, with a primary emphasis on the concept that cells are the smallest unit of life in organisms. Students will be provided images of plants, humans and other various organisms and must sort each image into the proper sequence of organization using a graphic organizer: cells, tissues, organs, systems and organisms. For each organism, a picture should be provided to represent each level of organization in that organism. Example images: root cell, root tissue, root (organ), root system, plant; or cardiac cell, cardiac tissue, heart, circulatory system, human.<br>8. Design an investigation to test the question: How do cells reproduce? Students will use Spallanzani's scientific process to observe and experiment with the growth rates of yeast. | discuss code-switching – and compare how students might write differently if they were communicating with Spallanzani, a highly educated scientist)<br>2. Using a microscope and provided resources, students will observe, identify and label the names and functions of various microscope parts on a provided diagram.<br><br>3. Students will use a compound microscope without assistance to accurately focus on a particular area of the specimen at low, medium and high power magnification- see attached rubric for criteria for success.<br>4. Student can prepare a specimen on a microscope slide. Specimen is sealed using a drop of water and a cover slip. Little to no bubbles are present under the coverslip.<br>5. Students will articulate any inquiry questions for the experiment, record materials used and detailed observations of each specimen, as well as a written conclusion answering the essential question: "What are cells? Where are they found and how do we know they exist?"<br>6. Students can predict and categorize images/items into the correct column (YES or NO). Student can accurately define the yes column as "made of cells" or pertaining to living/once-living/organic |

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They may opt to change a variable of their choice (environment, nutrient availability, etc.). All questions, observations and conclusions should be documented in a lab report, to be assessed by the attached rubric. Students may document/qualify the amount of yeast growth by placing a balloon over a flask and observing the increase in the balloon's size. Students should also observe and diagram yeast growth as seen under the microscope (which will lead to a discussion of budding/asexual reproduction). Many variations of this lab can be found online. This experiment will likely take 2-3 days.

9. Compare the experimental processes used by Leeuwenhoek and Spallanzani by reflecting on and relating to the various labs conducted in class. Possible conclusions that students may arrive at: the first two investigations (magnification and observing cells) were unstructured and based on curiosity/exploration (Leeuwenhoek). The yeast investigation was structured, included controls and variables and was based on the scientific method (Spallanzani). Discuss the following unit understandings:

- Successful scientists and inventors do not always rely on the same approach or method to accomplish their goals.
- Perseverance and problem solving are inevitably intertwined.

How are these understandings evidenced by our lab investigations?

10. Discuss students' findings during the yeast lab- with a particular emphasis on how the yeast reproduced, and how students could be certain that the cells were reproducing. Using a Venn Diagram, compare and contrast how and why organisms reproduce (sexual vs. asexual reproduction. (Including different forms of cell reproduction- budding, propagation, mitosis/meiosis, etc.). If desired, this may lead into a subsequent unit on how and why organisms reproduce (asexual and sexual reproduction).

11. Closure: Have students respond to the unit essential questions. Responses could be written, answered during discussion, or both. (Written response are scored using the Rubric for Open-Ended Questions in Science -see appendix)

- What role can (and should) perseverance play in my life? When I persevere, how does it impact my life and others?
- How do scientific inventions fundamentally change the human experience?
- How is problem solving related to perseverance?
- What are cells, where are they found, and how do we know they exist?
- Why are cells important to living things?
- How and why do microscopes magnify specimens?

Have students revisit their responses to the pre-assessment. How did your answers change, grow or develop?

substances.

7. Students will sort images of plants, humans and other various organisms into the proper sequence of organization: cells, tissues, organs, systems and organisms.
8. Students will articulate any inquiry questions for the experiment, record materials used and detailed observations of each specimen, as well as a written conclusion answering the question: How do cells reproduce? How can we be certain that cells reproduce?

10. Students will complete a Venn diagram to compare and contrast asexual and sexual reproduction.

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# APPENDIX: Student Materials

Evaluative Criteria: Reading Performance Tasks

**Storyboard CFS**
Each scientist should have two boxes (8 total)
Each box has…
The scientist's name as a title and either "perseverance" or "accomplishment"
A quote from the book highlighting a scientific accomplishment of the scientist.
A quotation from the book that shows how each scientist had to use perseverance.
An illustration that shows either the accomplishment or moment of perseverance
A brief (2 sentence) description of how the perseverance of the each scientist changed their life and the lives of others.

**Socratic Seminar CFS**
Participants must earn 5 points and points can be earned the following ways:
Ask a question to the group (1 point)
Answer a question using a quote from the book (2 points)
Answer a question without evidence (½ point)
Involve a new member (½ point)
Make a connection to your world (1 point)

| **Essay Rubric** | | | | |
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| | **4** | **3** | **2** | **1** |
| **Learned Skills** | **Shows strong command of grammar and usage, and correctly and effectively demonstrates learned skills** | **Shows evidence of what has been studied and command of grammar and usage, with occasional errors** | **Shows little command of grammar and usage; writing is either overly simple or marked with errors** | **Errors are numerous, of a wide variety and interfere with meaning** |
| **Style** | **Establishes and maintains** | **Establishes a** | **Shows attempts** | **Uses an** |

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| | **a consistent, formal style as appropriate to audience and purpose, but may switch to more informal style for effect**<br>**Varies sentence patterns for meaning, reader interest, and style**<br>**Chooses language to express ideas concisely, recognizing and avoiding unnecessary words (such as ineffective modifiers) and redundancy** | **formal style, with some unintentional lapses**<br>**Uses correct and varied sentence structures** | **to use a formal style, but often lapses into a more informal style**<br>**Uses mostly correct sentence structures, but may be repetitive**<br>**Words do not appear to have been selected purposefully and response may be unnecessarily wordy and redundant** | **inappropriately informal style (slang, too many abbreviations, etc.)**<br>**Does not demonstrate mastery of correct sentence structures and structures used are repetitive** |
| **Language** | **Uses varied words, phrases (prepositional, adjectival, verbal, adverbial, and nominal), and clauses (independent, subordinate, adverbial, adjectival, and nominal) to create cohesion effectively clarify the relationships among claim(s), reasons, and evidence**<br>**Uses precise and sophisticated vocabulary (grade-appropriate general academic and domain-specific words and phrases)** | **Uses words, phrases, and clauses to clarify relationships among claim(s), reasons, and evidence**<br>**Uses vocabulary appropriate for the audience and purpose** | **Uses a few simple words, phrases, and clauses to clarify the relationships among claim(s) and reasons**<br>**Uses more general words and language** | **Does not use words, phrases, or clauses to clarify the relationships among claim(s), reasons, and evidence; the reader must work to understand connections**<br>**Uses simple or limited vocabulary** |
| **Grammar and Conventions** | **Demonstrates command of grammar and usage, and shows evidence of mastering the elements studied in class** | **Makes few grammatical errors**<br>**Mostly demonstrates** | **Shows some understanding of grammar, but some errors interfere with** | **Misplaced and dangling modifiers interfere with meaning**<br>**Grammatical and** |

# APPENDIX: Student Materials

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| | **Places phrases and clauses within sentences so that the meaning is clear; avoids misplaced and dangling modifiers**<br>**Uses correct spelling and more sophisticated punctuation [including using a comma appropriately to separate coordinate adjectives (*It was a fascinating, enjoyable movie)*]** | **control over placement of phrases and clauses**<br>**Makes few errors in punctuation or spelling** | **meaning**<br>**Places phrases and clauses inappropriately in sentences, so that meaning may at times be unclear**<br>**Makes some mistakes in punctuation or spelling** | **conventions errors make writing difficult for the reader to understand**<br>**Makes many mistakes in punctuation and spelling** |

# APPENDIX: Student Materials

Evaluative Criteria: Science Performance Tasks

Problem Based Lab Rubric
Adapted from Mrs. Fix's Lab Rubric, Arcadia Middle School 2002-2003. Modified 10/16/03

| Category | 4<br>Exceeding Standards | 3<br>Meeting Standards | 2<br>Approaching Standards | 1<br>Not Meeting Standards | Self-Reflection | Peer Reflection | Teacher Reflection |
|---|---|---|---|---|---|---|---|
| **Introduction**<br><br>Topic<br>Purpose<br>Problem | The topic, purpose, and problem are related to each other. The lab problem is clearly testable. | The main purpose of the lab is clear and the problem can be tested. | The main purpose or problem of the lab is unclear. | The purpose and problem of the lab are unclear or miscommunicated to reader. | | | |
| **Research**<br><br>Variables<br>Hypothesis | Specific research is used to support the hypothesis and it clearly corresponds with the purpose and problem. Hypothesis is stated as an "If..then..because.." statement and accurately identifies the independent and dependent variables. | The hypothesis is partially supported by research of the topic. The proper variables have been identified and incorporated into the hypothesis. | Some research has been documented; however, it is not used to support the hypothesis or a mistake was made in identifying the variables. | Research is unrelated to topic or the hypothesis does not show a relationship. Variables not mentioned or incorrectly identified. | | | |
| **Plan**<br><br>Procedure<br>Data Table | The plan is sequential, logical, repeatable, and contains safety procedures. All variables are accounted | A logical plan including safety procedures is created that another scientist | The plan is logical but doesn't contain all of the environmental | The plan is not designed to find the answer to the identified problem or does | | | |

# APPENDIX: Student Materials

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| | for within the steps and are able to be collected using scientific measurements. The data table is set up to collect a minimum of 5 measurable pieces of data and includes a title and appropriate labels. | could easily repeat. All variables are identified. Steps have been made to appropriately control the environment and to collect a minimum of 3 measurable pieces of data. All important data has a place in the data table. | controls or safety procedures necessary for a scientist to repeat. Most variables are identified and have a place on the data table. | not follow a sequence of events that could be repeated. Safety has not been considered in the procedure. The data table has not been set up to collect appropriate data. The variables are not sufficiently identified. | | | |
| **Results**<br><br>Data<br>Graph<br>Data Summary | A minimum of 5 measurable pieces of data have accurately been collected and displayed. The graph visually displays the answer to the lab problem. There is a clear, concise data summary. | Data shows reasonable trends and patterns (minimum of 3 measurable pieces of data). The graph displays the answer to the lab problem. A data summary paragraph is accurately included but not concise. | Data is incomplete or inconclusive. Unreasonable patterns were shown on data table or graph or the data summary is lacking a connection to the problem. | Important data is missing or not organized appropriately. Graph does not show significant findings of this lab experience. | | | |
| ***Understandi*** | The analysis and | Analysis supports | The analysis is | Analysis and | | | |

# APPENDIX: Student Materials

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| ***ngs***<br><br>**Data Analysis**<br>Conclusion in CEI Format | conclusion demonstrate a complete understanding of the purpose of the lab, the results, interpretation into everyday life, and future investigations are identified. An exemplary conclusion is linked to the problem and hypothesis and is written in a CEI format (Claim, Evidence, and Interpretation). | results of lab. A satisfactory conclusion is written in a CEI format (Claim, Evidence, and Interpretation). | incomplete or is not based on findings. The conclusion does not address the research problem or does not use data to provide evidence for the claim. | conclusion are not related to findings in the lab or the research. Complete thoughts were not used to convey ideas. | | | |
| **Format**<br><br>Overall Appearance And Accuracy | Lab report is organized according to lab rubric, neat, and shows attention to detail with no grammatical errors. | Lab report is organized according to lab rubric, neat, and has few grammatical errors. | Lab report lacks organization and does not follow the order of the lab rubric. There are some grammatical errors. | Lab report is disorganized, incomplete, with little attention to detail. There are several grammatical errors. | | | |

# APPENDIX: Student Materials

Detailed Teaching and Scoring Rubric for Open-Ended Questions in Science

| Category | 1 point – Emerging | 2 points – Developing | 3 points – Proficient | 4 points – Advanced |
|---|---|---|---|---|
| **Response Completeness** | • An answer to the question is attempted but it may be unclear<br>• Not all parts of the question are addressed<br>• No explanation is provided for the answers given | • Some parts of the question are adequately addressed OR all parts are partially addressed<br>• An attempt is made at providing explanations for the responses given | • All parts of the question are answered with valid explanations for each response | • All parts of the question are answered and explanations for each that exhibit the logic and thinking behind the responses are provided |
| **Inclusion of Evidence** | • Evidence, if incorporated, does not support the topic | • Evidence is incorporated but may be incorrectly used or insufficient to support the topic | • Evidence is incorporated consistently, is used properly and is sufficient to support the topic | • Evidence is incorporated consistently and used properly; provides strong support for the topic |
| **Grasp of Content** | • Significant misconceptions or inaccurate information indicate minimal understanding of the concept; confusion is evident | • Basic understanding of the content is evident but some significant misconceptions are seen | • Understanding of the content is evident but some minor inaccuracies or misconceptions persist | • Content is clearly mastered<br>• No misconceptions or misinterpretations evident |
| **Use of Vocabulary** | • Few vocabulary words appropriate to the topic are incorporated and/or used correctly | • Most vocabulary words appropriate to the topic are used but not always correctly | • All vocabulary words appropriate to the topic are incorporated but may not all be used correctly or consistently | • Extensive use of vocabulary appropriate to the topic are incorporated and used correctly and consistently<br>• Vocabulary from prior units of study may be incorporated if appropriate and used correctly |
| **Response** | • Organization is not | • Some organizational | • Organization allows | • Organization leads |

# APPENDIX: Student Materials

| | | | | |
|---|---|---|---|---|
| **Organization** | evident or is ineffective; message is confusing or difficult to follow | structure is evident; response is logically or sequentially ordered but the message may be difficult to follow | reader to follow and understand the response; message is clear | reader through the response so that the message is clear and exhibits confident grasp of the material |
| **Response Grammar and Conventions (appropriate to grade level)** | • Many errors in spelling and various types of conventions are evident throughout the response; grammar errors make reading and comprehending the response difficult | • Simple conventions of capitalization and punctuation are correctly applied but inconsistent; grammar errors make reading and comprehending the response awkward but the message is clear | • Reasonable and correct use of standard conventions is evident; few grammar errors make for a clear message; may still need polishing but more is correct than incorrect | • Effective use of standard writing conventions is evident; errors in grammar are few and minor; punctuation is correct and effectively applied; the message is clear and easily understood |

**Scoring – average the scores from each category to obtain the overall score.**

Holistic Scoring Rubric for Open-Ended Questions in Science

| | |
|---|---|
| 1 point – Emerging (70) | An answer to the question is attempted but it may be incomplete or unclear and no explanation is provided for the answers given. Evidence may be included in the response but it does not address the topic. Misconceptions and inaccurate information indicate minimal understanding of the concepts addressed by the question. Few vocabulary words are included or many are used incorrectly. Lack of organization and numerous errors in spelling, grammar and conventions make the response difficult to read and comprehend. |
| 2 points – Developing (80) | Some parts of the question are adequately addressed or all parts are included but only partially addressed. An attempt is made at providing explanations for the responses given and evidence is included but is insufficient to support the topic or is incorrectly used. Though misconceptions may be evident, a basic understanding of the concepts addressed in the question is clear. Most of the vocabulary words appropriate to the topic are included but may be used incorrectly. The response is logically or sequentially organized but errors in spelling, grammar and conventions make the message understandable but awkward. |
| 3 points – Proficient (90) | All parts of the question are addressed and adequately answered with valid explanations for each response. Evidence is incorporated, used properly and sufficient to support the topic. Understanding of the concepts is clear but some minor misconceptions or misinterpretations may persist. All appropriate vocabulary words are included but may not all be used correctly. Organization of the response is clear and easy to follow though errors in spelling, grammar and conventions may interfere with the flow of the message. In general, more standard writing conventions are correct than incorrect. |
| 4 points – Advanced | All parts of the question are answered and explanations for each exhibit logic and thinking. Evidence |

# APPENDIX: Student Materials

| | |
|---|---|
| (100) | provided strongly supports the topic and is used correctly. Response shows clear mastery of the content with no misconceptions or incorrect interpretations. Vocabulary appropriate for the topic is used extensively and the response may incorporate vocabulary from prior units of study. The response exhibits clear, logical organization with few minor errors in spelling, conventions and grammar. In general, the response exhibits a polish and sophistication indicating above grade level knowledge and writing skills. |

# APPENDIX: Student Materials

## CREATE YOUR OWN MICROSCOPE!

Essential Question: How and why do microscopes magnify specimens?

**Stretch:**

1. **AIM**: I can illustrate how the lenses of a microscope work to _____ objects.
2. What does it mean to magnify something?

3. Read through the procedure below & on the back. What will you measure with the ruler?

Materials: Glass slide, Small cup of water, 2 Hand lenses, Ruler, Pipette

e

**SIMPLE MICROSCOPE (Single Lens) Procedure:**

1. Hold your glass slide over the letter "e" in the box above. What do you see? Write down your observations in the data table under "0 drops".
2. Move the slide up and down (closer and further from the paper) until you get the letter in clear focus. Measure the distance from the paper to the bottom of the glass slide using the ruler. Record the distance in your data table.
3. Using the pipette place one drop of water in the middle of the glass slide and hold it over the letter "e" again. What happens? Write your observations in the table below under "1 drop".
4. Move the slide up and down again until you get the letter in clear focus. Measure the distance from the paper to the bottom of the glass slide using the ruler. Record your answer.
5. Repeat steps 3 and 4, adding a new drop each time. Move the slide up and down again until you get the letter in focus with this "bigger" lens. Record the distance and your observations for each number of drops. (See back of page for next steps).

**DATA TABLE:** Complete the chart below to show your observations using the water drop lens:

| # of drops | Observations | Drawing | Distance from page to lens |
|---|---|---|---|
| **0** | | | |

# APPENDIX: Student Materials

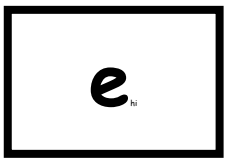
| | | | |
|---|---|---|---|
| **1** | | | |
| **2** | | | |
| **3** | | | |
| **Hand lens** | | | |

**A. What do you predict would happen to the magnification if you used more drops of water?**

**B. By adding drops of water to the glass, you created a "lens". In your words, what is a lens?**

6. Now use the large lens on the hand lens (magnifying glass) to view the letter "e." Record your observations in the data table.
7. Move the hand lens up and down again until you get the letter in clear focus. Measure the distance from the paper to the bottom of the glass slide using the ruler. Record your answer.

**C. How do your observations with the hand lens compare to the water lens you made?**




COMPOUND MICROSCOPE- (Created Using Two or More Lenses)

Materials: 2 hand lenses

**Procedure:**

# APPENDIX: Student Materials

1. As you did previously, place the large lens of the hand lens over the letter “e” above. Move the lens up and down until the “e” is in clear focus. Next move the hand lens until the smaller lens is over the “e.” What do you observe with the smaller lens?

2. Why do you think the smaller lens has more powerful magnification? (What do you think is different between the large lens and the small lens?)

3. Again using the large lens on the hand lens get the “e” in focus. Now place the large lens of a second hand lens between your eye and the first lens. What do you observe?

4. Next week we will be using a compound microscope, which uses many lenses to magnify. Explain in your own words how combining two hand lenses serves as a model for how compound microscopes work.

5. Explore: How else can you magnify objects? Experiment with the materials around you to try and create the strongest possible magnification. What worked the best? What was the strongest magnification you were able to achieve?

# APPENDIX: Student Materials

## Microscope Parts and Functions- Take Home Quiz

Write the correct term next to each definition. Use the Word Bank & your notes on p. 97 to help you.

**Note: You must score at least an 80% (12 answers correct) to use the microscopes!**

WORD BANK:

| | | | | |
|---|---|---|---|---|
| Arm | Eyepiece (ocular lens) | Compound Microscope | Glass Microscope Slide | Body Tube (head) |
| Base | Revolving Nose Piece | Course adjustment knob | Fine adjustment knob | Specimen |
| Diaphragm (iris) | Light Source | Stage | Stage Clips | Objective lens- High or Low power |

| Microscope Part | Definition or information |
|---|---|
| **1.** | The bottom part of the microscope |
| **2.** | Helps adjust the amount of light that reaches the specimen |
| **3.** | You look through this to view the specimen. Contains the ocular lens. |
| **4.** | This holds up the glass slide that is being viewed. (the slide is placed on top of this) |
| **5.** | A rectangular piece of glass used to put the specimen on. |
| **6.** | Moves the eyepiece and objectives up and down to help you get the specimen into view |
| **7.** | Attaches the eyepiece to the rest of the microscope. |
| **8.** | Projects light upwards through the diaphragm, allowing you to see the specimen |
| **9.** | Holds the glass slide in place on the stage |

# APPENDIX: Student Materials

| | |
|---|---|
| **10.** | Helps to “fine tune” or sharpen the image |
| **11.** | A microscope that has more than one lens |
| **12.** | Found on the revolving nosepiece. Can have Low or High power magnification. |
| **13.** | Holds the objective lenses and rotates to allow you change from one objective to another |
| 14. | You hold this to help carry the microscope. It also supports the objective and ocular lenses. |
| **15.** | Another name for the object you are looking at in the microscope. Ex: a plant, or a piece of hair |

# APPENDIX: Student Materials

## Compound Light Microsopes.

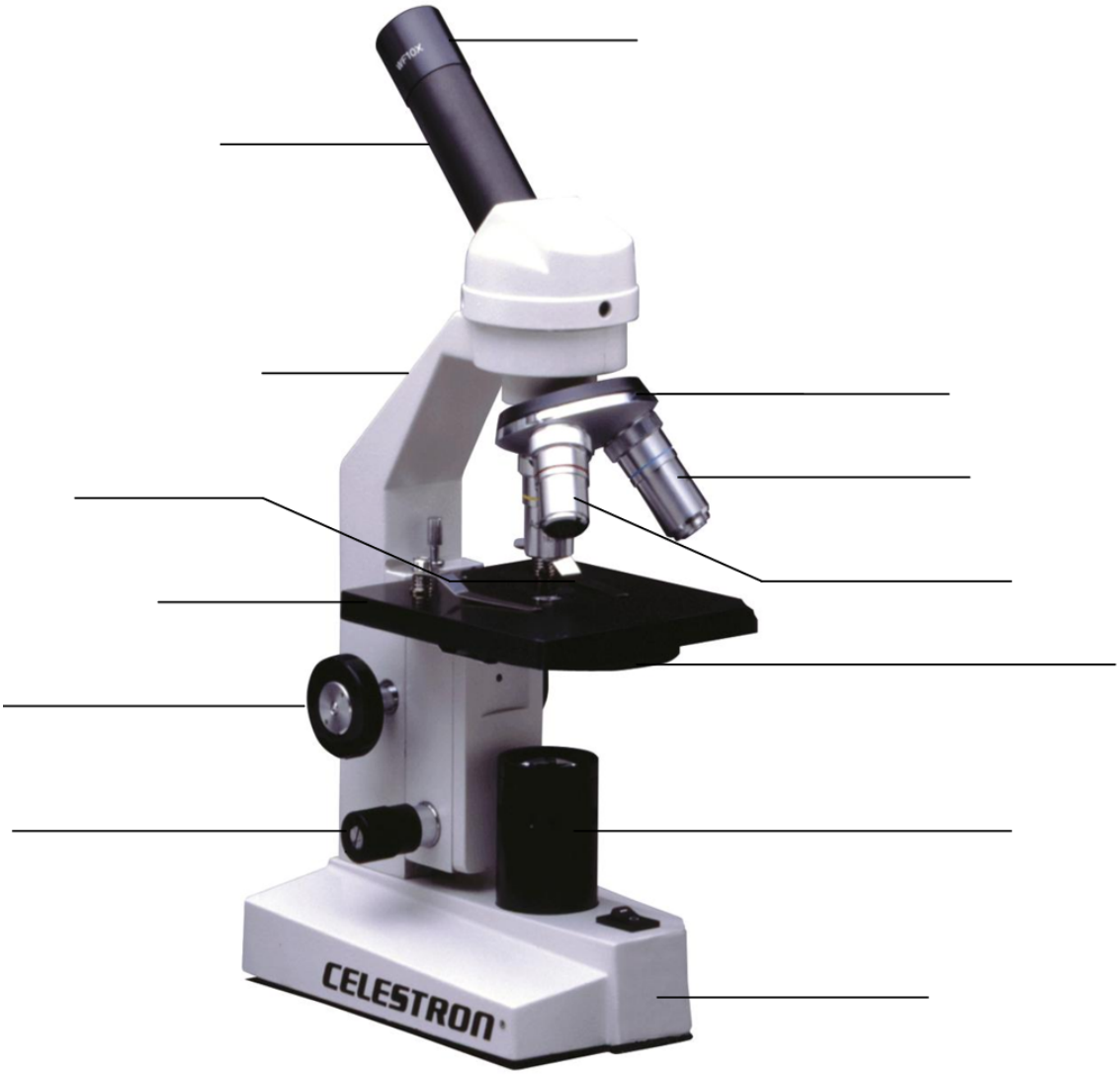
**Stretch:**

5. **AIM**: I can label and _____ the parts of a Compound Light _____.
6. What are two things you already know about microscopes?
   a. _____
   b. _____
7. What do you want to know about microscopes? (2 questions)
   a. _____
   b. _____

**Directions:** Once your teacher checks your labels on the microscope, begin labeling the diagram below using the word bank.

| | | | |
|---|---|---|---|
| Arm | Eyepiece (ocular lens) | Objective lens, high power | Objective lens, low power |
| Base | Revolving Nose Piece | Course adjustment knob | Fine adjustment knob |
| Diaphragm (iris) | Light Source | Stage | Stage Clips |
| Body Tube (head) | Light Switch | | |

# APPENDIX: Student Materials



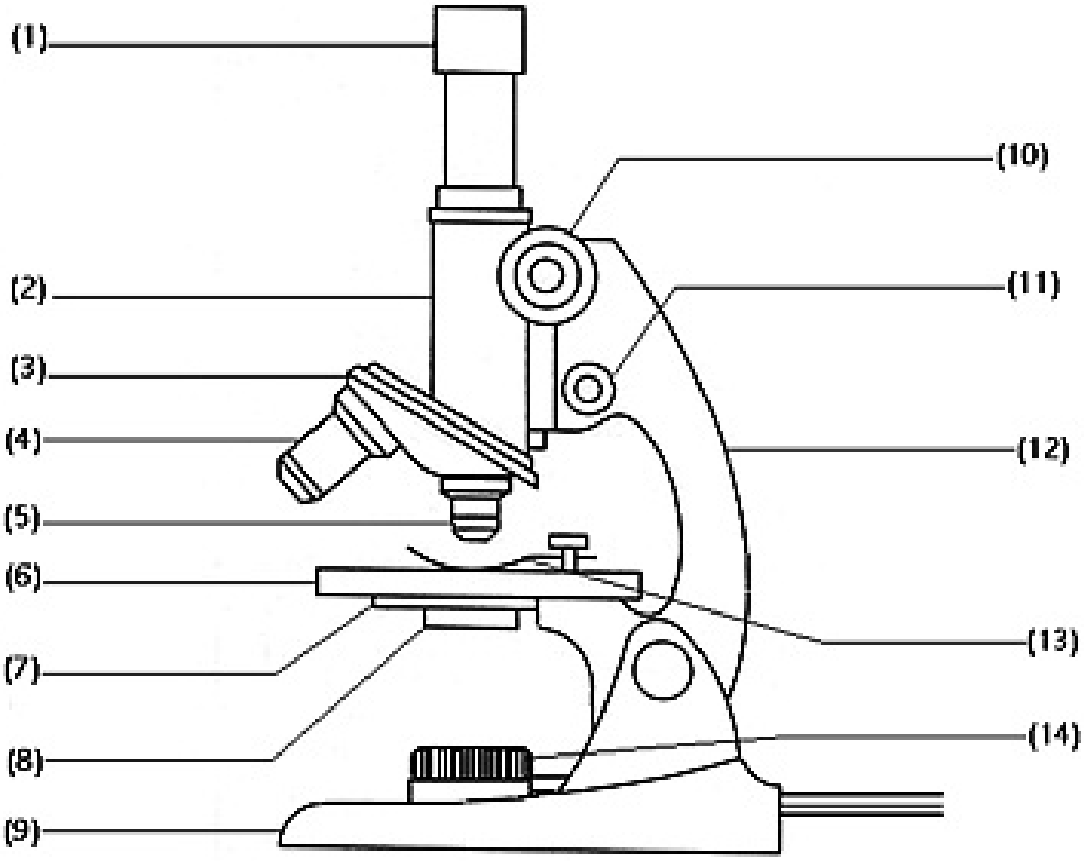
# APPENDIX: Student Materials

**Mini Quiz:**

1. Study your diagram on the previous page. When you think you are ready, begin labeling the diagram below. DO NOT turn your page back over until you are finished!!

2. Once you finish your quiz, circle any numbers you got wrong and re-write the correct label.

3. Create your "color key". Color each word below in a specific color- then color in the diagram to match




Key: Color each box below to match your diagram.

| | | | |
|---|---|---|---|
| **Arm** | **Eyepiece (ocular lens)** | **Objective lens, high power** | **Objective lens, low power** |
| **Base** | **Revolving Nose** | **Course adjustment** | **Fine adjustment** |

# APPENDIX: Student Materials

| | Piece | knob | knob |
|---|---|---|---|
| **Diaphragm (iris)** | **Light Source** | **Stage** | **Stage Clips** |
| **Body Tube (head)** | **Light Switch** | | |

Assign yourself: How many **lenses** can you see in the compound microscope?

Why are there so many?

NAME: _____

## MICROSCOPE FOCUSING QUIZ

| Task Accomplished | Yes | No |
|---|---|---|
| 1. Begins at starting position (stage lowered, 40X objective is in place) | | |
| 2. Student places slide on the stage with stage clips appropriately | | |
| 3. Student uses coarse adjustment to focus at 40X | | |
| 4. Item(s) in focus at 40X and at the end of the black pointer | | |
| 5. Student moves objective to 100X appropriately | | |
| 6. Student focuses with fine adjustment only | | |
| 7. Item(s) in focus at 100X and at the end of the black pointer | | |
| 8. Student moves objective to 400 X appropriately | | |
| 9. Student focuses with fine adjustment only | | |
| 10. Item in focus at 400X and at the end of the black pointer | | |

Total "No" = _____ Final Score = _____

# WORKS CITED:


- Reading content- adapted from the KIPP Wheatley 7th grade curriculum Module 2
- Science Problem Based Lab Rubric- adapted from Mrs. Fix's Lab Rubric, Arcadia Middle School 2002-2003. Modified 10/16/03
- Scoring Rubric for Open-Ended Questions in Science- adapted from the KIPP San Antonio Science Department