Name_____

DATA Nugget

Collaborative cropping: Can plants help each other grow?

Featured scientist: Jake Jungers (he/him) from the University of Minnesota
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Research Background:

Most of the crops grown on farms in the United States are annual plants, like corn, soybeans, and wheat. **Annual** plants die every year after harvest and must be replanted the following year. Preparing farm fields for replanting every year can erode soils and hurt important bacteria and fungi living in the soil.

Jake taking a soil core in a Kernza® field.

One way to change how we produce food is to grow more perennial crops. **Perennial** plants live for many years and don't need to be replanted. Perennials stay in the ground all year and start growing right away in the spring before annual crops are even planted. This early growth also gives perennial crops a "head-start" in competing with annual weed species that emerge later in the season.

While there are potential benefits of perennial crops, they are not commonly planted because they tend to make lower profits for farmers than annual crops. Crop scientists are still examining potential options to make perennial crops work at a large scale for farmers. For twenty years, researchers at The Land Institute in Kansas and at the University of Minnesota have been looking at a new perennial grain, called **Kernza®**, that could be used as an alternative to wheat and rye annual crops. Kernza® comes from the seeds of a plant called intermediate wheatgrass. Because Kernza® is such a new crop, scientists still have a lot to learn about it. Before it can be widely used by farmers, they want to know what field conditions help the plants grow to ensure the crop makes money for farmers.

One strategy to improve field conditions for perennial crops is to plant **legumes** in the field alongside them. Legumes can make nitrogen, a nutrient that plants need to grow, more available to the plants around them. Additionally, farmers can select legume species that typically don't compete with the crop but may outcompete weeds.

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Alfalfa (middle) planted in a Kernza® (left and right) field.

Jake is an ecologist who uses his knowledge about plants to make agriculture more sustainable. Jake wanted to do some research into alfalfa, a type of perennial legume that might work well with Kernza®. Jake thought that growing alfalfa alongside Kernza® would lead to increased profit and yield for two reasons. One, because it would add nitrogen to the soil to boost crop growth. Two, because alfalfa would compete with agricultural weed species, making valuable resources available for the crop plants.

To test this idea, Jake set up an experiment with his team. Alfalfa was grown with Kernza® at three different locations in Minnesota in 2019. The study was replicated four times at each site, with the same amount of alfalfa and Kernza® planted into each field. At the end of the growing season, the fields were harvested, and the plants were sorted into three categories: Kernza®, alfalfa, and weed species. He further sorted Kernza® by grain, which can be used for food, and straw, which can be used for animal feed. Jake wanted to compare **yield**, or plant growth per unit area, across the plant categories. To do this, he weighed all the plants in each category to get the **biomass** and then divided by the area of the field.

Scientific Question: What is the relationship between the amount of alfalfa growing in a field and 1) Kernza® yield and 2) weed biomass?

What is the hypothesis? Find the hypothesis in the Research Background and underline it. A hypothesis is a proposed explanation for an observation, which can then be tested with experimentation or other types of studies.

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Scientific Data:

Use the data below to answer the scientific question:

Site	Replicate	Alfalfa biomass (kg/ha)	Weed biomass (kg/ha)	Kernza® grain yield (kg/ha)	Kernza® straw biomass (kg/ha)
1	1	1124	0	455.3	6880.6
1	2	864	0	302.8	7197.1
1	3	712	6	271.8	5714.4
1	4	233	36	83.4	1623.2
2	1	851	56	395.7	4439.9
2	2	769	2	150.2	3639.0
2	3	1146	16	102.5	3415.1
2	4	364	1	114.4	2837.0
3	1	1450	44	493.5	3711.9
3	2	468	22	247.9	3216.0
3	3	340	6	262.2	4462.8
3	4				

*The missing row of data is the result of a lost bag of biomass. After it was in the drying oven it was lost before it could be weighed.

What data will you graph to answer the question?

Independent variable(s): _____

Dependent variable(s): _____

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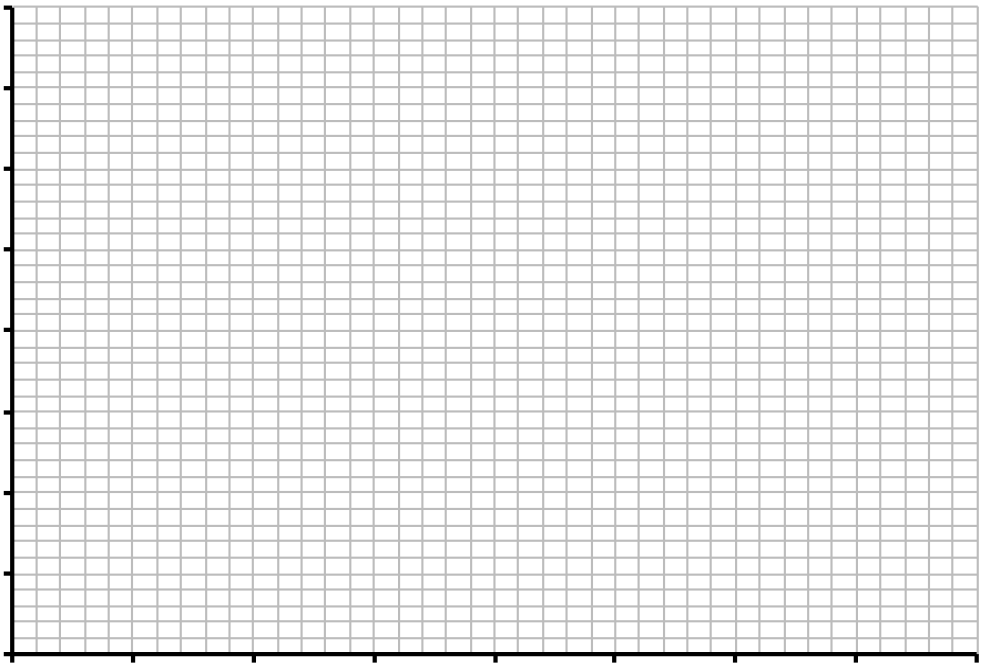
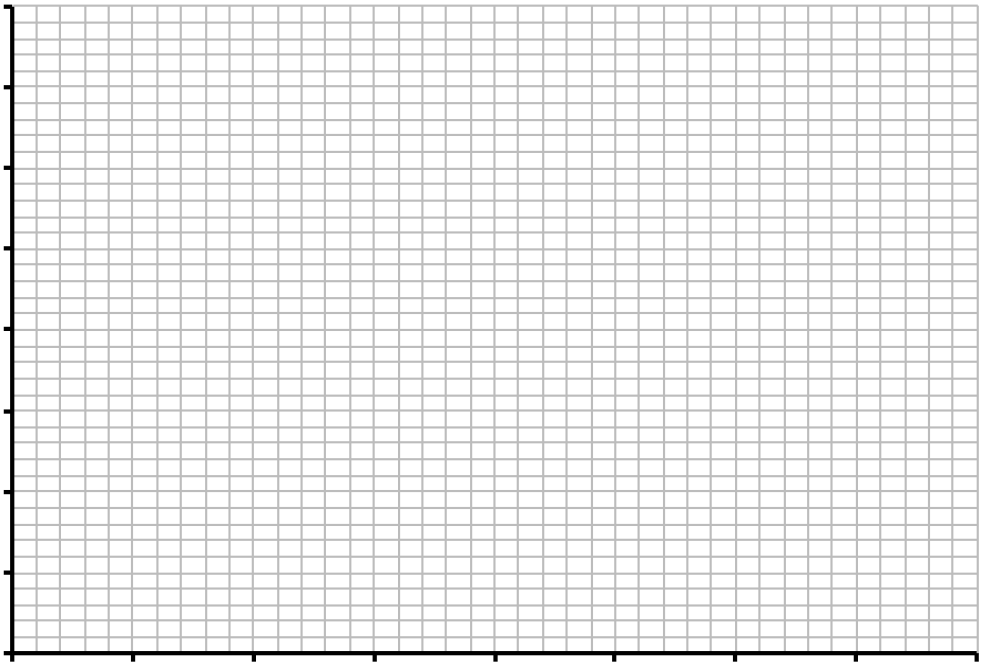
Draw your graph(s) below: Identify any changes, trends, or differences you see in your graph(s). Draw arrows pointing out what you see and write one sentence describing what you see next to each arrow.





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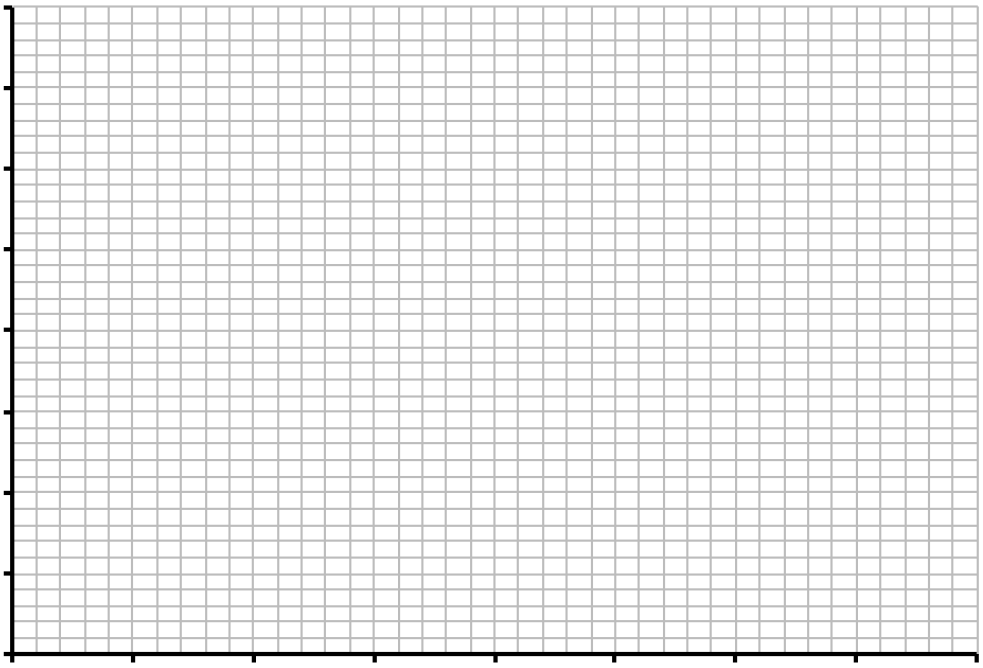

Interpret the data:

Make a claim that answers the scientific question, what is the relationship between the amount of alfalfa growing in a field and 1) Kernza® yield and 2) weed biomass?

What evidence was used to write your claim? Reference specific parts of the table or graph(s).

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Explain your reasoning and why the evidence supports your claim. Connect the data back to what you learned about legume/grain intercrops and nitrogen.

Did the data support Jake's hypothesis? Use evidence to explain why or why not. If you feel the data are inconclusive, explain why.

Your next steps as a scientist: Science is an ongoing process. What new question(s) should be investigated to build on Jake's research? How do your questions build on the research that has already been done?