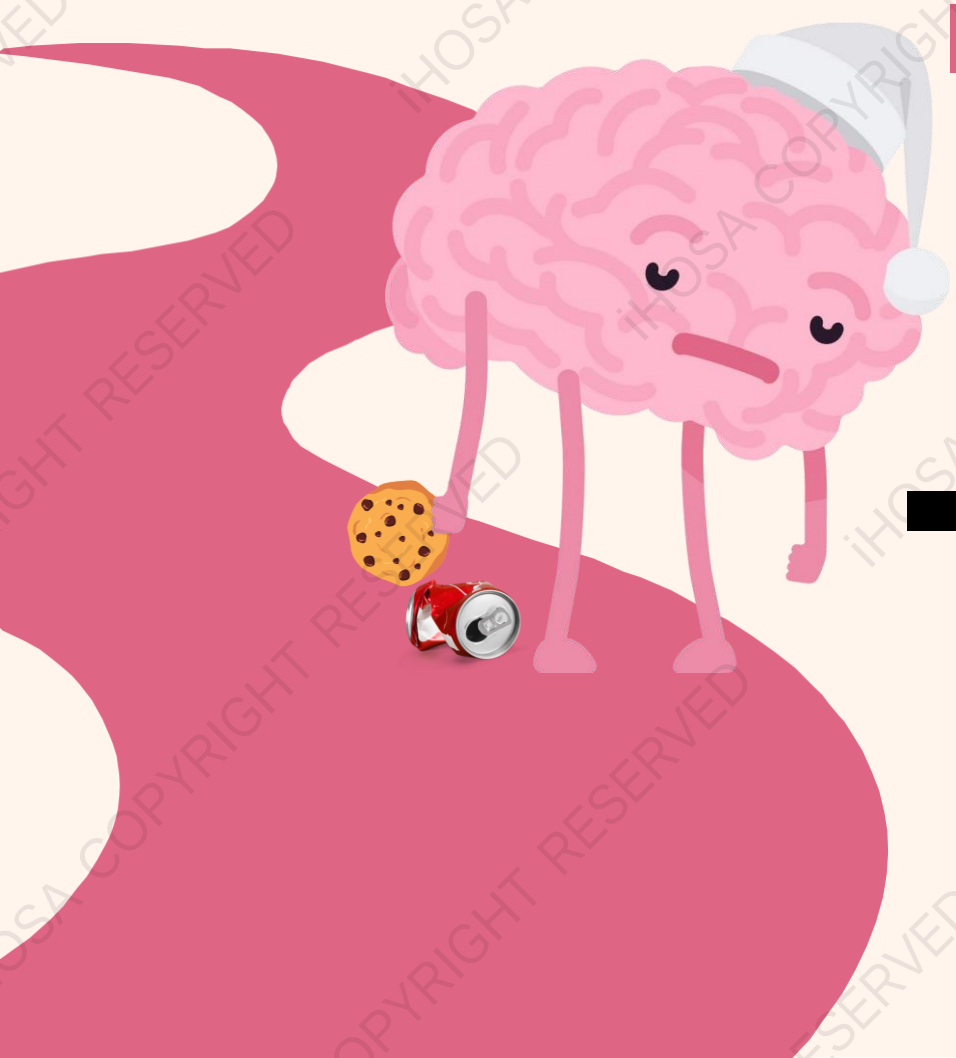
YOU ARE WHAT YOU EAT!



INVESTIVATING THE GUT-BRAIN AXIS

School Name:
[redacted]

School Division:
High School

Event:
BCE Health Education

Members:
[redacted]

Target Group:
13-18 yr (32 Participants)

Lesson Plan Narrative

You Are What You Eat: Investigating the Gut-Brain Axis

1. Lesson Topic Reasoning

Food for most is a luxury: it represents the few times of the day where our bodies are replenished with energy. However, for some, unhealthy dietary guidelines and a toxic relationship with food can cause extreme mental and behavioral disorders: this is because of the gut-brain axis, or how the gut and brain impact each other. A study published in the journal Circulation found that poor diet is a leading cause of death in the U.S., contributing to over 500,000 deaths annually (Brandt, et. al 2023). Additionally, WHO reports that fewer than 2 in 5 adolescents (38%) eat fruit or vegetables daily while consumption of sweets and sugary drinks remains high (World Health Organization, 2024). Food's effect on the brain may be the cause of multiple chronic diseases and development of mental illnesses, and the team's goal is to equip participants with sufficient knowledge, helping them create their own healthy diet plans.

2. Target Audience Analysis

The team's target audience revolves mainly around the ages of 13-18. This age range consists of students in their last years of middle school and those in high/secondary school. This quota of participants was selected specifically to tackle developmental changes, behavioral influences, and misinformation from social media. The 13-18 age group holds critical developmental changes occurring during adolescence, a time when individuals form their identities and lifestyle choices of long-term health. By focusing on behavioral influences (i.e. cognitive function and mental health) that could be impacted by succumbing to societal pressures, the team aims to equip teens with a toolbelt of dietary guidelines, and being able to relate to the group on a personal level allows for a better induction of ideas.

3. Lesson Goal

After the end of the lesson, the desired intent for participants is to gain two insights: a certain level of profound knowledge regarding the gut-brain axis and a growth mindset to proactively develop their own dietary plans. The core purpose of the team's lesson planning and proposed activities is to teach participants to become more conscious of their dietary and nutritional habits through interactive experiences. The team aspires to instruct scientific expertise surrounding the biochemical specifics of the complex relationship between the gut and the brain. Ultimately, the lesson will provide participants with adequate knowledge to aid in developing their own plans for a healthy diet.

4. Learning Objectives

- Understand the complex relationship between the gut and the brain.
- Learn the process of amino acids being converted into neurotransmitters/antioxidants.
- Understand the purpose of different food groups and the importance of a balance diet.
- Develop own plans for a healthy diet.

5. Instruction Order Preview

1. Activity 1: Questionnaire (10 min)
2. Group Discussion (10 min)
3. Shocking Statistics (5 min)
4. Presentation and lecture (30 min)
5. Activity 2: Molecule Puzzle (10 min)
6. Activity 3: Lesson Quizizz (15 min)
7. Activity 4: Diet Planning (15 min)
8. Reflection & Evaluation (10 minutes)

6. Materials Overview

1. Food Hair-Clip Souvenirs
2. Name Tag Sheets and Sharpies
3. TV/Screen Projector (for PowerPoint)
4. PPT Presentation (20 slides)
5. Laminated Puzzle Pieces (reference photo)
6. Quizizz: Post-lecture check for understanding
7. Clipboards and Pens (32, for ideal class size)
8. Questionnaire & Reflection form

Supportive Information:

You Are What You Eat: Investigating the Gut-Brain Axis

The gut-brain axis is an interaction between the nervous system and the digestive system. To be more specific, it is a bidirectional communication between the gastrointestinal tract (GI) and the central nervous system (CNS). To better understand the gut-brain axis, an understanding of the nervous system and the digestive system is necessary.

The nervous system consists of around 100 billion neurons, which are the basic units of the nervous system. The nervous system has two main parts: the central nervous system (CNS) which is made of the brain and spinal cord, and the peripheral nervous system (PNS) made of nerves branching from the spinal cord to all body parts. Through the use of different types of neurons, the nervous system controls voluntary movements such as movement or involuntary movements such as breathing and digestion. Although a part of the CNS, the brain itself is an extremely complex organ that sends signals throughout the body to regulate mood, behavior, cognitive process, and all kinds of voluntary or involuntary movements. Neurotransmitters are the chemicals in our body released in synapses (gaps between connected neurons) to be used as messengers throughout the body so that the brain's orders are sent to different body parts. Dopamine is a well-known example of a neurotransmitter.

The digestive system is made of the gastrointestinal tract (GI), which is a group of organs that connect from the mouth to the anus, and the liver, pancreas, and gallbladder. Organs included in the GI are: mouth, esophagus, stomach, small intestine, large intestine, and the anus. The digestive system breaks down (both physical and chemical methods used) nutrients such as carbohydrates, protein, fat, vitamins and minerals into smaller parts for the

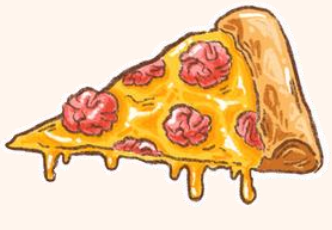
body to use (NIH, 2024). Gut microbiomes are microscopic organisms including bacteria, viruses, and parasites. Trillions of microbiomes are found in human intestines and each type of microbiome has a distinct function that contributes to digestion. Newborns inherit their first microbiomes during breastfeeding or vaginal delivery and acquire new microbiomes depending on their diet. Therefore, each individual has a unique gut microbiome (Cleveland Clinic, 2023).

Besides the communication between the CNS and GI mentioned above, the gut-brain axis also involves the intestinal peripheral nervous system (PNS) and gut microbiomes. The bidirectional communication between the brain and gut microbiomes is significant as it has neural, immune, endocrine, and hormonal links.

Gut microbiome to brain: Gut microbiomes interact with the nervous system in many different ways: microbiomes can modulate sensory nerves by inhibiting calcium dependent potassium channels and exciting neurons or produce molecules that function as local neurotransmitters.

Brain to gut microbiome: The brain sends signals to release neurotransmitters, hormones, and immune cells to the gut and therefore regulates the activity of gut microbiomes (Carabotti. M, 2015).

In one interesting study related to the gut-brain axis, surgeons transplanted feces to a patient with a severe C difficile infection (a fatal bacterial infection) to benefit the good bacteria, and the treatment worked. Surprisingly, the mood patterns and mentality of the patient started to



resemble the donor's. This evidence shows the connection of gut and brain and how our unique gut microbiomes contribute to forming and regulating our own personalities and moods (Koussa, 2019).

The three molecules used as an example to explain the gut-brain axis process are tryptophan, tyrosine, and Indole-3-Lactic Acid (ILA). Tryptophan, an essential amino acid, is converted into neurotransmitters such as serotonin and melatonin which mainly regulate sleep and mood. Tyrosine, a non-essential amino acid, is used to produce an essential amino acid (phenylalanine) and neurotransmitters such as dopamine that regulate the reward system and epinephrine used for the flight or fight response. ILA, a metabolite of tryptophan, is converted into Indole-Propionic-Acid (IPA) which is a crucial antioxidant (Angle, 2019).

As shown through such examples, the gut microbiomes take a crucial role in both mental and physical health, and therefore dysbiosis (the imbalance in gut microbiomes) can lead to serious issues such as eating disorders, mental and behavioral disorders such as anxiety or depression, and even cancer (Cleveland Clinic, 2024).

Lesson Outline:

You Are What You Eat: Investigating the Gut-Brain Axis

Date: December 13th-15th (3 Lessons)

Target Audience: Age 13-18, most critical ages of habit development

Duration: 1 hour 45 minutes

Presenters: [redacted]

Lesson Topic: You Are What You Eat: Investigating the Gut-Brain Axis

Ideal Participant Number: 32

1. Activity 1: Questionnaire (10 minutes)

- To better understand our target audience, a quick questionnaire will be done in the beginning of the lesson as an ice breaker.
- The participants will be asked to share what they had for breakfast and what their typical meal looks like.
- Then, the participants will be asked to make name tags with the name of their breakfast written and will be given pre-designed pins related to their breakfast dish. This activity's aim is to introduce the main idea of our lesson: "You Are What You Eat!"

2. Group Discussion (10 minutes)

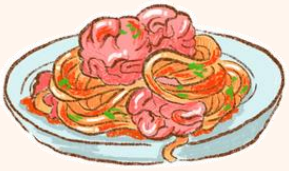
- Ask participants to share their initial thoughts on a healthy diet and their opinions on how many people nowadays are on a balanced diet.
- The aim of this activity is to check the audiences' understanding on a balanced diet and compare their initial understanding to their understanding after the lesson.

3. Shocking Statistics (5 minutes)

- Before moving on to the informative and scientific part of the lesson, few shocking statistics related to unbalanced diets will be shared to the participants.
- This raises awareness about the seriousness of the ongoing issues of an unbalanced diet so that the participants actively engage throughout the lesson and in all activities.

4. Presentation and Lecture (30 minutes)

- Learning objectives will be shared first for a preview of the information covered in the presentation.
- The key body systems mentioned in the lecture such as the nervous system and digestive system will be introduced.
- Gut microbiomes and the gut-brain axis will be described to illustrate the link between the digestive system and the nervous system. This will further elaborate the main idea of 'You are what you eat.'
- Three chemical molecule conversions in the body will be described in detail regarding the functions and roles of the molecules. Through such real examples of molecules coming from food consumed in daily life, the participants will have a better understanding of the gut-brain axis.
- The importance of a balanced diet and its link to gut microbiome balance will be presented with reference to the food pyramid.
- Consequences of issues in the gut-brain axis such as eating disorders, mental disorders, and cancer will be discussed in depth to further emphasize the importance of a healthy diet.



5. Activity 2: Molecule Puzzle (10 minutes)

- Participants will be asked to divide into 5 groups.
- A set of cards with chemical molecules written on each will be given out to each team.
- Members will be asked to cooperate and organize the orders of chemical conversions which were previously discussed in the lecture.
- This will be used as a review activity to check the audiences' understanding on the gut-brain axis processes.

6. Activity 3: Lesson Quizizz (15 minutes)

- As a final lesson review, an online quiz on Quizizz will be played by participants.
- 10 questions on the information discussed in the presentation will be asked.
- There will be a variety of ways to answer such as multiple choice or typed answers.
- This activity will be a quick overall review that is easy for all participants to access and engage.

7. Activity 4: Planning Out Diets on Clipboards (15 minutes)

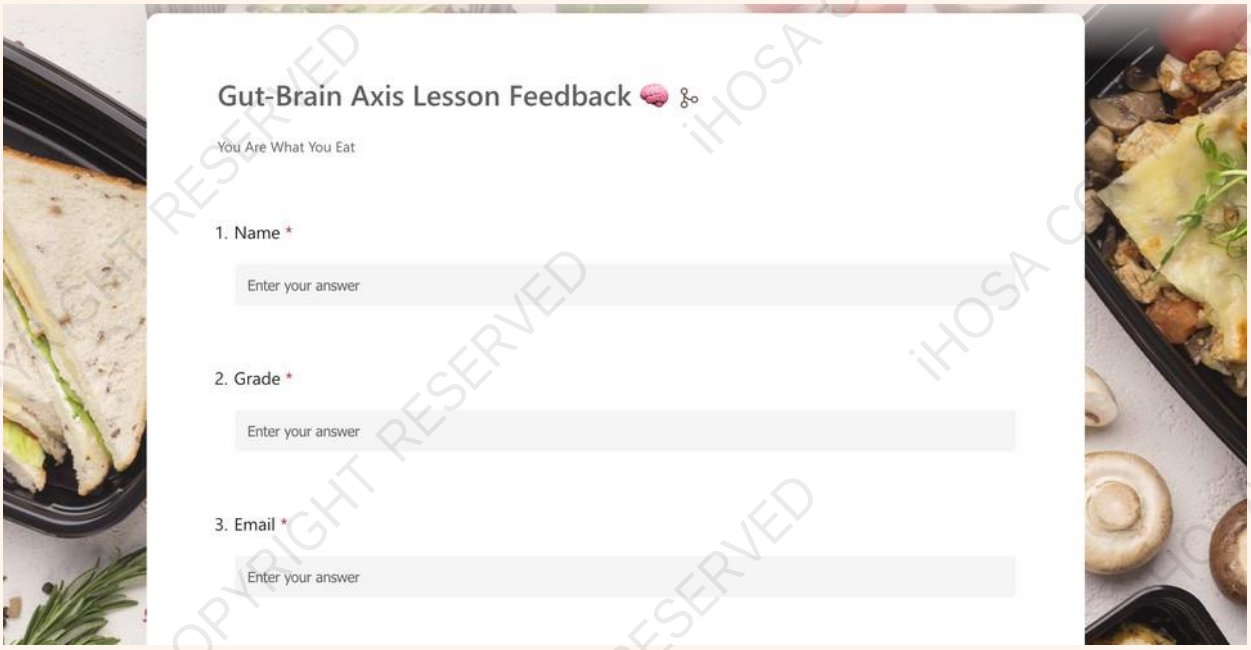
- On pre-designed activity sheets on clipboards, participants will be given time to plan and draw their own diets based on what they learned through the lesson.
- Participants will be asked to share their newly planned diet and compare it with their initial diet they mentioned in the beginning of the lesson.

8. Reflection & Evaluation (10 minutes)

- Participants will complete a Microsoft forms survey.
- The survey will help members have an insight on the impacts of the lesson and possible ways to improve qualities of the lesson for better engagement and understanding. In addition, it will offer them an opportunity to reflect on steps that they wish to take to improve their health.

Lesson Feedback:

You Are What You Eat: Investigating the Gut-Brain Axis



Gut-Brain Axis Lesson Feedback 🧠

You Are What You Eat

1. Name *

Enter your answer

2. Grade *

Enter your answer

3. Email *

Enter your answer

4. What does your current diet/meal look like? *

Enter your answer

5. How many different types of vegetables do you eat per day? *

- I don't eat any vegetables
- 1-2
- 3-4
- 5-6
- 7+

6. How often do you consume fast food per week? *

- I don't eat fast food.
- 1-3
- 4-6
- 7-9
- 10+

7. In your own words, how does the gut affect the brain (or vice versa), and how do you think this has played out in your day-to-day life? *

Enter your answer

8. We all know breakfast is the most important meal of the day, please list a typical breakfast for you. *

Enter your answer

9. What is your key takeaway from this lesson? *

Enter your answer

10. How likely is it for you to improve your diet in the short term? *

- Very likely
- Somewhat likely
- Neither likely nor unlikely
- Somewhat unlikely
- Very unlikely

11. How likely is it for you to improve your diet in the long term? *

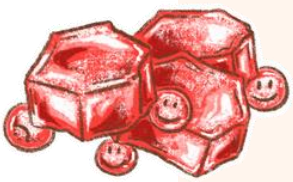
- Very likely
- Somewhat likely
- Neither likely nor unlikely
- Somewhat unlikely
- Very unlikely

12. Which aspects of your diet will you be improving from this day onwards? *

Enter your answer

13. Do you think it's worth spending time planning out your week's meals? *

- Yes
- No
- Maybe



14. Would you like some extra assistance and resources to help you along the way (in terms of meal planning)? *

- Yes
- No

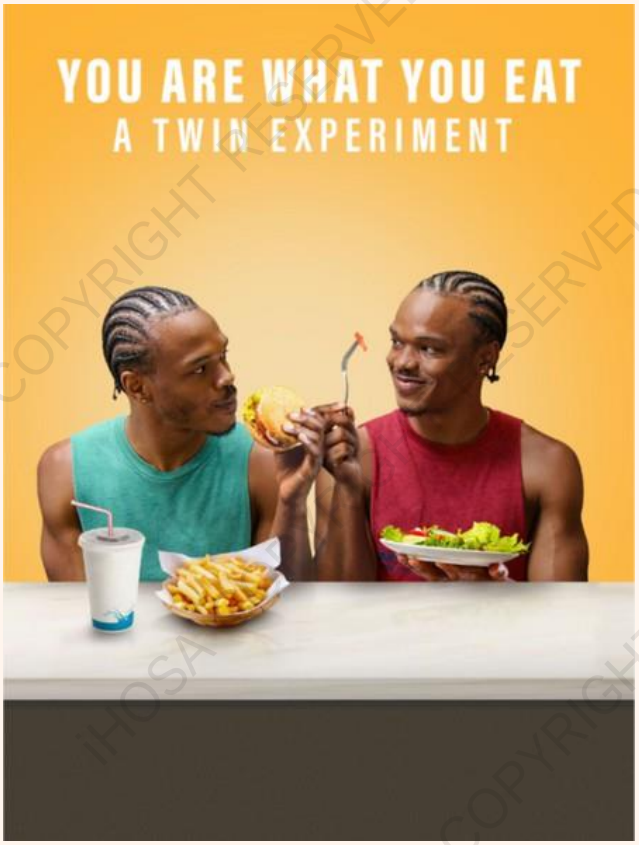
Feedback Form

SCAN TO TAKE SURVEY

Extra Resources to Explore:

You Are What You Eat: Investigating the Gut-Brain Axis

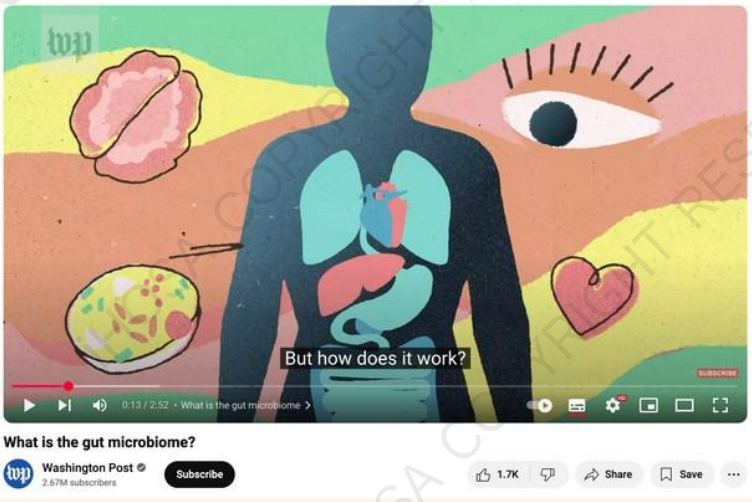
Documentary



TEDx Talks

Research Articles

Informative Videos



Ted Talks:
https://www.youtube.com/watch?v=NVYpigbij_c&t=375s
https://www.youtube.com/watch?v=B9RruLkAUm8
Washington Post:
https://www.youtube.com/watch?v=d-Ln9NNj2KY
NIH Article:
https://pmc.ncbi.nlm.nih.gov/articles/PMC2792687/
Netflix:
You Are What You Eat

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