| **Lesson Plan for Grades: 9-12 (potentially 7-8)**  **Length of Lesson:** |
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| **Authored by:** UT Environmental Science Institute  **Date created: 5/6/2025** |
| **Subject area/course: Biology (can be adapted to general sciences)** |
| **Materials:**   * [Chimpothesis slides](https://docs.google.com/presentation/d/11ICPX0iJtgLiJExk-BAAr5Fabg5K2qTgVcagB8w_Sx0/edit?slide=id.g3491284608c_0_44#slide=id.g3491284608c_0_44) (Provide students with a link to these slides) * [Chimpanzee stations](https://docs.google.com/document/d/1UebkD8ijTCtnwkmsc65rb9aPK19U8iZM3ncyZ2poFwU/edit?tab=t.0) (Print out 1 copy of each station) * [Chimpanzee stations worksheet](https://docs.google.com/document/d/1UebkD8ijTCtnwkmsc65rb9aPK19U8iZM3ncyZ2poFwU/edit?tab=t.0) (Print out one for each student) * [Testing the Hypothesis worksheet](https://docs.google.com/document/d/1VEEVY12BNVvt3vqYlo8Bt1dA2farjqSgOhU-ojpY3gA/edit?tab=t.0) (Provide students with a link and print out a few hard copies for students who may want to work on paper, It is not necessary to print the rubric) |
| **TEKS/SEs:**  **Rule §112.42. Biology**  (3) Scientific hypotheses and theories. Students are expected to know that:  (A) hypotheses are tentative and testable statements that must be capable of being supported or not supported by observational evidence. Hypotheses of durable explanatory power that have been tested over a wide variety of conditions are incorporated into theories; and  (B) scientific theories are based on natural and physical phenomena and are capable of being tested by multiple independent researchers. Unlike hypotheses, scientific theories are well established and highly reliable explanations, but they may be subject to change as new areas of science and new technologies are developed.  (4) Scientific inquiry. Scientific inquiry is the planned and deliberate investigation of the natural world using scientific and engineering practices. Scientific methods of investigation are descriptive, comparative, or experimental. The method chosen should be appropriate to the question being asked. Student learning for different types of investigations include descriptive investigations, which involve collecting data and recording observations without making comparisons; comparative investigations, which involve collecting data with variables that are manipulated to compare results; and experimental investigations, which involve processes similar to comparative investigations but in which a control is identified.  (A) Scientific practices. Students should be able to ask questions, plan and conduct investigations to answer questions, and explain phenomena using appropriate tools and models.  (B) Engineering practices. Students should be able to identify problems and design solutions using appropriate tools and models.  (5) Science and social ethics. Scientific decision making is a way of answering questions about the natural world involving its own set of ethical standards about how the process of science should be carried out. Students should be able to distinguish between scientific decision-making methods (scientific methods) and ethical and social decisions that involve science (the application of scientific information). |
| **Lesson objective(s):**   * Students will be able to create, evaluate and critique a scientific hypothesis * Students will be able to draft a scientific experiment/observation while taking into account ethical concerns. |
| **Differentiation strategies to meet diverse learner needs:**   * During the station activity, students can be grouped in homogenous or heterogenous groups depending on the students needs. The teacher can circulate to give support as needed. Consider making one of the stations a teacher led station. * Students will be given the option to complete worksheets digitally or on paper. |
| **ENGAGEMENT (10 minutes)**  Student will be shown 4 short videos showcasing common chimpanzee behaviors:   * During each video students will be writing down their observations on a piece of paper. They will also be asked to make a guess as to what was going on in the video * SOUND WARNING: The noises made by chimpanzees are very loud, even at lower volumes. Test the videos beforehand in order to find a suitable volume. * Content of each video:   + Video 1: Chimpanzee pant hoots used to communicate over long distances. This behavior is mostly used to indicate the location of a group of chimps or a valuable resource (primarily food).   + Video 2: Chimpanzee battle lines. When a group of male chimps encounters an unfamiliar group of chimps, they will form long lines and rush the other group, hoping to isolate one male from the rest of the group in order to attack them.   + Video 3: This video shows chimps on a territorial patrol. In this case they are quietly listening for the sound of rival chimps before moving forward.   + Video 4: This video showcases chimp grooming behavior. This is done to strengthen social bonds and relieve anxiety.   Students will then discuss what is observed in small groups (About 3 minutes).  The teacher will then lead a short class discussion over what the class had observed |
| **EXPLORATION (30 minutes)**  On slide 6, students will be asked to define a hypothesis in their own words, in a short classroom discussion (About 1 minute per question.)  Students will then go through various stations that explain the important parts of a hypothesis. The teacher will start by asking the students what they think a hypothesis is and what must be included. Students will be given 1 worksheet to work on throughout all the stations.   * Each student will be given a station activity [handout](#bookmark=id.2c6oitiq8tq3) (listed at the bottom of this document). * Each station has an instruction page (listed at the bottom of this document). These sheets will introduce their topic and give students instructions for how to complete the lesson plan   Stations (7 minutes each):   * [Hypothesis must be specific, precise and testable](#bookmark=id.c7dx2yxwfruq)   + Students will be introduced to basic criteria for determining whether a hypothesis is valid (specific/precise/testable)   + For this activity students will be asked to sort a set of hypotheses into 3 categories: Unclear, Untestable or Good. They will then be asked to rewrite a few of these hypothesis * [Hypothesis must be ethical](#bookmark=id.e8el77nkgydd)   + Students will be introduced to the concept of writing ethical hypotheses. In this introduction, they will learn about notorious experiments perform don chimps as well as some common ethical mistakes   + In this activity, students will be given several unethical hypotheses and asked to determine the problems with each . They will then be asked to rewrite each of these hypotheses to be more ethical. * [Practice writing hypothesis](#bookmark=id.ltum5lycjwvu)   + Students will be given an overview of the hypothesis creation process. They will then be introduced to the concept of the null hypothesis.   + Students will be given several sets of variables and expected outcomes and asked to turn a few of these into hypotheses. they will than be asked to create a null hypothesis for a few of these variables * [Claim, Evidence and Reasoning through the lens of chimpanzees](#bookmark=id.kul0a94zfnh3)   + Students will be introduced to the concept of forming an explanation through the Claim, Evidence and Reasoning method.   + Students will be given 2 smaller activities to complete     - Activity 1: Students will be given 2 true hypotheses about chimp behavior and asked to identify the claim, evidence and reasoning portion of each.     - Activity 2: Students will be given the claim and evidence for 2 true explanations of chimpanzee behavior and asked to connect them with their own lines of reasoning. |
| **EXPLANATION (30 minutes)**  Students will then be introduced to the split in the Ngogo chimp colony alongside some facts about the territory (population size, age of colony, etc. ) *On slides 8-10.* During this time, students will be taking note on a blank sheet of paper or a google doc (whichever they prefer).  On slide 11, students will be asked to perform their own research using the same notes sheet as before. They should also be given a link to the slides so that they can review its information while researching.  Using the information in their notes from, students will be asked to create a hypothesis that may explain the split. (slide 12)  After about 10 minutes students will present their hypothesis to their peers for review. Their peers will be asked to critique the hypothesis with the following checklist: (slide 13)   * Does it match the facts? * Is it testable/observable? * What would be the null hypothesis? * Can it be tested ethically? * What are the implications? (What would it mean for the hypothesis to be true?) |
| **ELABORATION (25 minutes)**  Students will be asked to create a draft of a scientific experiment/observation that would test their hypothesis using the “Testing the Hypothesis” worksheet. The rubric for this assignment is listed at the bottom of this document and at the bottom of the worksheet.  While creating their experiment, students will be encouraged to discuss their experiments with each other to receive constructive criticism and advice, |
| **EVALUATION (throughout entire lesson)**  Students will turn in their testing the hypothesis worksheets and will be graded based on the rubric below (also included in the worksheet itself). |
| **SOURCES AND RESOURCES**   * **Dr Aaron Sandal *Hot Science – Cool Talks #134,* “Love and War: What Can We Learn from Chimpanzees” https://www.esi.utexas.edu/talk/love-and-war-what-can-we-learn-from-chimpanzees/** |

Additional resources

* <https://www.seattleschools.org/wp-content/uploads/2022/03/AVID_Instructional_Strats.pdf>

**Rubric for designing an experiment activity.**

|  | **1** | **2** | **3** | **4** |
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| Hypothesis  40% | The hypothesis is incomplete.  The null hypothesis is incomplete. | The hypothesis is untestable and/or unfalsifiable.  The null hypothesis is written incorrectly. | The hypothesis is testable and falsifiable but unclear and/or overly general.  The null hypothesis is written correctly. | The hypothesis is testable, falsifiable, clear, and precise  The null hypothesis is clear, precise, and written correctly. |
| Variables  20% | The independent and dependent variables are incomplete.  Less than 2 controlled variables were listed.  No other variables listed. | The independent and dependent variables are vague, imprecise or not connected.  Controlled variables were given, but they do not connect to the experiment, or the explanation about how to control them were incomplete.  Other variables were given but they do not connect to the experiment, or the explanation about how to address their effects were incomplete. | The independent and dependent variables are connected to each other and the hypothesis.  Controlled variables connect to the experiment and their method of control is explained.  The other variables connect to the experiment and a method for limiting their effect was given. | The independent and dependent variables are clear, precise, and connected to each other and the hypothesis.  Controlled variables are clear. concise, and connected to the experiment. The method for controlling the variable is also clear and accurate.  The other variables are clear, precise, and connect to the experiment. The method for limiting their effect was clear and accurate |
| Experimental design  25% | Not enough materials listed.  Procedure is incomplete. Or the procedure does not follow from the hypothesis or variables.  Conditions and timespan of experiment not considered. | Materials are listed but vague or unrelated to the experiment .  Procedure is vague, too general, and unclear.  Conditions and timespan of experiment are vague | Materials are clear and related to the experiment.  Procedure is clear and logical.  Conditions and timespan of experiment are clear. | Materials are clear, specific, and related to the experiment.  Procedure is clear, logical, and detailed.  Conditions and timespan of experiment are clear and precise. |
| Ethical concerns and potential flaws  15% | Ethical concerns were not addressed.  Limits of the test were not discussed. | Ethical concerns were overlooked and not properly addressed.  Limits of the test were overlooked and not properly addressed. | Ethical concerns were clearly stated and addressed.  Limits of the test were clearly stated and addressed. | Ethical concerns were clearly stated, well considered, and well addressed.  Limits of the test were clearly stated, well considered, and well addressed. |