




*Henni's and Trisha's*  
*TriFold printout*  
*Copy*



Please keep in mind that this is our old copy of our trifold printout thing, *not our cysf copy*, so there may be many changes.



## problem/big question

### // STEP 1 :-

~**how can gluten affect your small intestine**~ the small intestine is the part of the body where it affects gluten A LOT because the small intestine is the part of the body where it absorbs/ digest food

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- Our project is about “How gluten can affect your small intestine when you have Celiac Disease”.
  - Gluten is able to effect your small intestine in many different ways , one of them are digestive problems. Some digestive symptoms you may have are diarrhea , bloating ,and weight loss when you consume wheat
- We need to learn more about celiac and some of these painful conditions because there can be consequences that can affect someone that has celiac in a bad way~ that is why we have created this project, because hopefully at the end of the day celiac people can be convinced to have a gluten free diet
- According to Henni's family doctor that had a personal conversation with Henni's Dad (Kirti Soni) about celiac (Henni has celiac), up till this date, “Celiac Disease” has not been curable. So scientists, doctors, etc, have been trying to cure Celiac so people with that disease can eat gluten for the rest of their life when it gets cured.
- Celiac disease can also have some long terms of health effects (condition or diseases connected to celiac). For example , heart disease , liver failure , and skin conditions.

## problem/big question // STEP 2:

### Step 2~ Why does our project matter

- Our project is important because when you have celiac, people would still eat it without caring how much damage it can do to our bodies. So this project is about the damage gluten can do to your small intestine (if you have celiac).
- Our project is also spreading awareness by telling people its symptoms, diagnostics , and how to manage your body with some of the conditions you may have. This project also educates people about celiac disease and how it digests in your body when you have problems with gluten.
- Celiac disease affects others because when someone has celiac, they can't eat gluten , meaning that when they may go somewhere like a social event, they may not be able to eat majority of the foods there. So we should be more mindful of the foods we pick next time when we host a social event and invite people with food allergies so they don't become hangry like me (henni).

## problem/big question // STEP 3:

### Step 3~ Aims & objectives

- This project's aim is to discover what will happen to our small intestine if we eat gluten for the celiac population.
- Also our aim is "how bad can gluten affect our small intestine if we eat too much gluten when we have a wheat related condition.
- One of our objectives for our project , is that when we are at the science fair and present , we hope that some people can learn more information about gluten, celiac disease and other conditions connected to celiac, how to handle the symptoms you might get + how to be aware of your body, and the main part is how can gluten affect your small intestine.
- This project explores the impact of celiac disease on patient's quality of life , sticking to a gluten free diet, and long-term health outcomes.
- The research aims I probably will research that is related to celiac is "Can celiac affect your mental health? What is biopsy surgery for celiac? What are the different parts of the small intestine? Are there different levels for celiac? And last but not least How do you know if you are diagnosed with celiac?"

1. Our question is “how can gluten affect your small intestine”. ,
2. Since your small intestine is in charge of digesting food~ you can have a really bad reaction which can lead to damaging your small intestine.
3. So if you have celiac, when you consume gluten it can damage your small intestine lining , and preventing the proper digesting , due to the damage from the celiac.
4. People having a gluten free diet will have less impact on there health.
5. **If** people had a gluten free diet and this not take risks in eating gluten, **then** people with celiac probably would not damage your small intestine and not put their life in risk. Also, they probably would not get any reactions (but some people don't get reactions when they eat gluten like Henni, but gluten still affects your body in a bad way). To add to this, I think, that if we compare people that have celiac who have a gluten free diet and a normal diet; people with a gluten free diet probably have a healthier body since they are avoiding risks of damaging their small intestine.
6. People with a gluten free diet will probably have **no effect** since they are less likely to affect their small intestine in a bad way , and less damages to your body.

## Small intestine Hypothesis (henni + trisha together)

**Trisha** ~ What i think will happen to your small intestine when you eat gluten , is that the effect on gluten entering the small intestine is that it all depends on that person's health conditions or underlying conditions , such as coeliac disease. i also think that it would cause many headaches and joint pain (for coeliac disease). Another hypothesis that i have is that because the gluten goes through other organs on the way to the small intestine , i think that it would affect those organs as well. Although it does depend on that persons sensitivities & conditions it would still affect your body in some way.

**Henni**~ My hypothesis is on how gluten can affect your small intestine, I think that it can give you like a rash or scar on the celiac body part. I do not have a reaction when I eat gluten, but some people do that have celiac disease, so I think that the people who have a reaction on eating gluten would not only get the reaction but also probably damage their celiac a little bit every time they eat gluten & since its close to their small intestine, + the small intestine is in charge of digestion, I think when the gluten goes through the small intestine then the small intestine hurts since the small intestine breaks down the food and its left with the bad parts which then gives the small intestine pain.

## Variables

### **Variables: How can gluten affect your small intestine? ~ celiac disease**

**Controlled:** The gluten, ( it's always gonna stay the same)

**Manipulated:** The parts of the small intestine is gonna change because of the reactions that people with celiac disease have when they consume gluten. The villi is gonna be one of the biggest impacts because it absorbs nutrients for certain parts of the body like the bloodstream. The area of the villi is the upper part (jejunum). Since the villi gets damaged because of gluten, it makes it very hard for the villi to absorb nutrients which leads to health issues. But overall, the small intestine will have the most impact in changes.

**Responding:** the responses that the small intestine will give to gluten entering the small intestine is that eating gluten triggers an immune response gluten protein in your small intestine. Over time, this reaction damages your small intestine lining and prevents it from absorbing nutrients.



## Summary

For our topic, some of the very important information we learnt that is very important, when people with celiac disease eat gluten (gluten is wheat, barley, and rye,) it triggers the immune response and damages the lining of the small intestine (aka the villi, the villi is tiny finger like projections that absorbs nutrients from food into the bloodstream ) overtime when you keep on eating gluten and the immune response damages the villi, it can lead to serious digestive issues; so yahh

In our topic we also learnt a lot about the parts of the small intestine, such as the main parts of the small intestine ;ileum, jejunum, duodenum, and also did a dive finding information about the lining of the small intestine; the villi.

If i were to do this project again but different topic question that is obviously related to celiac disease, I would do: The damage celiac disease causes to other parts of the body; because you never know, some parts of the body that does not even take in nutrients for food or practically anything that affects food the most, can maybe have a pretty big impact on celiac disease such as the brain, you can also do: can celiac disease completely destroy the villi (or anything that does a deeper dive into the villi), the last topic question I think is pretty cool and you should do is; Are you born with celiac disease even if you find out later in your life?



## Conclusion // trisha , small intestine -

**Trisha** - I think my hypothesis was pretty accurate for the most of it. Because we mostly talked about in mine and hennis project about symptoms for celiac disease and other stuff , and that it is also true that when you consume gluten and it goes through other organs to make its way to the small intestine , that it will affect all of the organs that the gluten goes through , and also that it does depend on the person's health conditions or underlying conditions when they eat gluten. But the only reason why i kinda think that my hypothesis is not fully correct was because henni was correct , i basically just named the basic stuff. So just to sum this all up , i mostly got everything right on my hypothesis , but the downside was basically me just stating the obvious.

**Henni** - I feel like my hypothesis was pretty similar to the research me and Trisha found.

**1 / 2.** Some things that was not correct though is you don't get a rash or a scar on the celiac body part, you mainly damage your villi which then affects the small intestine because the villi is one of the most important parts of the small intestine because it absorbs the nutrients in food.

**3.** You get "the pain" when the immune response mistakenly attacks the gluten thinking it is similar to a foreign substance.

One of the things that I stated out the is pretty important is ~**The body part where celiac disease is impacted the most is definitely the small intestine (though I did not state about the Villi)**

## Conclusion // trisha & henni , main hypothesis

- Our main hypothesis was mostly right. And i am going to break down the questions 2-6 whether they were right or not.
- **2. Yes this is true.** Because when you eat gluten , it will damage your small intestine lining , and preventing the proper digestion. But something i will say is that everybody's body is different , therefore some people will have different reactions because that person might have celiac disease , coeliac disease , and so on.
- **3. Yes this is true.** Because it is true that if you consume gluten , it will damage your small intestine lining and will prevent the proper digestion ( due to all of the celiac).
- **4. Yes this is true.** Because people who have a gluten free diet will therefore have no gluten enter their small intestine and cause any damage to them.
- **5. Yes this is MOSTLY true.** Because it is true that people who have a gluten free diet would be healthier then the people who have celiac and don't follow the gluten free diet. And they also might not always get reactions when they eat gluten (like henni) , And that it would still affect your body in some way. But the only thing that i found pretty wrong was the lack of detail we put into this hypothesis. And what i mean by this is that we only stated the obvious.
- **6. Yes this is true.** Because if u were to have a gluten free diet , then there would be less of a risk of damaging your small intestine and to your body , and someone with a gluten free diet body would be way healthier then someone who isn't follow it when they have celiac

## Acknowledgements// henni & trisha

Henni: First of all, I would like to acknowledge my science teacher (Ms.Easton) for helping me with all the questions me and Trisha has, without Ms. Easton, this project would have been missing alot of key information. I would also like to give a big thank you to my dad for giving me a lot of great ideas, and information about celiac disease since I have it. Huge thank you to google for helping me find websites which then had a positive impact on my science fair project. Last but not least, I would love to thank you science partner, Trisha, for making this amazing journey possible.

Trisha: I would first like to acknowledge my partner and gurneet , because they had so much experience before , they knew all of the stuff that was gonna and what specific topics there were gonna be in the CYSF program , and because we also got a lot of inspiration from their last project as well to tell us how to organise , do , and learn from it all so that we can add it onto our project. But i would also like to acknowledge my science teacher for telling me & my partner how many mistakes we made on our project , it taught us to do things that we didn't do before , and to fix all the mistakes we made.

## application

This project proves that if you were to have some sort of gluten disorder, but you don't follow a gluten free diet, that could really affect specific parts of your body in a really bad way, such as your small intestine lining. So that is exactly why you should not take any risks on getting horrible reactions to gluten and start following a gluten free diet. An example of this idea is, when you go to a restaurant to eat dinner, and a waiter gives you a menu to choose your meal to eat, the menu should have a symbol that represents gluten next to that specific food item so the the person with a gluten disorder knows that the food has gluten, this way the person will be positive that the food has gluten instead of the waiter asking the chef. I (henni) wish that there was a certain app that tells about gluten free recipes, gluten free foods, and even restaurant options. Something that would be so useful for me is if the app could also give you personalized recommendations for managing a diet (& even some perks). So yeahh

## **Who should avoid eating gluten?**

### **Celiac disease~**

If you have a celiac disease and consume food with gluten , it will affect your immune system and will start growing pain to your intestine. Which is able to stop you from eating foods with nutrients. But a celiac disease can be hard to diagnose, infact 30% of the world are properly diagnosed.

### **Gluten intolerance~**

It is able to make you unwell after devouring gluten , and some of the signs for that is bloated, nauseous or gassy. gluten intolerance also causes most symptoms likes a celiac disease , but not the same condition. gluten intolerance is a autoimmune disorder that has mostly all the symptoms that Celiac disease has. Gluten Intolerance also has other symptoms.

### Who should avoid eating gluten?

Wheat allergy~ If you have a wheat allergy and you consume wheat, you will get an allergic reaction that can vary to every human being.

### Is gluten free healthier?

Eating gluten is much more healthier, the reason why eating gluten is much more healthier than a gluten free diet is because a gluten free diet has less minerals, and vitamins. Also, apparently gluten free foods have less fiber but more sugar and fat. //

### Why is a celiac disease so serious?

With an untreated celiac disease, it can start developing other autoimmune disorders, like type 1 diabetes, and a lot of other conditions, Abdominal bloating and pain, Anxiety and depression, Fatigue, Headaches, and weight loss. If you eat wheat, and you have Celiac Disease, you can put your life in risk.



### **What are some examples of foods that are gluten free?**

Here are the following food items that do not contain gluten/wheat: Fruits and vegetables  
Rice flour, Eggs, Most low-fat dairy products

### **What are some examples of foods that have gluten?**

Here are some of the following food items that contain Wheat/ Gluten ~ Muffins, pretzels,  
cookies, chocolate {only some tho} , Cake , Bread ,Brownies

Your small intestine! Your small intestine is the body part that break down food, absorbs nutrients from your food, and get rid of unnecessary stuff (like unnecessary nutrient and waste).Your small intestine is about as big as 20-25 feet in length , and about as big as your middle finger.

The small intestine is divided into 3 main parts~ the **duodenum**, (doo-oh-duh-num) **jejunum**, (je-jen-num) and the **ileum** (i-lee-uhm).



## What does the jejunum, duodenum, & ileum do in the small intestine?

- One of the things that the **jejunum** does is absorb sugars, amino acids, and also fatty acids. According to the website I used is the jejunum and the ileum is like a protective layer for you stomach.
- The **ileum** is in charge of absorbing any other remaining nutrients that the jejunum, or duodenum did not absorb. Some particular nutrients that the ileum probably absorbs is vitamins B12 and bile acids (like acids that help with digesting fats)
- The **duodenum** is the part of the small intestine where all the absorption actually begins (the duodenum is one of the most important parts of the small intestine for absorbing nutrients and other important chemical molecules) the duodenum is one of the first parts of the small intestine. Apparently there is 4 parts of duodenum, there is superior, descending, horizontal, & also ascending. The superior part of the small intestine is the only part that is peritoneal (like a protective layer).

## What are the different types / levels of celiac disease

- **The first type is *classical*.** For the people who have classical celiac disease but tend to still eat gluten , have a higher likelihood that people who have classical celiac disease , will make pale , smelly , and fatty stools. Some warning signs for classical celiac disease are digestive issues and symptoms , diarrhea , unexplained weight loss , & stunted growth in children.
- **The second type is *Non-classical*.** The difference between classical & non-classical , is that non-classical celiac disease people may not experience bad symptoms of the amount of difficulty it Takes to digest food.
- **The third type is *silent*.** And it is called this because People who suffer with it do not experience any Kind of symptoms connected to celiac at all. But Wait , if someone doesn't have any symptoms , then How do they know if they have celiac? Well that's Because someone who suffers with it , will Experience damage to their small intestine , but Yet can still live life fine.

## What is coeliac disease? , & what causes it?

- When you have coeliac disease , your immune system Will attack your very own cells when you digest Gluten. It then damages your small intestine to the Point where your body cannot properly digest Nutrients. It's also about to cause a bunch of Symptoms which includes diarrhea , and Abdominal pain + bloating.
- Because coeliac disease is an autoimmune system (that's where the immune system mistakenly Attacks a healthy tissue) . The immune system Mistakes a substance that's inside of the gluten To be a threat that can harm the body. So It attacks it. It then damages the surface of the Small bowel (intestines) & disturbing the body's Ability to digest nutrients from food.

## What part of the small intestine is affected by celiac disease?

- The main part that wheat affect is the small intestine lining, one of the main reason why is because the small intestine lining absorbs nutrients from digested food, but the fact is that wheat is a grain that is sometimes not even digested properly. The small intestine area is mostly damaged by the jejunum (upper part of the intestine).
- The reaction of the gluten to the lining of the small intestine can inflate and sometimes even become leaky ~~ like the inside of the villi there is this thick slippery fluid called the Mucosa, so sometimes the cells can Leak ; water & salt will leak and other molecules.

## How can you find out if you have celiac disease?

- You can find out if you have celiac disease with 2 types of blood tests, Serology testing & Genetic testing.
- Also, if you really wanna be exact if you have celiac disease then you could take a endoscopy, ( there is also a capsule endoscopy) and another surgery is biopsy.
- Endoscopy~ Endoscopy works with a long tube with a tiny camera attached to the tube that goes through the digestive system to see the small intestine which lead for the person to see the damage gluten has done to the villi, if that person has celiac.
- Capsule endoscopy~ Capsule endoscopy is when you use a wireless camera (which is basically the size of a vitamin capsule) that can take a lot of pictures of the entire small intestine.

Humans eat on average between one and 2.7 kilograms of food a day.

That is 265 kilograms of food a year per person.

And every last scrap makes it through that digestive system.

**Comprising 10 organs** covering 9 meters and containing over **20 specialized cell types**.

This is one of the most diverse and complicated systems in the body.

Spanning the entire length of your torso, **the digestive system has 4 main components**.

First there is the **gastrointestinal tract**, a twisting channel that transports your food and has an internal surface area between 30 + 40 square meters, enough to cover half a badminton court.

Second there is the **pancreas, gallbladder, & liver**, a trio of organs **that break down foods using an array of special juices**.

Third, the **body's enzymes, hormones, nerves and blood**, which all work together to break down food, modulate the digestive process, and deliver its final products.

Finally there is the **mesentery, a large stretch of tissue** that supports and positions all your digestive organs in the abdomen, enabling them to do their job.

The digestive process begins before food even hits your tongue.

Anticipating a tasty morsel glands in your mouth start to pump out saliva. Once inside your mouth, **chewing combines with the sloshing saliva** to turn food into a moist lump called a **bolus**. Enzymes present in the saliva break down any starch. Then food finds itself at the rim of a **25 cm long tube called the esophagus**, down which it must plunge to reach the stomach. Nerves in the esophageal tissue sense the boluses' presence and trigger the peristalsis, which is a series of defined muscular contractions. That **propels the food into the stomach**, where it's left at the mercy of the muscular stomach walls, which pound the bolus, **breaking it into chunks**. Hormones, secreted by cells in the lining, trigger the release of acids and enzymes-rich juices from the stomach wall that start to **dissolve** the food and break down its proteins. These hormones also alert the pancreas, liver, and gallbladder, to produce digestive juices, and transfer bile, a yellowish-green liquid that digests fat in preparation for the next stage. After 3 hours inside your stomach, the once shapely **bolus is now a frothy liquid called chyme**, and it's ready to move into your small intestine. The liver sends bile to the gallbladder, which secretes it into the first proportion of the small intestine called the duodenum. Here it dissolves the fats floating in the slurry of chyme so they can be easily digested by the pancreatic and intestinal juices. These enzyme rich juices break the fat molecules down into fatty acids and glycerol for easier absorption into the body. The enzymes also carry out the final deconstruction of proteins into amino acids, and carbohydrates into glucoses. This happens in the small intestine in the lower regions, the jejunum and ileum.



Which are coated in millions of tiny projections called the villi. **These create a huge surface area to maximize absorption and transference into the bloodstream.** The blood takes them on the final leg of their journey, to feed the body's organs & tissues. But it's not over quite yet, **leftover water, fiber, and dead cells, sloughed off during digestion** make it into the large intestine, also known as the colon. The body drains most of the remaining fluids through the intestinal wall. What's left is a soft mass called a **stool**. The colon squeezes this byproduct into a pouch called the rectum, where nerves sense it expanding and tell the body when it's time to expel this waste. The byproduct of digestion exit through the anus and the foods long journey typically **lasting 30 to 40 hours is finally complete**

### What is a GI tract?

The GI tract (also known as the gastrointestinal tract) is the pathway that leads to the digestive system (mouth to anus). The GI tract contains all the major organs in the digestive system, including the esophagus, stomach, and the small + large intestine. The gastrointestinal tract is divided into the upper and lower gastrointestinal tract.

*"Gastrointestinal is an adjective meaning of or pertaining to the stomach and intestines."*



Citations (there's a lot)~

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Citations (there's a lot) ~

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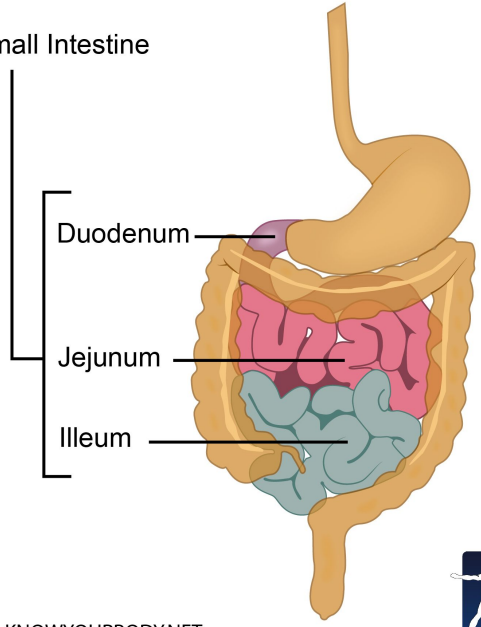
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Small Intestine

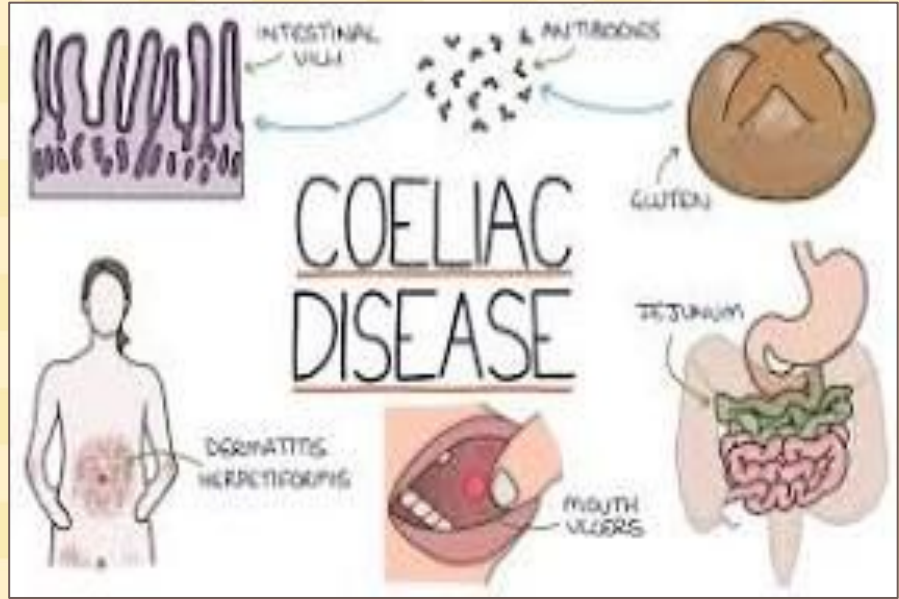


Duodenum

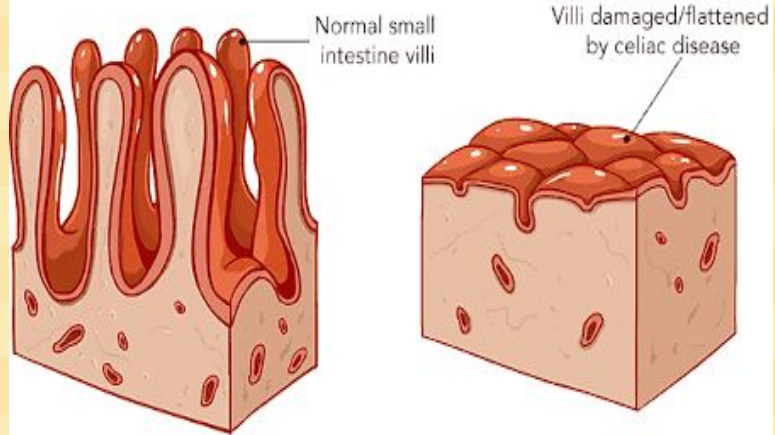
Jejunum

Ileum

KNOWYOURBODY.NET



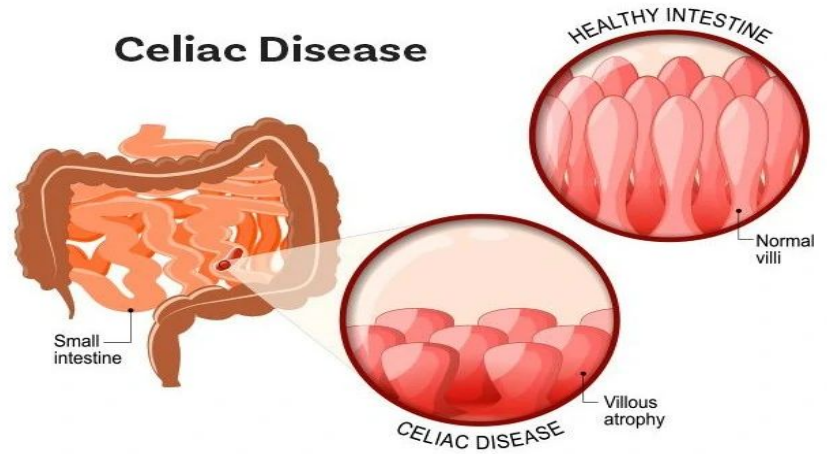
## Lining of the small intestine



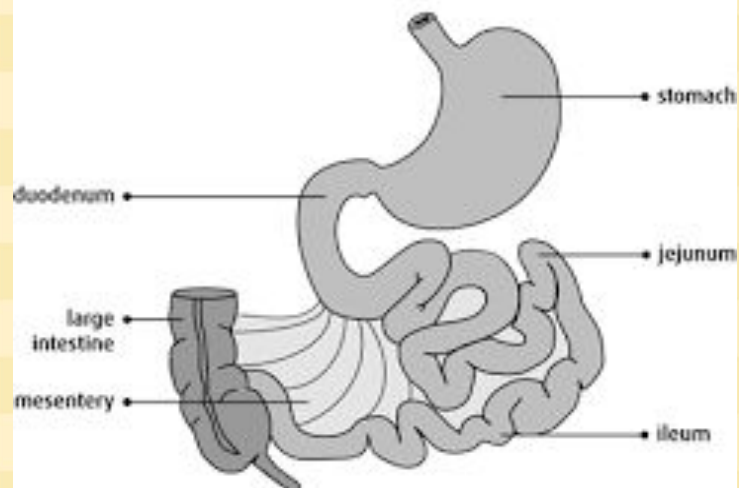
Normal villi

Celiac disease

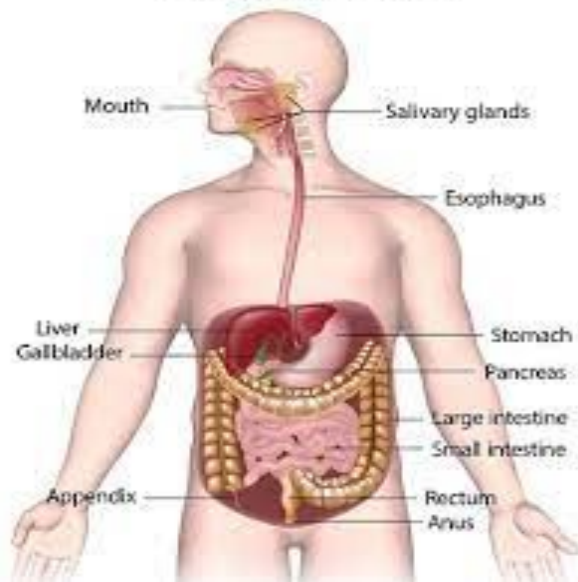
## Celiac Disease

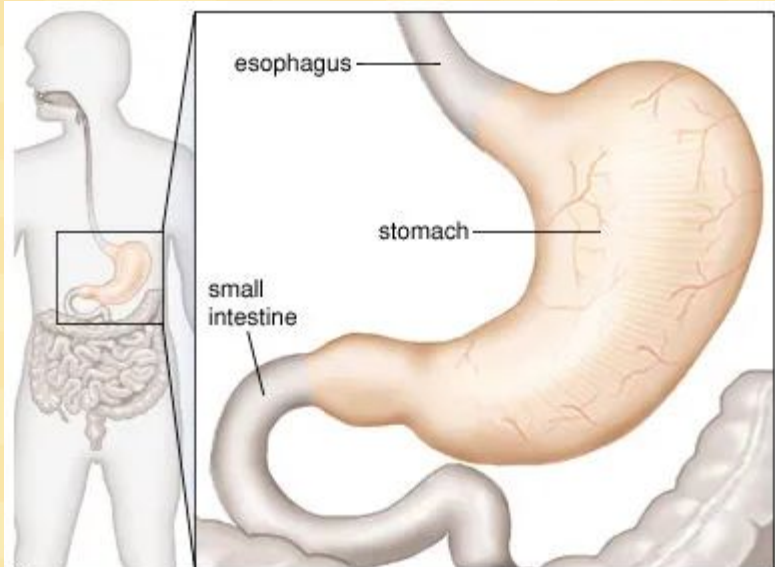


Small Intestine and Surrounding Organs



The Digestive System





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HOW CAN GLUTEN



AFFECT THE SMALL INTESTINE?