

Hypotheses and Experiments Worksheet KEY
BIOL 01104 Spring 2020, Dr. Spielman

I. Hypotheses: For each hypothesis below, determine...

- Is it directional or nondirectional?
 - If *directional*:
 - What would the nondirectional version be?
 - What is the hypothesis for the other direction?
 - If *nondirectional*:
 - What is one directional version of the hypothesis?
 - What is its corresponding null hypothesis?
1. The presence of calcium increases the activity of neurons.
 - **Directional**
 - Nondirectional version: *The presence of calcium affects the activity of neurons.*
 - Other direction: *The presence of calcium inhibits/reduces/decreases the activity of neurons.*
 - **Null:** *The presence of calcium has no effect on the activity of neurons.*
 2. Lower temperatures cause goosebumps on skin.
 - **Directional**
 - Nondirectional version: *The temperature affects whether there are goosebumps on skin*
 - Other direction: *Higher temperatures cause goosebumps on skin*
 - **Null:** *The temperature has no effect on whether there are goosebumps on skin*
 3. Iron availability determines the size of algal blooms.
 - **Nondirectional**
 - A directional version: *More iron availability increases the size of algal blooms.*
 - **Null:** *Iron availability has no effect on the size of algal blooms*
 4. More complex organisms have larger-than-average genomes.
 - **Directional**
 - Nondirectional version: *Organismal complexity is related to genome size.*
 - Other direction: *More complex organisms have smaller than average genomes.*
 - **Null:** *Organismal complexity is not related to genome size.*
 5. Exposure to sunlight affects the length a plant will grow.
 - **Nondirectional**
 - A directional version: *Exposure to sunlight increases the length a plant will grow.*
 - **Null:** *Exposure to sunlight has no effect on the length a plant will grow.*

Hypotheses and Experiments Worksheet KEY
BIOL 01104 Spring 2020, Dr. Spielman

II. Experiments: On the following pages are two experimental scenarios. Each scenario contains an alternative hypothesis and a description of the experiment performed. For each scenario, determine the following:

- The null hypothesis.
- The independent and dependent ("response") variables.
- Any confounding factors you can think of.
- Experimental validity based on: a) Presence of a control group(s); b) Presence of replication, c) Presence of randomization.
- Suggest at least one way the experiment could be improved, *considering one of the principles of experimental design*.

1. Hypothesis: Thyroxin (a thyroid hormone) release triggers amphibian metamorphosis.

Researchers collect 100 tadpoles. They randomly place fifty tadpoles into a tank with just water, and they place the other fifty tadpoles into a tank with thyroxin. After four days, they count how many tadpoles have undergone metamorphosis in each tank.

- Null hypothesis: *Thyroxin release does not affect/is not related to amphibian metamorphosis.*
- Independent variable: *presence of thyroxin*
- Dependent variable: *number of tadpoles who underwent metamorphosis*
- Confounding factors (for example): *age of tadpoles at start of experiment, species of tadpole, concentration of thyroxin in tank, length of time for experiment, amount of nutrients in the water...*
- This is a valid experiment because:
 - Control group: *yes - one tank receives no thyroxin*
 - Replication: *yes - 50 tadpoles per experimental group. But, could use additional replication through more trials*
 - Randomization: *yes - researchers RANDOMLY assign tadpoles to groups*
- One way to improve: *Include more trials (repeat experiment)*

Hypotheses and Experiments Worksheet KEY
BIOL 01104 Spring 2020, Dr. Spielman

2. Hypothesis: Acetylcholine stimulates muscle contraction.

Researchers prepare fifty identical replicate cell cultures of muscle fibers. They randomly divide these cultures into five groups with 10 dishes each. Three of the groups are treated with an acetylcholine solution of a different concentration. The fourth group receives a treatment of the solvent without acetylcholine, and the fifth group receives no treatment. They record whether the muscle fibers in each petri dish contract over a subsequent 10 minute period. They also record the amount of time that the muscle fibers in petri dish contract for.

- Null hypothesis: *Acetylcholine does not affect muscle contraction*
- Independent variable: *concentration of acetylcholine*
- Dependent variable: *there are TWO: a) whether muscle fibers contract, b) the time amount of time muscles contract for*
- Confounding factors (for example): *source/type of muscle fiber*
- This is a valid experiment because:
 - Control group: *yes - there are TWO controls here (one solvent but no acetylcholine, and one water alone)*
 - Replication: *yes - 10 petri dishes per experimental group*
 - Randomization: *yes - researchers RANDOMLY divide dishes into groups*
- One way to improve: *Include more petri dishes. Could also have more groups to test more acetylcholine concentrations.*