

## Training Header Sheet with Change Log Form

Kentucky  
Science - Biology  
2022 Spring Op

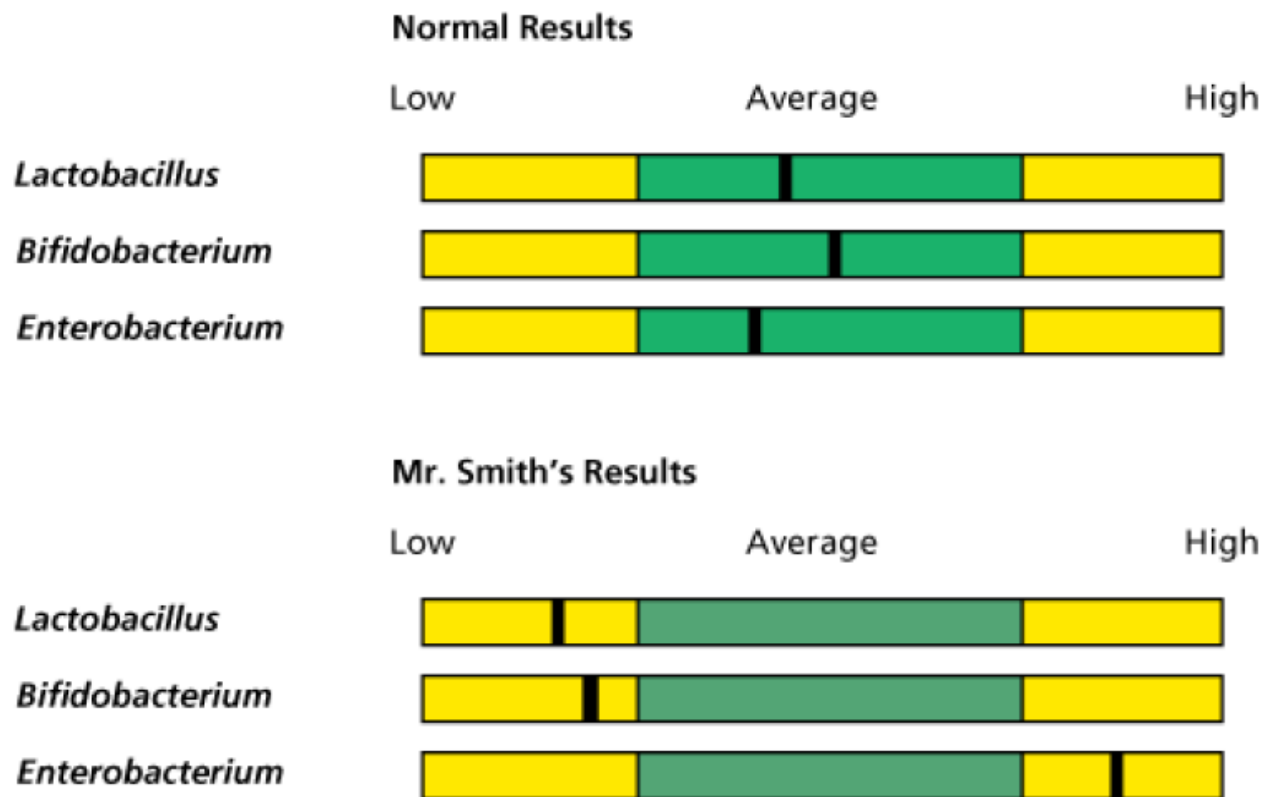
BI1701\_08  
Impact of Sucralose on Gut  
Ecosystem

Anchor Set

| Date    | Comments     | Version |
|---------|--------------|---------|
| 10/2022 | Training Set | Set A   |
|         |              |         |
|         |              |         |
|         |              |         |
|         |              |         |

# Stimulus

Mr. Smith is a healthy 40-year-old man. He was interested in losing a few pounds, so he decided to eliminate all table sugar from his diet and replace it with a new kind of low-calorie artificial sweetener. However, Mr. Smith has suffered from diarrhea after the change. Mr. Smith's doctor checked his stool (feces) for abnormalities. The results of his labs are compared to normal results.



The gastrointestinal tract in humans is an ecosystem that involves complex interactions between bacteria and other abiotic and biotic factors. Three species of bacteria present in the gastrointestinal ecosystem are *Lactobacilli*, *Bifidobacteria*, and *Enterobacteria*. All three species of bacteria consume carbohydrates in order to survive and reproduce.

Mr. Smith's doctor reads about a study done on the impact of the sweetener on intestinal bacteria. Four trials were done in the study:

Trial 1: Cultures of the three bacteria were placed in an environment with 100% artificial sweetener under environmental conditions that supported their growth for 72 hours.

**Trial 1**

| <b>Bacteria Colonies</b> | <b>Time = 0</b> | <b>Time = 72 hours</b> |
|--------------------------|-----------------|------------------------|
| <i>Lactobacillus</i>     | 1               | 0                      |
| <i>Bifidobacterium</i>   | 1               | 0                      |
| <i>Enterobacterium</i>   | 1               | 0                      |

Trial 2: Cultures of the three bacteria were placed in an environment with a 50% mix of the artificial sweetener and ordinary table sugar under environmental conditions that supported their growth for 72 hours.

**Trial 2**

| <b>Bacteria Colonies</b> | <b>Time = 0</b> | <b>Time = 72 hours</b> |
|--------------------------|-----------------|------------------------|
| <i>Lactobacillus</i>     | 1               | 75–100                 |
| <i>Bifidobacterium</i>   | 1               | 75–100                 |
| <i>Enterobacterium</i>   | 1               | 75–100                 |

Trial 3: Cultures of the three bacteria were placed in an environment with 100% ordinary table sugar under environmental conditions that supported their growth for 72 hours.

**Trial 3**

| <b>Bacteria Colonies</b> | <b>Time = 0</b> | <b>Time = 72 hours</b> |
|--------------------------|-----------------|------------------------|
| <i>Lactobacillus</i>     | 1               | >3,000                 |
| <i>Bifidobacterium</i>   | 1               | >3,000                 |
| <i>Enterobacterium</i>   | 1               | >3,000                 |

Trial 4: The bacterial colonies that were grown in Trial 3 were counted and then fed with the artificial sweetener and counted again after 72 hours.

**Trial 4**

| <b>Bacteria Colonies</b> | <b>Time = 0</b> | <b>Time = 72 hours</b> |
|--------------------------|-----------------|------------------------|
| <i>Lactobacillus</i>     | >3,000          | 750                    |
| <i>Bifidobacterium</i>   | >3,000          | 810                    |
| <i>Enterobacterium</i>   | >3,000          | 1,700                  |

Mr. Smith's doctor suggests to him that the addition of the artificial sweetener to his diet is the reason the stability of his internal ecosystem has been disrupted.

Mr. Smith usually considered ecosystems on a much larger scale and was surprised to learn that it was possible to have a functioning ecosystem inside his body. The doctor explained that the relationship between the different bacteria inside his intestine was similar to the dynamics of other ecosystems.

Mr. Smith is considering several possible treatment options to resolve his symptoms due to the imbalance in his intestinal ecosystem. He is resistant to removing the sweetener from his diet because he is afraid of gaining weight, but he only has a limited amount of money to pay for other options.

| <b>Treatment Option</b>                                      | <b>Cost</b>        | <b>Benefit</b>   | <b>Negatives</b>   | <b>Mechanism</b>   |
|--|--------------------|--|--|--|
| Removing sweetener from Mr. Smith's diet                     | no additional cost | Removes harmful factor that is likely causing his illness            | Recovery time is long because the bacteria return to normal levels slowly      | Normal return to environmental conditions within his intestinal ecosystem  |
| Using over-the-counter bacteria replacements (probiotics)    | moderate           | Supplements normal, healthy ecosystem inhabitants (bacteria) quickly | Can cause gas, bloating  | Restores healthy bacterial balance to his intestinal ecosystem quickly   |
| Using broad-spectrum antibiotics (available by prescription) | high               | Can stop growth of harmful bacteria quickly                          | Can cause side effects including allergic reactions, gastrointestinal distress | Reduces the population of all bacteria in the body, including those causing distress in his intestinal ecosystem |
| No change, continue using the sweetener                      | no additional cost | No unknown side effects from untried drug or treatment options       | Diarrhea will probably continue or worsen                                      | N/A  |
| Substitute another type of artificial sweetener              | low                | Removes likely factor causing his illness                            | Will probably not improve the imbalance in his intestinal ecosystem quickly    | Removal of factor causing the bacterial imbalance  |

# Prompt

## BI1701\_08

Evaluate the treatment options. Explain which **two** treatment options you think are **best** and the reasons for your choices. Describe how important you considered each of the criteria listed (cost, benefit, negatives, mechanism) in deciding which treatment options were best.

## Kentucky Academic Standards Science Rubric

| Score    | Description  |
|----------|--|
| <b>4</b> | <p>There is evidence in this response that the student has a complete and thorough understanding of the multi-dimensional question as evidenced by their explanation of the phenomenon and/or solution to the problem.</p> <p>The response is complete, thorough and correct and based on appropriate knowledge and skills<br/>                     The response does not contain errors or flaws in logical thinking or those flaws are irrelevant to the accuracy of the answer<br/>                     The response reflects complete synthesis and understanding of complex ideas<br/>                     The response is completely coherent and based on effective application of relevant dimensions (SEP and/or DCI and/or CC)<br/>                     The response integrates a solution that is completely correct and based on the principles of engineering design (if applicable)</p>          |
| <b>3</b> | <p>There is evidence in this response that the student has a general understanding of the multi-dimensional question as evidenced by their explanation of the phenomenon and/or solution to the problem.</p> <p>The response is generally complete and the question is answered using appropriate knowledge and skills<br/>                     The response may contain minor errors or flaws in logical thinking and those flaws may or may not be irrelevant to the accuracy of the answer<br/>                     The response reflects a general synthesis and understanding of complex ideas<br/>                     The response is generally coherent and based on application of relevant dimensions (SEP and/or DCI and/or CC)<br/>                     The response integrates a solution that is generally correct and mostly based on the principles of engineering design (if applicable).</p> |
| <b>2</b> | <p>There is evidence in this response that the student has a limited understanding of the multi-dimensional question as evidenced by their explanation of the phenomenon and/or solution to the problem.</p> <p>The response is partially complete and/or the question is answered using limited understanding of knowledge and skills<br/>                     The response may contain significant errors or flaws in logical thinking<br/>                     The response reflects a limited synthesis and understanding of complex ideas<br/>                     The response may or may not be coherent and based on some application of relevant dimensions (SEP and/or DCI and/or CC)<br/>                     The response integrates a solution that is partly correct and may or may not be based on the principles of engineering design (if applicable).</p>                                    |
| <b>1</b> | <p>There is evidence in this response that the student has a minimal understanding of the multi-dimensional question as evidenced by their explanation of the phenomenon and/or solution to the problem.</p> <p>The response is minimal and/or the question is answered using minimal understanding of knowledge and skills<br/>                     The response may contain major significant errors or flaws in logical thinking<br/>                     The response reflects a minimal synthesis and understanding of complex ideas<br/>                     The response is not coherent or is not based on application of relevant dimensions (SEP and/or DCI and/or CC)<br/>                     The response integrates a solution that is minimally correct and may or may not be based on the principles of engineering design (if applicable).</p>  |
| <b>0</b> | <p>There is no evidence that the student has an understanding of the material related to the question being asked in terms of science content and logical thinking skills.<br/>                     The response is blank, entirely incorrect and/or irrelevant.</p>   |

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it is a part of the body that is what it does and it is what it needs to do



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1.I would eat less grade A or B food

2.He could stop eating all the food that causes him to gain weight

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negatives because it would be harder to recover faster

benefit it would remove something causing his illness

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I think removing sweetener will be helpful because it is a really concentrated ingredient. using spectrum antibiotics may help his issues as well.

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removing sweetener because no cost bacteria returns to normal slowly

antibiotics it can stop growth of bacteria and can reduce the population of all bacteria in the body

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Option 1, because it doesn't cost anything and it will probably remove the factor causing illnesses.

Option 5, because it doesn't really change his diet except for the substituted artificial sweetener which would let his body adapt easier.

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i believe that the best two options for Mr. smith would be 1. To switch to another type of artificial sweetener, and 2. to use probiotics.

Option 1 would be the best option if he doesnt want to use real sugar, is low on money, and doesnt want to gain weight. However, the sweeteneer may not help his problem, so if that does not work, option 2 would be a better option, because even though it can cause gas and bloating, he is still restoring his digenstion system to a healthy balance.

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The two best options are removing the sweener for his diet and/or replaceing the sweetener with another one. I think this because they are both cost efetive and would help solve the problem even if it take a few weeks.Also he wouldnt have to take any meds because his body would repair itself. Over all these are the two best options.

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I think Mr. Smith should use broad spectrum drugs to stop his illness, but even though it costs more it still works faster and more efficient. The only downfall to using these is the side effects, he could suffer from allergic reactions or gastrointestinal distress.

Another option I think would be more efficient and work just as well is just removing the artificial sweetener in particular, it doesn't cost anything but there is a couple downfall to this one too. It takes longer to regain all the bacteria come back to normal that was lost or gained.



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The best two treatments to use are removing the from Mr. Smith's diet and using over-the-counter bacteria replacements. Removing the sweetener is best due to the fact that it costs him nothing, it will remove his illness and his intestinal environment will return to normal even though the recovery process is long for it to return to normal. Using over-the-counter bacteria replacements is also a great option because the benefits include healthy ecosystem inhabitants quickly removing his illness. The balance is restored in his intestinal ecosystem quickly. The only down sides are that it costs a little bit, moderate, and it can cause gas or bloating.

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The two treatment options I feel are best for Mr. Smith are, removing sweetener from Mr. Smith's diet, and/or using over the counter bacteria replacement. Removing the sweetener from his diet will have no additional cost. It also removes harmful factors that are most likely to be causing the illness. There recovery time is very slow and long, the bacteria levels will recover over time. This treatment option will help the environmental condition, in his intestines return to normal, hopefully reducing and treating the illness. The other treatment option is to use over the counter bacteria replacement. The benefits of this treatment is that Mr. Smith will be able to continue using the sweetener, and this restores healthy bacterial balance to his intestinal ecosystem quickly. The down fall to this treatment option is that it does have a cost, although it is moderately priced. It can cause some gas and bloating also. It is very important to consider and look over the side effects, cost, and benefits of each treatment in deciding which treatment will best benefit your life style.

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There are multiple treatment options for Mr. Smith's bacterial imbalance. I have chosen two treatment options that are best for Mr. Smith's situation. The first treatment is removing the artificial sweetener from Mr. Smith's diet. This treatment doesn't cost Mr. Smith money, will remove the harmful factor that is likely causing his illness, and will have a normal return to environmental conditions within his intestinal ecosystem. However, Mr. Smith will have a long recovery time because the bacteria return to normal levels slowly. The other treatment I have chosen is to use over-the-counter bacteria replacements (probiotics) to remove Mr. Smith's illness and restore a healthy bacterial balance to his intestinal ecosystem quickly. This treatment does cost Mr. Smith a moderate amount of money, but it is very much worth it because he will become healthy again quickly. Also, the treatment may cause gas and bloating, but can be treated with low-cost over-the-counter medications. I believe these two treatment options are the best choices for Mr. Smith's illness and situation.

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Considering the circumstances surrounding Mr. Smith's illness and the interaction between the bacteria within his intestinal tract, I conclude that over-the-counter bacterial replacements and substituting the artificial sweetener he currently used. Purchasing the bacterial supplements is the best solution, however considering that they are of acceptable cost to Mr. Smith, ensure the restoration of his bacterial ecosystem in a relatively timely manner, and cause minimal side effects. While substituting the sweetener he is currently using is of lower cost than bacterial supplement, it is not guaranteed to restore his bacterial ecosystem and requires more time to do so than the use of bacterial supplements. The main goal of this predicament is to ultimately restore the health of Mr. Smith by replenishing the bacteria within his stomach, and while both are options of doing so bacterial supplements are guaranteed to work and do so in a short period of time as opposed to a sweetener substitution. Furthermore, the cost effectiveness is a significant factor to consider as well, as Mr. Smith does not have much money to spend on treatment and bacterial supplements are within a reasonable price range. By comparison, a sweetener substitution is the more cost effective, costing little to nothing. Lastly, these two options offer the least potential for discomforting side effects of treatment out of all others and the side effects present are well within the manageable range.

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The 2 treatments I believe Mr. Smith should use are "Removing sweetener from his diet" and "Substitute another type of sweetener," The reason I believe Mr. Smith should remove this sweetener from his diet even though the recovery process is long, is because it is the safest. The only downside to removing this sweetener from his diet is the recovery process, and waiting for the bacteria to return to normal is a whole lot better than, bloating allergic reactions, and the bacteria still acting up. Also it has no cost at all making it affordable, so he does not have to spend any money at all. Second the reason I think that if Mr. Smith still wants to have sweetener in his diet he should replace it with another type of sweetener because it is the second safest and the second cheapest for Mr. Smith. Using another type of sweetener has a low cost and a low risk. Unlike using over-the-counter bacteria replacements Mr. Smith will not suffer from gas and bloating, and unlike using antibiotics Mr. Smith will not suffer from gastrointestinal distress or allergic reactions. The only downside to this treatment is like taking the sweetener out of his diet which is the recovery time is not quick. Also the cost of this treatment is very cheap. Both of these treatments also have really great benefits, like both removing the harmful factor which is causing his illness, and he is not suffering from any other side effects that go along with the other treatments. Both of these treatments work by removing the artificial sweetener from Mr. Smith's body and leave him back to normal at a very cheap cost. These are the reasons I believe removing the sweetener out of his diet, and replacing the artificial sweetener with another sweetener are Mr. Smith's two best options.

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The first treatment option that I think is best for Mr. Smith is to remove the sweetener from his diet. This is the most logical choice because the sweetener is what started causing him problems in the first place. If he continues with this sweetener, his diarrhea will probably continue and worsen. This option is also at no additional cost, so he will not lose money. While this option can be time consuming, it will be worth it to have a normal return of his intestinal ecosystem.

The second treatment that I believe will benefit Mr. Smith is to take over-the-counter bacteria replacements. These probiotics will help the bacteria return back to their normal quantity, but will do it very quickly. Although this option can cause gas and bloating, he would only have to take this drug for a short period of time. Those small side effects are nothing compared to the diarrhea he is having currently. Also, the cost is moderate, which is better than high.

While I was deciding which treatments were best, the most important criteria was the benefit and the mechanism. For the negatives, I looked at them less than the benefits because those things are a small price to pay to get Mr. Smith healthy again. While the cost was on the less important side, I still kept that in mind since Mr. Smith has a limited amount of money.