Hypotheses and Experiments Worksheet
BIOL 01104 Fall 2019, Dr. Spielman

I. Hypotheses: Determine the null hypothesis for each alternative hypothesis given below.

1. Calcium is required for the proper functioning of neurons.

   Calcium is not required for the proper functioning of neurons.

2. Lower temperatures cause goosebumps on skin.

   Temperature does not affect whether goosebumps form on skin.

3. High amounts of iron (a key nutrient) lead to larger algal blooms in the Sargasso Sea.

   amount of iron does not affect algal bloom size in Sargasso Sea.

4. More complex organisms have larger genomes.

   Organism complexity is not related to genome size

5. Biological synthesis of glutamine requires ATP.

   Glutamine synthesis has no dependence on ATP.

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 variables you can think of.
- Experimental validity based on: a) Presence of a control group(s); b) Presence of replication, c) Presence of randomization.
- Predict results if the alternative hypothesis is *true.*
- Predict results if the alternative hypothesis is *false.*
- Suggest any way(s) the experiment could be improved.

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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.

Ho: Thyroxin has no effect on amphibian metamorphosis.

Independent: Presence of thyroxin
Dependent: # of tadpoles who underwent metamorphosis

Validity:
① Yes control (no thyroxin tank)
② Yes replication (50 tadpoles each)
could use multiple trials though!
③ Yes randomization ("randomly place")

predict true:
more metamorphosis in thyroxin tank than in control tank

Predict false:
same levels of meta. in each tank
(or more in control tank)

Improve w/ a) more tadpoles
b) more trials (only 1 done here)
could bias!

c) diff concentrations of thyroxine

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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.

Ho: acetylcholine has no effect on muscle contraction

Independent: acetylcholine concentration
Dependent: level of muscle contraction

Validity:
① Yes control (x2 < dishes w/ only solvent, dishes w/ only water)
② Yes replication — 10 dishes per group
③ Yes randomization — "randomly divide"

predict true: contraction in presence of acetyl. and none w/out acetyl.

Predict false:
same contraction w/ and w/out acetylcholine

Improve w/ more concentrations, more samples...