

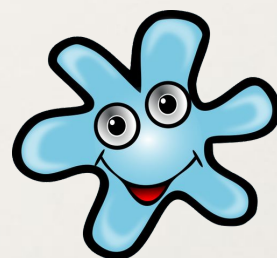


PSYCHBIOTICS

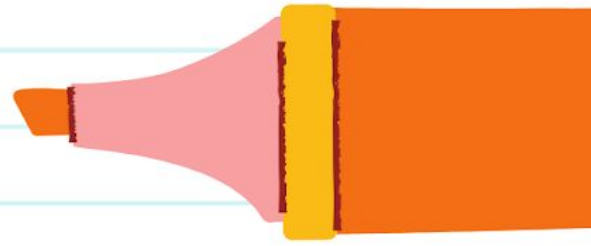
(Name) _____

WORKBOOK

20__



INSTRUCTIONS



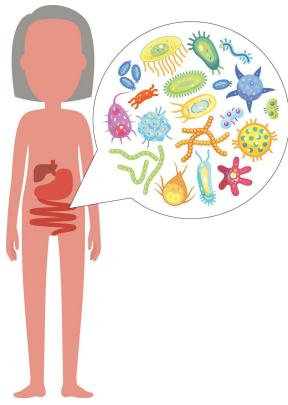
Make a copy of this workbook in the Google Drive, and add your name to the title.

Open the workbook and fill in your name on the title page.

Read the following pages and study the material.

Test your knowledge on page **4** and complete the activity on page **6**.

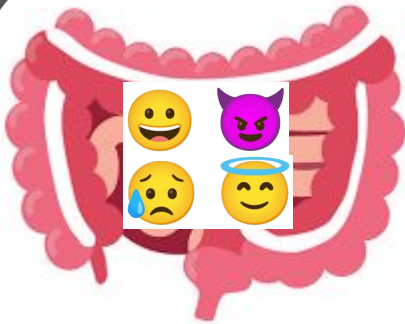




THE GUT MICROBIOME

Definition: the microorganisms including bacteria, viruses and fungi that live in the digestive tracts of humans and other animals.

What makes a healthy gut microbiome?



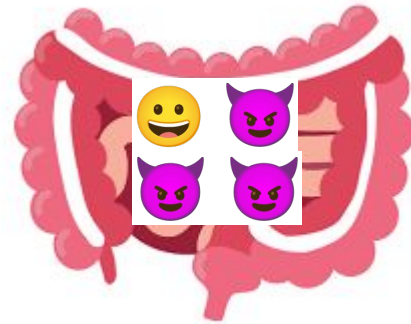
A healthy gut microbiome is **diverse**. That means that there is a variety of bacteria inside of it.



This comes from a diverse diet including lots of fruits and vegetables.



A healthy and diverse gut microbiome is important. These bacteria play a role in digestion, a healthy immune system, and a healthy brain.



An unhealthy gut microbiome is **not diverse**. It means that there are many of the same kinds of bacteria living inside.

This comes from a plain diet of unhealthy foods and overuse of antibiotics. This means that the gut is out of balance, or in *dysbiosis*.



Dysbiosis leads to diarrhea, cramping, constipation, bloating, indigestion, IBS, cancer, obesity, anxiety, and more.

Supplementing a healthy gut:

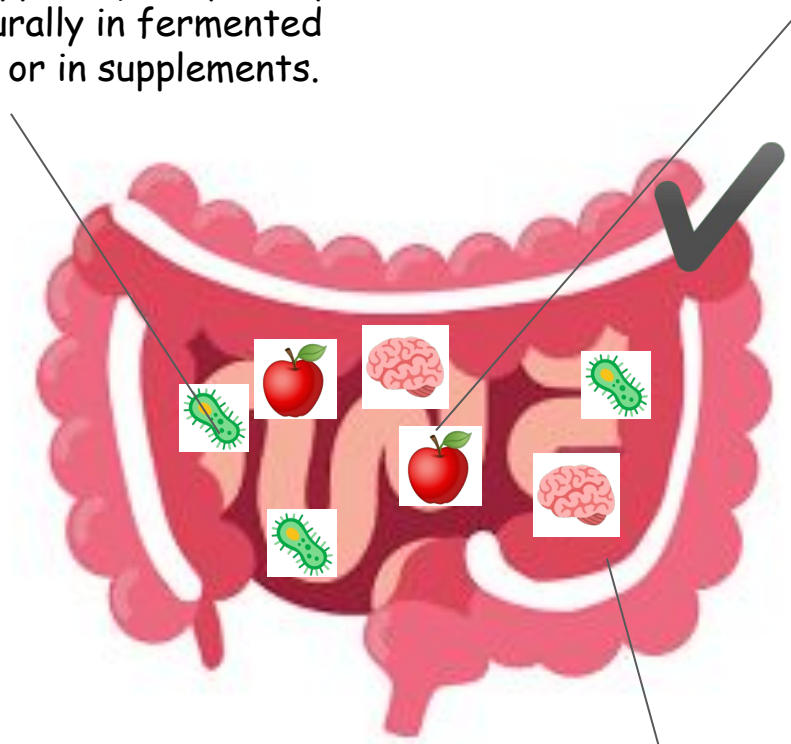
Right now, the best way to maintain a healthy gut microbiome is by eating a **variety of healthy foods** on a daily basis and **minimizing stress** throughout the day. However, there are supplements and treatments used to maintain a healthy gut as well, especially for people with severe intestinal illnesses.

Probiotics

Probiotics are **live microorganisms** that have health benefits. When you ingest them, they make your gut even more diverse! These must be consumed often, because they disappear quickly. They can be found naturally in fermented foods like yogurt or in supplements.

Prebiotics

Prebiotics are **food for probiotics**. Prebiotics are found naturally in starches and fibers like fruits, vegetables and grains. It's important to eat prebiotics when taking probiotics.



BONUS! ⚡

Another kind of treatment is the **fecal microbiota transplantation (FMT)**: the transfer of an entire microbial community from a healthy donor's poop to a sick recipient.



Psychobiotics

A psychobiotic is a probiotic that specifically provides **mental health benefits** through interactions with gut bacteria.

YOUR BRAIN AND GUT: GUT-BRAIN AXIS

The microbes in your intestines affect the way that your brain and nervous system function. This happens via the **gut-brain axis (GBA)**, a *bidirectional* link between the emotional and cognitive centers of the brain with the intestinal tract. Communication occurs when the gut-microbiota and the brain signal to each other through neural, endocrine, immune, and humoral links.

The vagus nerve

Microbes communicate with the brain in different ways, but the primary way is via the **vagus nerve**, the longest cranial nerve. The vagus nerve is **bidirectional**, meaning signals can go both ways.

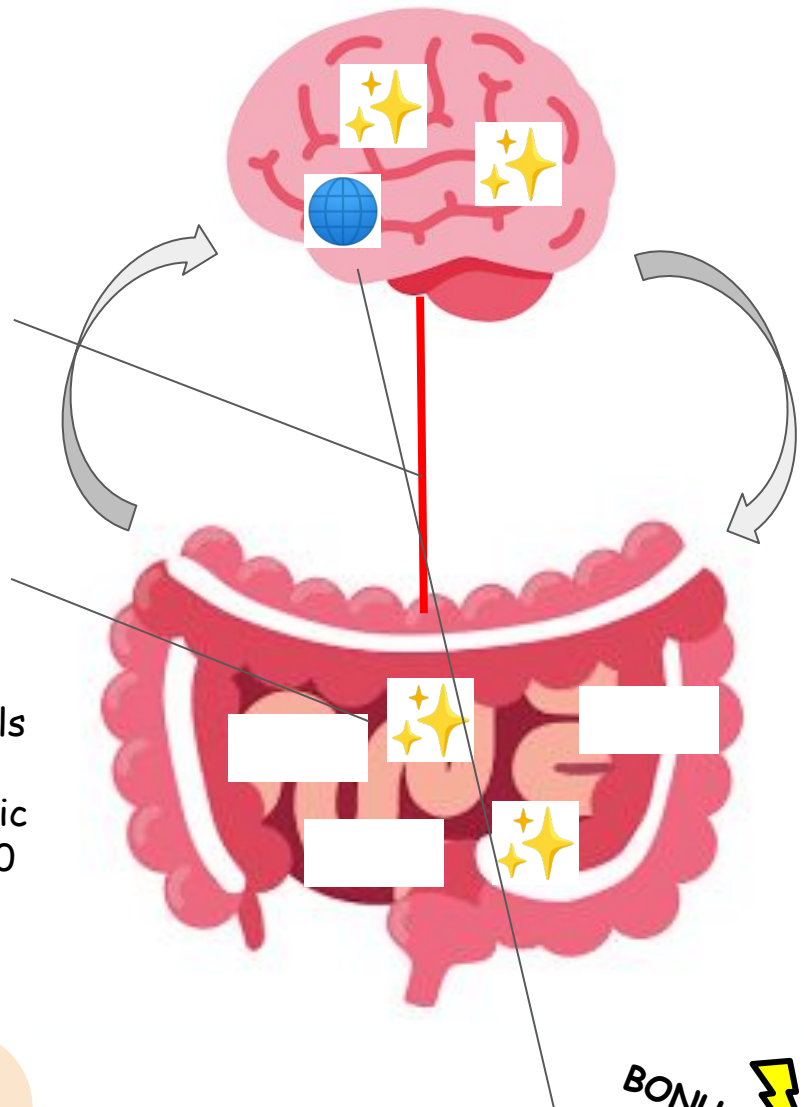
✨ Neurotransmitters

Neurotransmitters are **chemicals/hormones** that brain cells use to communicate. But your gut produces them too! The gut's enteric nervous system (ENS) uses over 30 neurotransmitters.



Neurotransmitters also produced by gut bacteria:

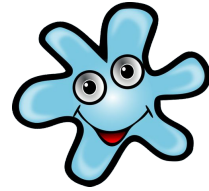
- Serotonin: happiness
- GABA: relaxation
- Dopamine: motivation
- Norepinephrine: adrenaline (fight or flight)



Neuropathways

BONUS! ⚡

Learning new skills or behaviors means you need to form new **pathways** in your brain. This process is called **plasticity**: your brain's ability to create new pathways between neurons. These pathways are strengthened by practice and reinforcement.



TEST YOUR KNOWLEDGE!

1. What is the gut microbiome?
2. What makes a healthy gut?
3. What is dysbiosis and its side effects?
4. What are psychobiotics and how do they work?
5. What is the gut-brain axis?
6. What are neurotransmitters and how do they affect humans?
7. **BONUS:** What is neuroplasticity?

RED TEAM'S PROJECT: SUMMARY

We have created a therapeutic psychobiotic for children. The child will ingest a daily psychobiotic (which is in food form), and the live bacteria will be delivered to the intestines. There, the bacteria will synthesize the neurotransmitters like oxytocin, serotonin, dopamine, and GABA. Other bacteria (which operate through the neuroendocrine system not the vagus nerve) will lower cortisol.

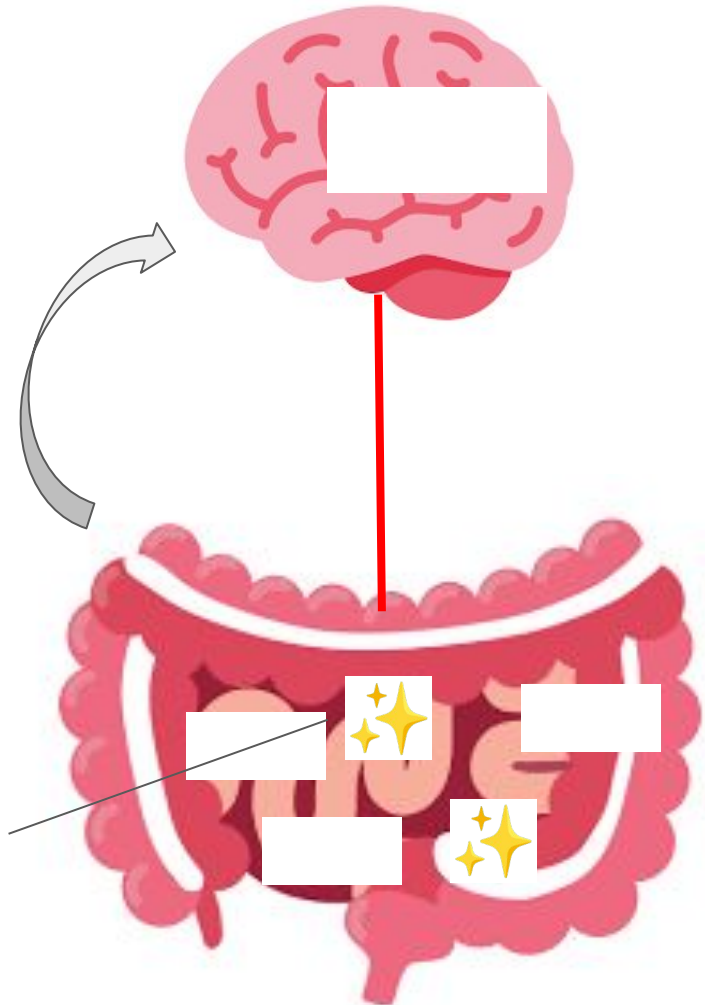
Delivery

Probiotics + prebiotics are **eaten** daily, and the live bacteria will be delivered to the gut. Once in the gut, they will synthesize neurotransmitters.



Neurotransmitters

Neurotransmitters like **oxytocin, serotonin, dopamine, and GABA**, will make the child less stressed and fearful, more relaxed, and more happy around new people.



Result:

By combining our psychobiotic with a healthy diet, and with parents reinforcing inclusive behavior, the child will form better **neural pathways**. The pathways that help Emily to see new people as friends, not foes, will be strengthened over time. As the child reaches adulthood, she will be comfortable with all types of people. Over time, our hope is to develop a new generation of people like this, who are less prejudice, leading to social equality.

RED TEAM'S PROJECT: ACTIVITY

Decide the order of each step and type in the corresponding number. Move the emojis into the correct body location in which they occur.

Step #_

Neurotransmitters will help Emily to form healthy **neural pathways**; She will see new people as friends, not enemies.

Step #_

Emily will ingest our **psychobiotic** starting at age 5.

Step #_

The psychobiotic will increase or reduce the production of specific **neurotransmitters**.

EMOJI BANK

