



## **Leaky Gut**

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**1999**

**Grade Level:**  
Middle-High School

## Leaky Gut

### Purpose:

The “leaky gut” is a physiological phenomenon that gastroenterologists have been working to understand and find effective drugs to treat the diseases associated with this phenomenon. Leaky gut allows “diffusion” of toxic substances from the gut lumen into organs, leading to tissue damage.

The gut has specific absorption pathways which readily receives nutrients, such as sugars, amino acids, vitamins and minerals from the gut lumen, and transfers them into blood stream. The “mucosal barrier to diffusion” in the gut prevents absorption of toxin, allergens and pathogens into blood stream and tissues. When nutrients are absorbed by specific absorption pathways, diffusion of toxic substances is absent under normal physiologic conditions. This means that the gut mucosa and other organs are totally protected from toxic substances that would otherwise diffuse along the concentration gradient to funnel their way into gut mucosa and other organs.

When the mucosal barrier of the gut is disrupted due to factors relating to syndromes found in “Inflammatory Bowel Disease” and “Alcoholic Liver Disease,” a pathophysiologic state arises. This syndrome in general is called the “leaky gut syndrome.” In the leaky gut syndrome toxic substances from the gut lumen diffuse into the tissue along the concentration gradient.

The purpose of this lesson is for students to become aware of how the diffusion process can affect the normal physiologic workings of the body, as well as to demonstrate how a normal gut barrier differs from disrupted gut barrier using a laboratory demonstration.

This activity can be adjusted for any middle or high school grade level.

### Objective:

Students will be able to:

- explain how diffusion works.
- explain how foreign materials may enter by diffusion and affect the living cells.
- use dialysis bags to demonstrate the “leaky gut” phenomenon.
- list different pathophysiologic conditions that may occur in respect to the gut when the mucosal barriers are disrupted.
- write a report on their laboratory experiences.

### Materials:

Students should be placed into groups of three or four.

- two beakers of 100ml volume
- two dialysis bags:
  - one with molecular mass cut off of 100 Da (daltons)
  - and other molecular mass cut off of 10,000 Da
- \*Trypan Blue (blue dye) - with molecular mass of 1000 Da, which means it can diffuse out from bag (B) but not from bag (A)

**Preparation:**

- Students should have a basic understanding of the gut.
- The teacher should model for the students how to perform the experiment, as well as how to prepare the dialysis bags.
- The students should be familiar with basic measurements that they may follow instructions for preparing the dye solutions within their groups.
- The students should view the lab report and address appropriate sessions before beginning the lab.

**Procedures:**

1. The students should be placed into groups of three or four. Each group's materials' person should come up and get one set of supplies for the experiment.
2. The students should prepare a 100 ml beaker with 80 ml of water. They should then add one drop of phenol red solution (dye). The beaker should be labeled normal gut (A). The students should prepare another beaker as the first labeling it leaky gut (B).
3. The students should then prepare a dialysis bag with small pore size (mw cut off 100 Da) with five ml of water and one drop of Trypan blue dye. This bag should be labeled normal gut (A). Another dialysis bag should be prepared, this time with large pore size (mw cut off 10,000 Da) with five ml of water and one drop of Trypan blue dye. This bag should be labeled leaky gut (B).
4. Take the dialysis bag labeled normal gut (A) and place into the beaker labeled normal gut (A). Observe the beaker for 15 minutes. Record your observations.
5. Take the dialysis bag labeled leaky gut (B) and place into the beaker labeled leaky gut (B). Observe the beaker for 15 minutes. Record your observations.

**Safety:**

There are no real safety issues in this lab. Standard classroom safety rules, however, do apply. The dyes used in the lab should also be handled with care.

**Questions To Ask:**

1. What do the dialysis bags represent?
2. What will happen to the dye in the dialysis bag that represents the healthy cell barrier versus the dialysis bag representing the cell with a disrupted barrier?
3. Why is it that the dye in the healthy cell with the intact mucosal barrier not mix with the dye found on the outside of that cell?
4. What are some pathophysiological conditions that may arise due to a disrupted mucosal barrier?
5. What can be done to the dialysis bag that represents the disrupted barrier to prevent any further toxic transfer via diffusion? (pore size of the bag in respect to the special dyes did not have to be explained prior to this question, based on what the students have learned they should suggest changing the pore size in respect to the type of dye used)

**Where To Go From Here:**

This lab is appropriate for units on the digestive system, nutrition, cell structure and function, diffusion, or a study on various kinds of diseases.

At the conclusion of this lesson, it would be appropriate to invite a physiologist in to discuss the pathophysiologic issues surrounding the “leaky gut.” The students can then be given an opportunity to write a reflection in their science journal in respect to their experiences surrounding the activity and guest presenter.

**Suggestions for Assessment:**

- The students should fill out a detailed report of their lab experiences.
- A quiz should be given to evaluate the students understanding of the concepts relayed.
- The students’ journal entries should also be checked for an assessment of what the students themselves may have felt that they gained from the experience.

**References and Resources:**

1. Cowan GO, Das KM, Eastwood MA. Further studies of sulfasalazine metabolism in the treatment of ulcerative colitis. *Br Med J.* 1977; 2:1057-9.
2. Ma,Thomas Y. Mini Review: Intestinal Epithelial Barrier Dysfunction in Crohn’s Disease. *P.S.E.B.M.* 214:318-327, 1997.

## Leaky Gut Lab Report

### Problem:

What will happen to a cell when its mucosal barrier is disrupted?

### Hypothesis:

### Materials:

### Procedures:

### Results:

- Draw each beaker and its content. Be sure to include labels. You should include a set of pictures for each condition, which includes before reaction, during, and after reaction. Colored pencils should be used to represent the various colors of dye involved.
- Answer the following questions as you proceed through the lab experience:

#### BEAKER 1

1. What happens when the dialysis bag is placed into the beaker labeled gut?
2. Do any changes in color occur?
3. What is the color of the dye solution inside the bag?
4. What is the color of the dye solution inside the beaker?

#### BEAKER 2

1. What happens when the dialysis bag is placed into the beaker labeled disrupted gut?
2. Does any change in color occur?
3. What is the color of the dye solution inside the bag?
4. What is the color of the dye solution inside the beaker?
5. Explain why Beaker 1 and Beaker 2 gave different results.

### Conclusion:

1. Was your hypothesis correct? Why/Why not?