### **Station 1: Sorting Hypotheses**

Introduction & Activity:

For a statement to be a hypothesis, it MUST be testable and falsifiable (can be proven false). When writing a hypothesis, you should be able to come up with a list of results that would prove your hypothesis correct and a list of results that would prove your hypothesis false. If you cannot come up with at least one condition for each list, the statement is probably not testable.

 A hypothesis should also be clear and specific so that it can be tested through experimentation. Some hypotheses are too broad, making them hard to investigate or test.

For example:

The hypothesis that "Animals behave differently in the wild than in captivity" is impossible to test because it is too general. Notably, a more specific hypothesis like “Wolves behave differently in the wild than in captivity” is much better, but still lacks detail as animals can be held in various types of captivity (zoos and laboratories primarily).

The statement that “Unicorns prefer to eat carrots over any other vegetable” is simply impossible to test without access to unicorns, so it does not meet the requirements of being a testable hypothesis.

The statement that “chocolate ice cream tastes better than vanilla ice cream” is unfalsifiable because it is a matter of opinion not based on objective facts.

At this station, you will examine different statements and decide whether they are *Overly General (hard to test)*, *Not a hypothesis (unfalsifiable and/or completely untestable)*, or *Good*. You will receive a set of hypothesis statements and sort them into these three categories. If you have extra time, try to rewrite some of the overly general hypotheses and the not hypotheses into good hypotheses.

| Not a hypothesis (Unfalsifiable, impossible to test) | Over general (hard to test) | Good |
| --- | --- | --- |
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**Hypothesis to sort (cut out for students so that they can physically sort them):**

1. *“*Chimpanzees in larger social groups display more frequent dominance interactions than those in smaller groups."
2. “Apples are better for horses than any other fruit”
3. “Children aged 7-12 prefer the taste of vanilla ice cream to chocolate ice cream”
4. “Animals can solve mazes with food located at the exit faster then they can solve mazes without food”
5. “Canines are more genetically similar to plants then they are to felines”
6. “If an animal disappears, it has moved to another dimension."
7. "People who exercise are healthier."
8. “Roosters who know that they descended from dinosaurs are angrier than roosters who don’t”

### **Station 2: Writing Ethical Hypotheses About Animal Behavior**

**Introduction & Activity**:
When studying animal behavior, scientists must be careful to avoid biases and ethical concerns. One common mistake is *anthropomorphism*—The assumption that animals think and behave as humans. This is problematic because animals often demonstrate behaviors that look kind of like human behaviors but aren’t.

Additionally, studying animals in a lab setting instead of their natural habitat can affect their behavior, leading to different results. This occurs for a variety of reasons, but one of the common ones is the fact that animals are very sensitive to changes in their environment and new environments often lead to discomfort. When writing a hypothesis, you should consider whether or not it could be tested in an animal's natural environment.

Ethical research also requires minimizing harm and distress to animals. Some historical experiments crossed ethical boundaries, causing unnecessary suffering.

One infamous unethical example is *Harry Harlow’s maternal deprivation experiments* in the 1950s and 1960s. Harlow studied the effects of social isolation on baby rhesus monkeys, separating them from their mothers and placing them in isolation chambers. The monkeys developed severe psychological distress. While the research contributed to understanding attachment, it raised major ethical concerns about animal cruelty. Today, such experiments would not be approved.

Analyze animal behavior hypotheses and determine if they are ethically and scientifically sound.

1. Identify ethical concerns in provided hypotheses.
2. Rewrite them to ensure they are objective, testable, and ethically appropriate.

Note that hypothesis B-D are all based on widely publicized experiments

**Example**:

* **Flawed Hypothesis**: "Dogs comfort their owners when they feel sad because they care about human emotions." (*Anthropomorphism – assumes dogs understand emotions the way humans do.*)
	+ **Revised**: "Dogs are more likely to stay close to their owners when their owners exhibit behaviors associated with sadness, such as crying or a lowered posture."

Hypothesis to rewrite

1. "Bulls in bright red rooms react aggressively because they are frustrated with the color red”
2. "Rats exposed to cocaine will become addicted”
3. “Male chimpanzees often form strong friendships with other males”
4. “Certain pesticides will kill at least 50% of the rabbits that inhale them”
5. “The introduction of wolves into forest ecosystems reduces the prey population”
6. “Cats believe that humans are there servants”

### **Station 3: Writing Hypotheses**

Scientists don’t just make random guesses—they create hypotheses based on observations and educated predictions. A good hypothesis clearly states what is being changed (**independent variable**) and what is being measured (**dependent variable**). It also predicts what will happen when the independent variable changes.

Sometimes, you don’t expect anything to happen at all. This is called the **null hypothesis**. Unlike proving regular hypothesis, to prove the null hypothesis you need to show that the independent variable has no effect on the dependent variable

At this station, you’ll take a set of variables and turn them into strong, testable hypotheses. You will be given an independent variable, a dependent variable, and an expected result. Your job is to identify the independent and dependent variables, and write a hypothesis that connects them correctly. Than you will write the null hypothesis for the statement

Example:

* Variables: Amount of sunlight (IV) and tree growth (DV).
* Expected Result: More sunlight leads to more tree growth.
* Hypothesis: "A tree that receives 4 hours of sunlight a day will grow larger than one that only receives 3 hours of sunlight a day.”
* Null hypothesis: “There will be no difference in the growth of a tree receiving 3 hours of sunlight a day and the growth of a tree that receives 4 hours of sunlight a day.

Write a hypothesis and null hypothesis for the following (pick 3 to record on your worksheet)

h1:

* Variables: Distance traveled and food consumed by cheetahs
* Expected Result: Cheetahs consume more food when traveling long distances.

h2:

* Variables: Amount of rainfall and color of grass
* Expected Result: Grass exposed to more rain is greener.

h3:

* Variables:Temperature of water and time it takes for a fire to go out
* Expected Result:Come up with your own

h4:

* Variables: Size of an organism and the lifespan of an organism
* Expected Result: Larger animals live for longer

h5:

* Variables: Amount of rainfall and color of grass
* Expected Result: Grass exposed to more rain is greener.

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### **Station 4: Claim, evidence, reasoning through the lens of chimpanzees**

Any good explanation contains 3 important traits. A **claim**, supporting **evidence**, and a line of **reasoning** that connects them. This is especially important in the realm of science as the core component of the scientific method, the hypothesis, is a proposed explanation of a natural phenomenon.

The core principles of Claim, Evidence, and Reasoning (or CER for short) are as follows. First, any explanation must include a concrete claim such as “The ocean is composed of salt water”. Then, the claim must be supported by some sort of evidence such as “When ocean water is boiled, clumps of salt are left behind” and “Ocean water tastes like salt water”. Lastly, a line of reasoning is used to connect the evidence to the claim. In this case, a connecting line of reasoning could be “ ocean water tastes like salt water and leaves salt behind when boiled just like salt water, therefore, the ocean is primarily comprised of salt water”

At this station, you'll be asked to apply the principles of CER to various hypotheses concerning the behavior of chimpanzees through 3 different activities.

Activity 1: Identify the Claim, Evidence, and Reasoning of explanation.

Hypothesis 1: "Chimpanzees who groom each other have a closer bond than those who don't because chimps hunt with those that have groomed them. This is likely because grooming is a soothing behavior that calms chimps"

Hypothesis 2: ”Chimpanzees who make constant displays of dominance (such as charging at other chimps or wildly screaming and snapping branches) are supported by the other members of their community more often than chimpanzees who don’t. This increased support implies a higher standing in the social hierarchy, thus we can conclude that displays of dominance increases or maintains the hierarchical standing of a chimpanzee.

Activity 2: Read the claims alongside supporting evidence. Create a line of reasoning connection between the two.

Claim 1: Chimps release pant hoots (loud calls) to alert other chimps to the presence of food.

Evidence: Chimps who find fig trees will perch on top of it and scream until more chimps arrive.

Claim 2: Chimps view foreign groups of chimps as threats and competitors

Evidence: Chimpanzees react violently towards unfamiliar chimps, attacking and often even killing the unfamiliar chimp.

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### **Stations worksheet**

Each station has an activity which you will complete on this worksheet

**Station 1: Hypothesis or not:**

* Each hypothesis has a letter in front of it. Next to each category name, list the letter of each hypothesis that fits into that category
	+ Not a hypothesis:
	+ Overly general:
	+ Good Hypothesis:
* In the spaces below, rewrite a few of the overly general/not a hypothesis statements to better fit the definition of a hypothesis
	+ Rewrite 1:
	+ Rewrite 2:
	+ Rewrite 3:

**Station 2: Ethical hypothesis**

* Each hypothesis has a letter in front of it. In the spaces below, rewrite these statements next to their corresponding letter to better fit ethical standards.
1.
2.
3.
4.

**Station 3: Writing hypothesis**

* In the following table, Record your chosen independent and dependent variables

| Hypothesis number | Independent variable | Dependent variable |
| --- | --- | --- |
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|  |  |  |
|  |  |  |

* Next, turn each set of variables and conclusions to turn into a hypothesis below.

Hypothesis:

Hypothesis:

Hypothesis:

* Null hypothesis: Pick **2** of the hypothesis. Write the null hypothesis for them

Null Hypothesis 1:

Null Hypothesis 2:

**Station 4: Claim, evidence and reasoning**

Activity 1: Write down the claim,evidence and reasoning of each of the presented hypothesis in the space below:

* Hypothesis 1:
	+ Claim:
	+ Evidence:
	+ Reasoning
* Hypothesis 2:
	+ Claim:
	+ Evidence:
	+ Reasoning

Activity 2: In the spaces below, write down the reasoning connecting the evidence to the claim

* Hypothesis 1:
* Hypothesis 2:

**Answer key**

Station 1:

1. Good hypothesis. Its variables are clear, testable and objective.
2. Not a hypothesis . The use of the term better indicates that this is an opinion rather than a statement, making it unfalsifiable
3. Good hypothesis. Its variables are clear and testable.
4. Overly general. The term animals is far too broad to fully test.
5. Good hypothesis. Its variables are clear and it is falsifiable. This is an example of how good hypotheses are not necessarily true.
6. Not a hypothesis. It is unfalsifiable
7. Overly general. Both the terms healthy and exercise are vague.
8. Not a hypothesis. It is unfalsifiable as we can’t reliably find roosters who remember their ancestry.

Station 2:

1. Animals outside of their natural environment behave differently than normal. Frustration is an emotion primarily attributed to humans, thus the hypothesis is also anthropomorphising
2. Drugging animals is unethical
3. Friendship is a human concept, thus the hypothesis is anthropomorphising
4. Forcing animals to ingest poison is unethical.
5. Realising invasive species into an environment can not only cause unnecessary harm to other animals, but it can disrupt the ecosystem entirely.
6. Belief and servitude are human concepts.