**The Fascination with Fermentation**

**Wine and Beer Fermentation Observations and Questions:** Use the following source.

http://www.nature.com/scitable/topicpage/yeast-fermentation-and-the-making-of-beer-14372813

Type these answers on a separate document.

1. When were the first wines thought to have been made?

Archaeologist discovered wine in jars that are 7,000 years old. These were thought to be made by accident.

1. Describe the first time someone might have been drunk and their hangover.

Someone would’ve drank from a fruit jar containing a honey bee. They would’ve then felt the effects of alcohol, feeling powerful and laughing a lot along with their head feeling like it was spinning. The next morning they would’ve woke up with a headache, pain, and unpleasant taste in their mouth along with dizziness.

1. Use this table to better understanding fermentation history.

|  |  |  |
| --- | --- | --- |
| Region/Country | Years | What were they fermenting? |
| Asia | 1700-1100 BC | Meade-honey wine |
| South America | unknown | Chicha |
| North America | 6000 BC | Octli |
| China, Egypt, Babylon, Rome | 3000 BC – 1000 BC | Malted Barley |

1. Where does the word fermentation come from? How was this named derived- what observations were made?

Came from Latin word *fervere*, meaning “to boil”

1. How do traditional wine makers transfer microorganisms into the wine making process?

Wine makers used their feet to make wine, which transferred the microorganisms from their feet to the wine.

1. Define yeast.

A very small, one celled eukaryotic fungus. Invisible to the naked eye.

1. Describe the contributions of each of these scientists.

|  |  |
| --- | --- |
| Scientists | Contributions to Common Understanding of Fermentation |
| Leeuwenhoek | Developed high quality lenses and was able to observe yeast for first time. Recorded detailed drawings of microorganisms, including yeast. Yeast were globules floating in a fluid. |
| Lavoisier | Discovered the nature of chemical reactions and structure of sugar. Conclude sugars were broken down in two ways: 2/3 alcohol, one third other 1/3 to carbon dioxide. |
| Gay-Lussac | Used Appert method to maintain grape juice wort in an unfermented state. Preserved grapes to be unfermented for a long period of time.  |
| Cagniard | Observed during alcoholic fermentation yeast will multiply by gemmation or budding. Confirm yeast are one-celled organisms and related to fermentation. |
| Pasteur | Concluded only microorganisms are capable of converting sugars into alcohol. Demonstrated that fermented beverages are result of living yeast transforming glucose to ethanol. Showed more yeast = more fermentation. |
| Bigo | Had a distillery and aided Pasteur in finding that there are two types of fermentation:  |
| Buchner | Discovered fermentation is a chemical reaction that happens inside the yeast, due to enzymes which act a catalyst and modifier. Won Nobel Prize in 1907. |
| Karl Lohmann, Yellapragada Subbarao, and Cirus Friske | All independently discovered adenosine triphosphate (ATP), a molecule vital to animal tissue. Versatile molecule which enzymes use in cellular processes.  |
| Lipmann | Speculated the ATP was the main energy transfer molecule in a cell. |

1. What are ALL of the products or components that go into the process of fermentation?

Yeast, glucose, lactic acid or ethanol, other microorganisms.

1. Fermentation is a \_\_\_\_\_consequence\_\_\_\_\_ of yeast multiplication. The yeast have to be \_\_\_\_alive\_\_\_\_ for alcohol to be produced.
2. What is the difference between alcoholic and lactic acid fermentation? Why did the beets used by Bigo not produce fine brew?

Alcoholic fermentation is a result of the action of yeast and lactic acid is the result of action of bacteria. The beets used by Bigo contained more lactic acid than alcohol, which produced a bitter taste.

1. What is glycolysis?

Metabolic pathway that convers glucose (type of sugar) to pyruvate (first major step to fermentation or cellar respiration).

1. When and why did glycolysis evolve?

Glycolysis most likely evolved 3.5 billion years ago due to the lack of oxygen on earth at the time.

1. What is glucose converted into during glycolysis?

Pyruvate (first major step to fermentation or cellar respiration).

1. What two routes can pyruvic acid take?

Pyruvate can either turn into ethanol or carbon dioxide due to alcoholic fermentation or lactate due to lactic acid fermentation; depending on the type of cell.

1. What are the two byproducts of fermentation?

1. Ethanol / carbon dioxide

2. Lactate

1. Which byproduct are we most concerned with in our food science courses? Why?

Beer and wine, because they are a huge market in the modern world.

1. What does the accumulation of alcohol do to the yeast cells?

The alcohol which accumulate is toxic and eventually kills the yeast.

1. How are wine and beer alcohols produced differently than liquors?

Wine and beer are produced by yeast, which can survive form 5% to 21% alcohol depending on the type of strain of yeast. Liquor must be distilled since the alcohol level is so high.

1. How is fermentation so essential for the agriculture and food science industries?

Beer brewing and wine are a huge industry in agriculture. Many food products are a result of fermentation; such as cheese, yogurt and sour dough.

1. Rewrite the summary in your own words, in three sentences.

Fermentation in the modern world has been a consequence of ancient knowledge and scientific understand. This understanding of science has been a result of hundreds of years by scientist who wants to further humanities’ understanding of fermentation. These chemical processes have created a massive industry in agriculture & food science.

**Microbial Fermentations:** Use the following source.

<http://www.accessexcellence.org/LC/SS/ferm_background.php>

1. Three ways fermentation is important in our lives:

 Food can be spoiled by Muscle cells use fermentation

 microbial fermentation to provide us with quick responses

 Foods can be made by microbial

 fermentations

1. Fermentation is the process that produces \_\_\_\_\_alcoholic\_\_\_\_ beverages or acidic \_\_\_\_dairy\_\_\_\_ products. In general, fermentation involves the breaking down of complex \_\_\_\_\_\_\_organic\_\_\_\_\_\_\_ substances into simpler ones.
2. What are the four substances produced as waste products from the fermentation process that we use in our everyday lives and industry?

4.How are lactic acid and alcohol fermentation alike and different?

Differences

Simularties:

Both are from a process due to mircoorganisms. Both are a type of fermentation. Both are used to create a product.

Differences:

Lactic acid are due to bacterial fermentaiton while alcholic are due to the process of fermenetaion. These also produce two different products, one carbon dioxide/ethonal and the other lactate.

5. How could industry use microbial fermentation to alleviate its dependence on petroleum?

Plant starch and cellous from agriculture waste can be used as fuel.

6. How could plant starches, cellulose from agricultural waste, and whey (a byproduct from cheese manufacturing) be problematic for the environment but a potential benefit, as well?

These also produce waste, but are nonrenewable.

7. Describe what this bioreactor does and list three products created by an industrial bioreactor.

Bioreactors are used to make products such as insulin, human growth hormone, and food additives such as xanthan. The bioreacton montiors temperature, pH, and growth in the bioreactor and does this in large volume.



8. What was the greatest factor (historically) in the development of synthetic rubber?

John Dunlop used heated rubber to make automobile tires in 1898.

9. Why did the British government need a high yield of butyl alcohol and acetone?

World War 1 was in full swing the British government needed gunpowder.

10. What crops were fermented to produce butyl alcohol and acetone?

Corn was fermented. The corn was unreliable because of the German blockade so Weizmann tried to use other fermentable carbohydrates, even trying horse chestnuts collected by children.

Extra somethin’ something’:

\*After WWI, what did the British Prime Minister find that Weizmann wanted for a reward for his scientific (fermentation) contributions to the war effort?

He wanted a national home for his people and was given 15 minutes to explain why his the national homeland should be Palestine.

\*Ultimately, what notable position did this microbiologist undertake in 1949?

He would become President of the World Zionist Organization in 1920.