

# Kansas Corn: Fermenting Fuel

## Grade Level: High School

### Fermenting Fuel: Student Data

Name Sample Data

Design an investigation that tests the effect of each enzyme as well as a combination of both on the fermentation rate of corn.

When you have decided what to include in each of your samples; record in the table below.

Record

	Test Tube 1	Test Tube 2	Test Tube 3	Test Tube 4	Test Tube 5	Test Tube 6
Amylase (ml)	2.0 ml	0 ml	2.0 ml	0 ml	2.0 ml	2.0 ml
Glucoamylase (ml)	2.0 ml	0 ml	0 ml	2.0 ml	2.0 ml	2.0 ml
pH buffer	2.0 ml	2.0 ml	2.0 ml	2.0 ml	2.0 ml	2.0 ml
Yeast (g)	1.0 g	1.0 g	1.0 g	1.0 g	1.0 g	0.5 g
Heated	No	10 min	10 min	10 min	10 min	10 min

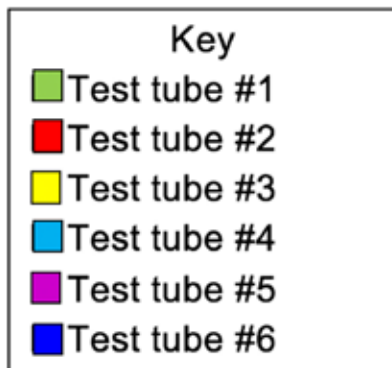
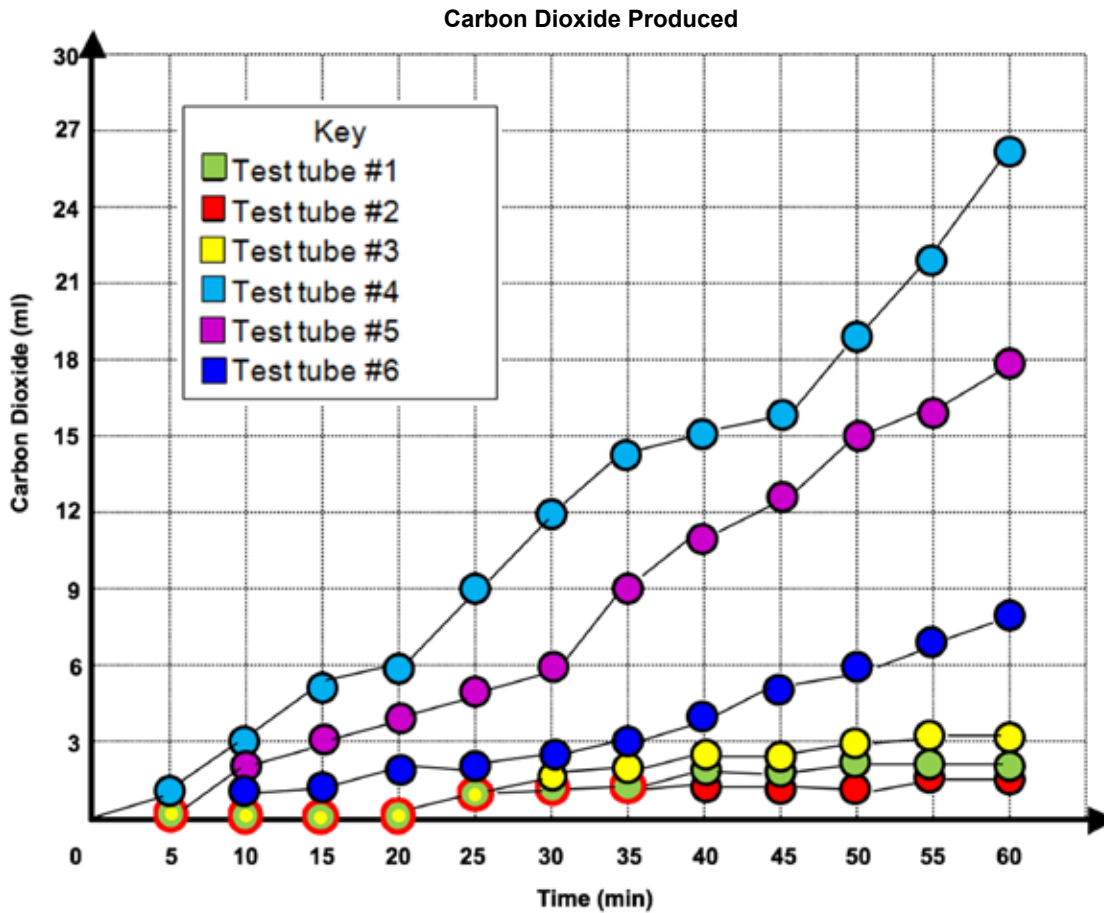
Data Collection: CO<sub>2</sub> produced (ml)

Time (min)	Test Tube 1	Test Tube 2	Test Tube 3	Test Tube 4	Test Tube 5	Test Tube 6
5	0	0	0	1	1	0
10	0	0	0	3	2	1
15	0	0	0	5	3	1
20	0	0	0	6	4	2
25	1	1	1	9	5	2
30	1	1	1.5	12	6	2.5
35	1	1	2	14	9	3
40	1.5	1	2.5	15	11	4
45	1.5	1	2.5	16	12.5	5
50	2	1	3	19	15	6
55	2	1.5	3.5	22	16	7
60	2	1.5	3.5	26	18	8

# Kansas Corn: Fermenting Fuel

Grade Level: High School

Graph of sample data



# Kansas Corn: Fermenting Fuel

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### Reflection and Conclusion

How could you tell when fermentation was occurring?

*Bubbles were forming in the sample.*

What effect did the enzymes have on the fermentation?

*From Sample Data: The enzymes increased the rate of the fermentation when comparing samples 3-6 with sample 2 that did not contain enzymes.*

Was one enzyme or combination more effective?

*Answers may vary, from Sample Data: Sample 4, only containing glucoamylase, produced the fastest rate of fermentation.*

What evidence supports your claim?

*Sample 4 produced much more carbon dioxide in the time measured.*

Based on your data, write a step-by-step procedure to produce the highest rate of fermentation of ethanol from corn?

- 1.
- 2.
- 3.
- 4.
- 5.
- 6.

## Fermenting Fuel from Corn: Assessment

Lisa

Name \_\_\_\_\_

Design an investigation that tests the effect of each enzyme as well as a combination of both on the fermentation rate of corn.

When you have decided what to include in each of your samples; record in the table below.

Record

	Test Tube 1	Test Tube 2	Test Tube 3	Test Tube 4	Test Tube 5	Test Tube 6
Amylase (ml)	2.0 ml	0 ml	2.0 ml	0 ml	2.0 ml	2.0 ml
Glucosylase (ml)	2.0 ml	0 ml	0ml	2.0 ml	2.0 ml	2.0 ml
pH buffer	2.0 ml	2.0 ml	2.0 ml	2.0 ml	2.0 ml	2.0 ml
Yeast (g)	1.0 g	1.0 g	1.0 g	1.0 g	1.0 g	0.5 g
Heated	No	10 min	10 min	10 min	10 min	10 min

1. In Lisa's experiment, which two samples should she compare to determine the effect of heating the sample?

Test Tube # \_\_\_\_\_ and \_\_\_\_\_

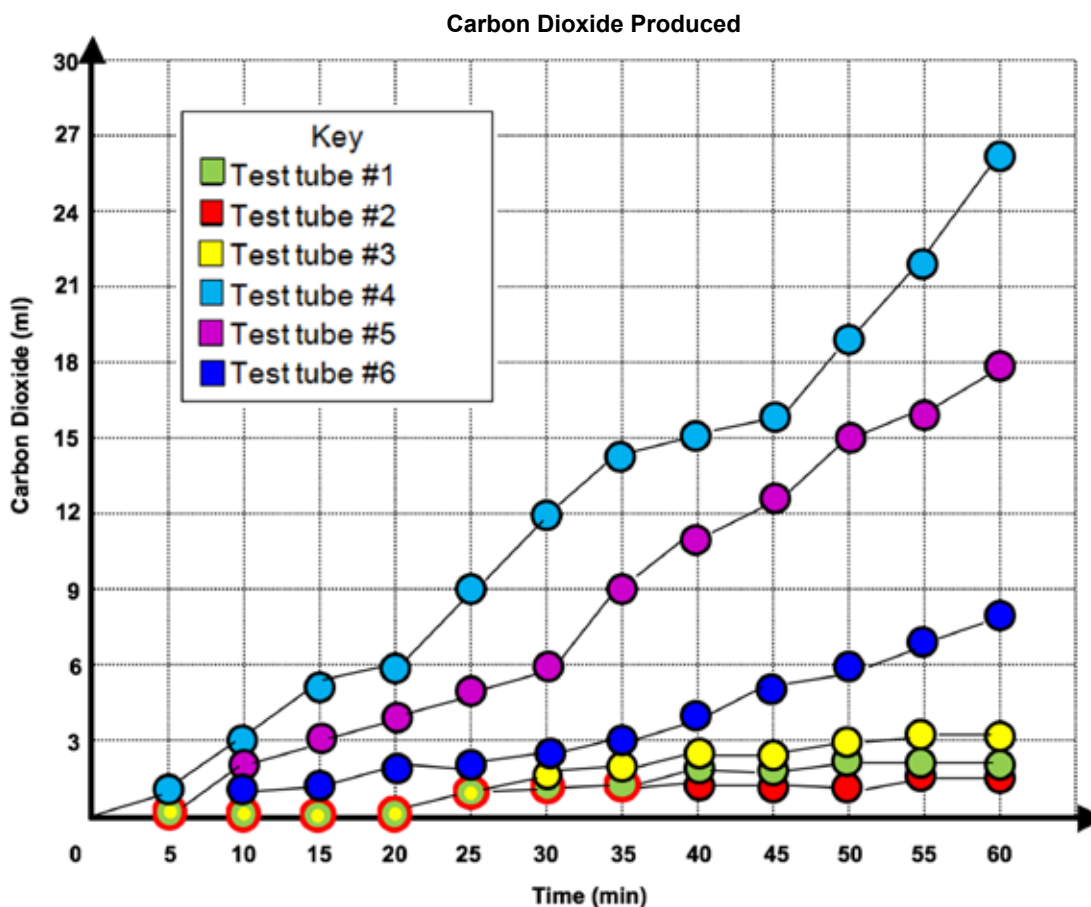
Why did you select those two samples?

2. Which samples should she compare to determine the effect of the amount of yeast in a sample?

Test Tube # \_\_\_\_\_ and \_\_\_\_\_

Why did you select those two samples?

Graph of data



Looking at Lisa's graph above of the data her group collected; answer the following questions.

3. \_\_\_\_ Which enzyme or combination produced the greatest rate of fermentation?
- A) Amylase
  - B) Glucoamylase
  - C) Both Amylase and Glucoamylase
  - D) She did not conduct a test that would answer this question.

What evidence supports your answer?

4. \_\_\_\_ How did the reduced amount of yeast affect the rate of fermentation?
- A) The sample with half as much yeast produced twice the CO<sub>2</sub>.
  - B) The sample with half as much yeast produced half as much CO<sub>2</sub>.
  - C) The sample with half as much yeast produced roughly the same amount of CO<sub>2</sub>.
  - D) Lisa's group did not isolate the amount of yeast as a variable so we don't know.

## Fermenting Fuel from Corn: Assessment (KEY)

Name     Lisa    

Design an investigation that tests the effect of each enzyme as well as a combination of both on the fermentation rate of corn.

When you have decided what to include in each of your samples; record in the table below.

Record

	Test Tube 1	Test Tube 2	Test Tube 3	Test Tube 4	Test Tube 5	Test Tube 6
Amylase (ml)	2.0 ml	0 ml	2.0 ml	0 ml	2.0 ml	2.0 ml
Glucoamylase (ml)	2.0 ml	0 ml	0ml	2.0 ml	2.0 ml	2.0 ml
pH buffer	2.0 ml	2.0 ml	2.0 ml	2.0 ml	2.0 ml	2.0 ml
Yeast (g)	1.0 g	1.0 g	1.0 g	1.0 g	1.0 g	0.5 g
Heated	No	10 min	10 min	10 min	10 min	10 min

1. In Lisa's experiment, which two samples should she compare to determine the effect of heating the sample?

Test Tube #   1   and   5  

Why did you select those two samples?

The only difference between these samples is that test tube 5 was heated for 10 minutes while test tube 1 was not

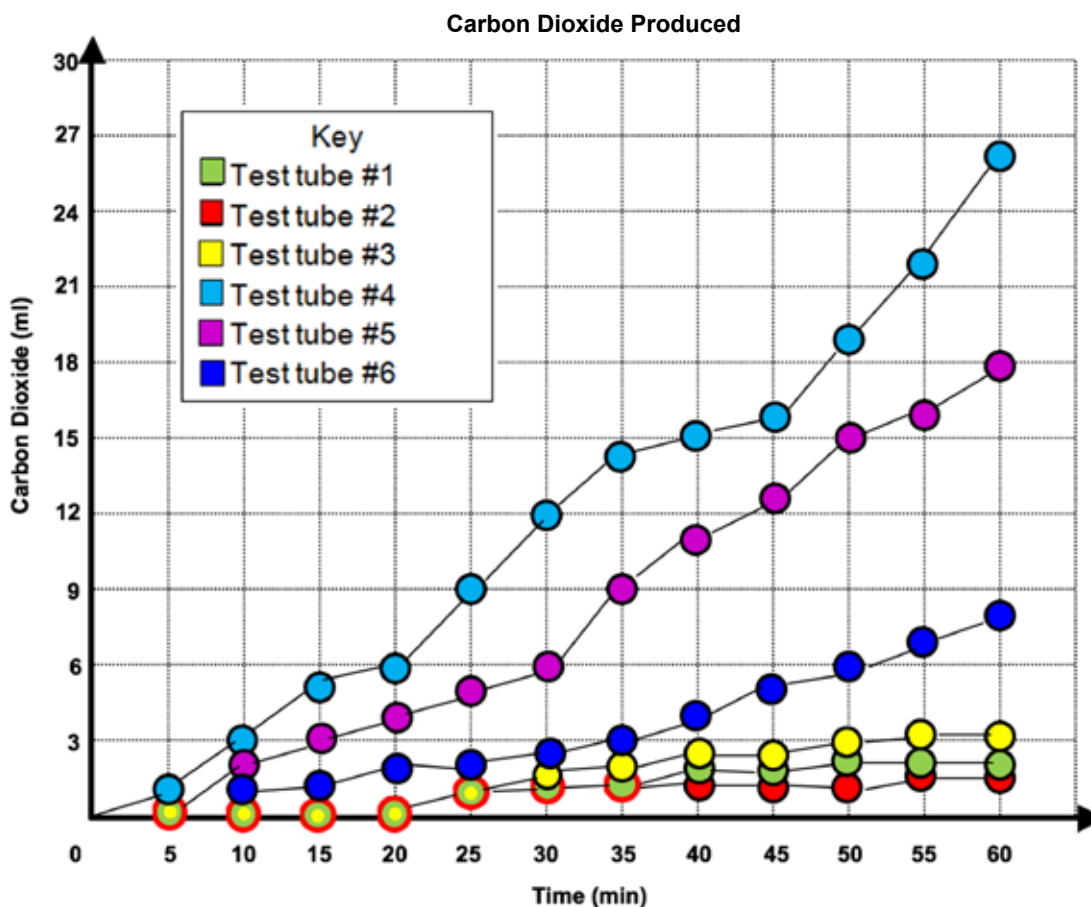
2. Which samples should she compare to determine the effect of the amount of yeast in a sample?

Test Tube #   5   and   6  

Why did you select those two samples?

These two samples are the same except that number 6 has half of the yeast as number 5.

Graph of data



Looking at Lisa's graph above of the data her group collected; answer the following questions.

3. B Which enzyme or combination produced the greatest rate of fermentation?
- A) Amylase
  - B) Glucoamylase
  - C) Both Amylase and Glucoamylase
  - D) She did not conduct a test that would answer this question.

What evidence supports your answer?

Test tube #4 had the greatest rate of fermentation and it only contained Glucoamylase.

4. C How did the reduced amount of yeast affect the rate of fermentation?
- A) The sample with half as much yeast produced twice the CO<sub>2</sub>.
  - B) The sample with half as much yeast produced half as much CO<sub>2</sub>.
  - C) The sample with half as much yeast produced roughly the same amount of CO<sub>2</sub>.
  - D) Lisa's group did not isolate the amount of yeast as a variable so we don't know.