Research Idea: I want to know whether tomato plants grown with the fertilizer OptiGro yield juicier, tastier, tomatoes than plants raised in otherwise similar conditions but without the fertilizer and if additional watering impact the results.

To determine **cause and effect** we need to conduct a properly designed and executed experiment.
The **dependent (response)** variable is juiciness and tastiness (judges rate on scale of 1-7 for each).

List all possible questions(variables) you can think of regarding the design of an experiment to test the idea. (Things that could affect the response variable)

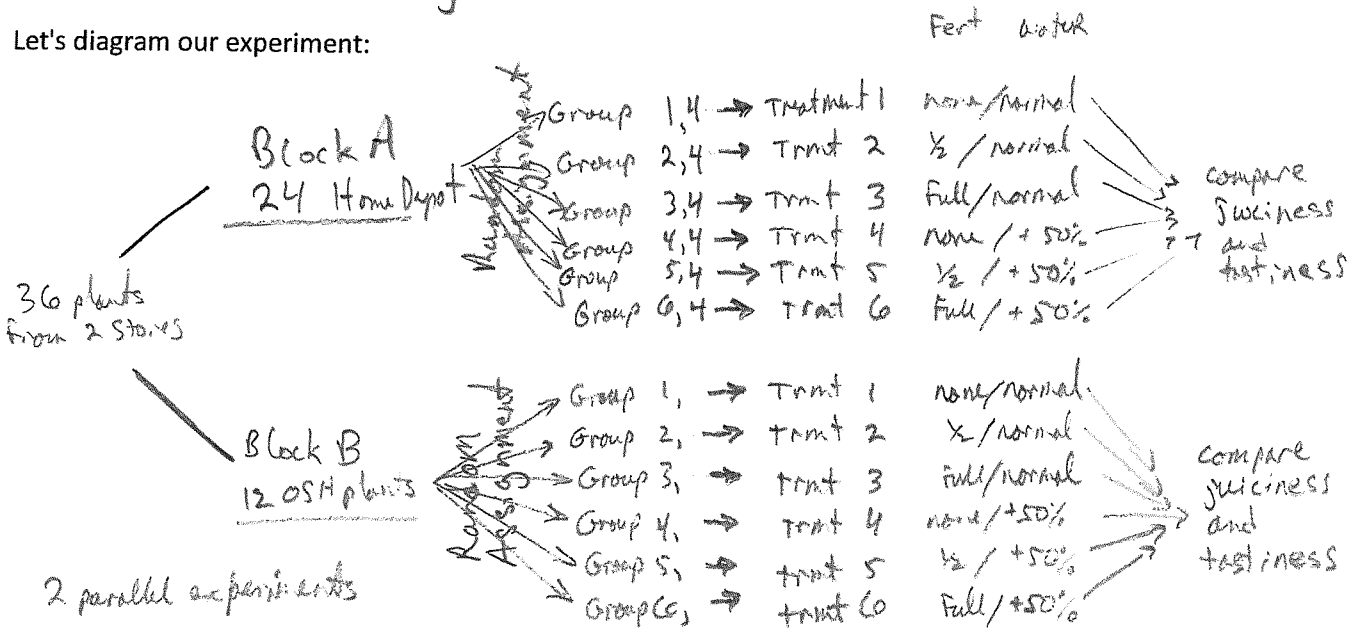
	answers(levels)	
How much OptiGro fertilizer will the plants receive?	None	1/2 Dose Full Dose
How much water will the plants receive?	Normal	50% more
✓ How many plants will be tested?	(a multiple of # of factors = 3Lx2L = 6, this exp. 36)	
✓Will they be exposed to similar temperatures?	yes. They will be planted in the same location.	
✓Are the plants of the same variety?	yes?	
Where were the plants purchased?	24 from Home Depot and 12 from OSH	
Did the plants receive similar care before purchase?	I don't know.	
Are they planted in similar soil conditions?	I think so. They came in soil from the store.	
✓Will they receive the same amount of sun?	yes. They will be planted in the same location.	
Will I test the same plant with and w/o fertilizer?	No. I only have 1 growing season.	
Are there genetic differences between plants?	I don't know.	

explanatory variables

Potential confounding variables

Circle any questions(variables) being tested in the research idea. These are the explanatory independent variables
Check off any remaining questions(variables) you can control.
Confounding variables are variables other than your explanatory variable(s), which might have an effect on your response variable.
Box any remaining questions(variables) where you can identify specific plants with potential differences.
How can we keep these identifiable potential differences from influencing the response variable?
Isolate potential variability between stores by testing the plants separately Blocking (parallel experiments)
What about the remaining questions(variables)? Is there any way to prevent them from confounding our response variable?
Random Assignment

Let's diagram our experiment:

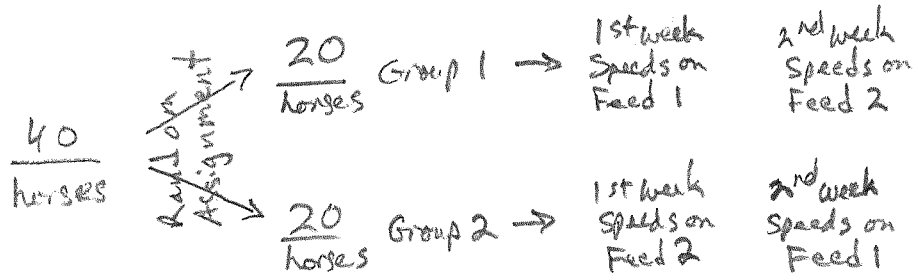


Many experiments compare two sets of measurements of the same variable. There are many ways of setting up an experiment to produce such data, but when we talk about experimental design, we are referring to a specific aspect of the experiment: whether or not the two sets of measurements can be sensibly paired off with each other. If you can pair off each measurement from one sample with a natural partner from the other sample, then you have a **matched paired design.** This may be because you are measuring something twice under different conditions (usually before and after) or because the two things you are measuring are naturally related. If there is no sensible way of pairing off the values from the two samples, then you have an **independent design.**

example 1: The tomato experiment above is
independent design as we only have one growing season.

example 2: Comparing the running speeds of horses and zebra would be
an independent design as there is no sensible way to pair off each horse with each zebra.

example 3: Comparing the running speed of horses for a week of eating one type of feed with the **same** horses for a week on a different type of feed would be
a paired design as you can pair off measurements from the same horse.
diagram this experiment below:



The 4 principals of experimental design:	1. **Control** sources of variation other than the factors we are testing by making conditions as similar as possible for all treatment groups. 2. **Randomize** subjects to treatments to even out effects that we cannot control. 3. **Replicate** over as many subjects as possible. Would like to get results from a representative sample of the population of interest. 4. **Block** and then randomize within to reduce the effects of identifiable attributes of the subjects that cannot be controlled.
Placebo	A (fake) treatment known to have no effect, administered so that all groups experience the same conditions.
Placebo effect	The tendency of many human subjects (often 20% or more of experimental subjects) to show a response even when administered a placebo.
Blinding	Individuals associated with an experiment are not aware of how subjects have been allocated to treatment groups.
2 main classes of individuals who can affect the outcome of an experiment: **Single-blind** **Double-blind**	1. those who could influence the results (subjects, treatment administrators, or technicians) 2. those who evaluate the results (judges, treating physicians, etc.) When every individual in either of these classes is blinded. When everyone in both classes is blinded.