



A Cornucopia of Symptoms

Corn and Nutrition

Language Booster

Did you know that our bodies need many different **nutrients** to grow, think, move, and stay healthy?

Nutrients, such as vitamins, minerals, proteins, and carbohydrates, come from the foods we eat. If you look at the foods you eat, you may even see some labeled as **enriched**, which means they were processed to add nutrients to the product. A healthy **diet** includes a variety of foods that provide the right balance of nutrients. When a person does not get enough of an important nutrient over time, they can develop a **deficiency** that can lead to health problems, even if they feel full and eat enough calories.



One important nutrient is **niacin**.

Without enough niacin in the diet, the body cannot work properly. Corn contains niacin, but in its dried form, much of that niacin is chemically bound inside the grain. If dried corn is simply ground and cooked, the body cannot easily access all of its **nutrients**. This means that a diet based mostly on untreated corn (cornmeal or grits) could lead to a niacin **deficiency**.

Corn (maíz) has been a principal food in Mexico and other parts of the Americas for thousands of years. To prevent malnutrition, Indigenous communities in Mexico developed a remarkable solution long before modern nutrition science existed. They used a process called nixtamalization, which involves soaking and cooking dried corn in water mixed with lime (a natural mineral made from limestone) or wood ash. This process releases the chemically bound niacin, making it available for absorption. After soaking, the corn is rinsed and ground into dough to make foods such as tortillas and tamales.

This example teaches an important lesson: knowledge about food preparation can be just as important as the food itself. A healthy diet depends not only on what we eat, but also on how we prepare it.

Traditional practices like nixtamalization show how cultural knowledge, passed down through generations, can protect communities from nutrient deficiencies and support long-term health.



Watch the video [What is nixtamalization?](#) And talk to your team about these questions:



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Why is it important to have a balanced diet instead of eating mostly one kind of food, like corn?

How did the process of nixtamalization make corn healthier to eat?

Why do you think some communities stayed healthier when they used traditional food practices?



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Science Investigation

In this investigation, you will solve a real scientific mystery that has puzzled doctors for many years. Through this activity, you will examine victim profiles, analyze patterns, and evaluate evidence. Working like real scientists, you will develop and test hypotheses about the causes of this cornucopia of symptoms!

Materials:

- Worksheet
- Case Study Profiles (Part I, Part II, Part III)

Procedure:

1. A mysterious illness is introduced that is affecting members of a community. With your group, learn about the symptoms and your role as a Chief Medical Officer.
2. Examine the Case Study profiles. For each profile:
 - a. Carefully read all information provided.
 - b. Identify symptoms.
 - c. Pay attention to diet, lifestyle, and environment.
 - d. Record any important information on your worksheet.
3. After taking notes on the profiles, look for patterns. What symptoms do the victims have in common? What foods do they eat? What differences exist between them? Is there anyone who did not get sick? How come?
4. Develop a hypothesis. What do you think is causing this illness? Try to answer this question using information and patterns you recognize from the victim profiles.
5. After reviewing your hypothesis, present your conclusion to the class. Your conclusion should include:
 - a. What caused the illness
 - b. Evidence to support that claim
 - c. How could this illness be prevented
6. Complete reflection questions.



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Scenario Introduction

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Something strange is happening in the southern United States.

Over the past several months, more and more people have been getting sick. At first, it was just one or two people. But now, doctors and town leaders are becoming concerned.

People who are sick have unusual symptoms. Many have developed dark, painful rashes on their skin, especially after spending time in the sun. Others feel weak and tired all the time. Some have stomach problems, and a few have even begun having trouble thinking clearly or remembering things.

The illness does not seem to spread from person to person like a cold or flu. Entire families may have one sick person, but others remain healthy.

Doctors have tested the water. It appears clean. They have examined homes. Nothing unusual has been found.

No one knows what is causing the illness.

Your team has been called in as the **Chief Medical Officer**. Your job is to investigate the evidence, examine Case Study profiles, talk with other experts, and determine:

- What is causing the illness
- Why do some people get sick, and others do not
- How can the illness be prevented

You will receive profiles of people who have become ill and who are not exhibiting symptoms. Study them carefully. Look for patterns.

Some clues may seem small, but even small clues can solve big mysteries.

Your mission: **Solve the Case of the Cornucopia of Symptoms.**



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Step 1 - Case Study Profiles with Symptoms

Take a look at the Case Study Profiles of folks with symptoms of the illness. Use your handout to make observations and collect information about this illness.

Step 2 - Case Study Profiles without Symptoms

Congratulations! You've made it to Part 2! Now that you've examined the folks who have symptoms of this mystery illness, you'll have to examine folks who don't have any symptoms and see if there are any differences. Take a look at the next profiles and answer the questions on your handout.

Step 3 - Consult with Experts

Now it's time to talk with experts about the trends that you're seeing. What are other doctors saying about this mystery illness? From your examinations of patients with and without symptoms, and what you've learned from your expert friends, what is causing this cornucopia of symptoms?!



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Final Reveal Explanation

Mystery Solved: A Cornucopia of Symptoms

The illness affecting the people of the southern USA is called pellagra.

Pellagra is caused by a lack of an important nutrient called niacin (Vitamin B3).

Niacin is essential for:

- Healthy skin
- Proper digestion
- Brain function
- Energy production

Without enough niacin, people develop:

- Skin rashes
- Digestive problems
- Fatigue
- Confusion

Many people in the southern US ate corn as their main food source. Corn DOES contain niacin—but in its natural form, the human body cannot absorb it easily.

However, Elena Alvarez prepared her corn differently.

She soaked her corn in limestone water, an alkaline solution. This process is called nixtamalization.

Nixtamalization unlocks the niacin, allowing the human body to absorb it.

Because Elena used this process, she remained healthy.

This process was developed thousands of years ago by Indigenous peoples of Mesoamerica. Their scientific knowledge prevented pellagra.

When corn spread to other parts of the world without this preparation method, pellagra became common.

The real cause of the illness was not the corn itself, but the lack of proper preparation. This led to the Food Enrichment Policy, an emerging understanding of vitamin deficiencies, and the idea that to be healthy, you need to eat a wide variety of foods.



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Family Activity: Family Vitamin Scavenger Hunt

Learning Goal:

Families will learn about important vitamins, identify foods at home that contain them, practice reading food labels, and understand how vitamins help keep their bodies healthy.

Materials (use what you have at home):

- Food and packaged food items from your pantry, refrigerator, or freezer (fruits, vegetables, cereal, milk, canned foods, yogurt, bread, snacks, etc.)
- Access to Nutrition Facts labels on those foods
- Vitamin chart handout (from the activity)
- Paper or printed recording sheet
- Pencil or pen
- Optional: calculator (to look at % Daily Value more closely)

Step 1: Learn About Key Vitamins

Vitamin	Helps Your Body...	Foods to Look For
Vitamin A	Keep eyes and skin healthy	Carrots, sweet potatoes, spinach, milk
Vitamin C	Heal cuts & support the immune system	Oranges, strawberries, bell peppers, broccoli
Vitamin D	Build strong bones	Milk, yogurt, eggs, fortified cereal
Vitamin B3 (Niacin)	Turn food into energy & keep skin and nerves healthy	Chicken, tuna, turkey, peanuts, fortified cereal
Vitamin B6	Help the body use protein and make red blood cells	Bananas, chicken, potatoes
Vitamin B12	Keep blood and nerves healthy	Meat, fish, milk, eggs



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Vitamin K	Help blood clot and support bone health	Leafy greens like spinach, kale
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Step 2: The Scavenger Hunt (15–20 minutes)

Search your kitchen (pantry, fridge, freezer).

Challenge:

- Find at least one food that contains each vitamin listed above.
- Use the Nutrition Facts label to check for the vitamin.
- Look at the % Daily Value.

Tip: If a vitamin shows 10% or more of the Daily Value, it's a good source.

Step 3: Record Your Findings

Write what you discovered:

Vitamin A → Found in: _____

Vitamin C → Found in: _____

Vitamin D → Found in: _____

Vitamin B3 (Niacin) → Found in: _____

Vitamin B6 → Found in: _____

Vitamin B12 → Found in: _____

Vitamin K → Found in: _____

Nutrition Facts	
2 servings per container	
Serving size	1 oz (28g)
Amount Per Serving	
Calories	150
% Daily Value*	
Total Fat 6g	8%
Saturated Fat 2.5g	13%
Trans Fat 0g	
Cholesterol 60mg	20%
Sodium 250mg	11%
Total Carbohydrate 0g	0%
Dietary Fiber 0g	0%
Total Sugars 0g	
Protein 22g	44%
Calcium 26mg	2%
Iron 1.08mg	6%
Vitamin A	2%
Vitamin C	40%

*The % Daily Value (DV) tells you how much a nutrient in a serving of food contributes to a daily diet. 2,000 calories a day is used for general nutrition advice.

Step 4: Family Discussion

1. Which vitamin was easiest to find? Which vitamin was hardest to find?

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2. Did you find any fortified foods (vitamins added during processing)?
3. Which foods had more than one vitamin?
4. “When we look at our typical meals and snacks, do you notice any vitamins that might be missing or too low? How could we add foods to include them?”

Bonus Challenge (Optional)

Create a snack or meal that includes **at least 3 vitamins** from your list.

Example:

- Peanut butter (B3) on whole-grain toast with strawberries (Vitamin C) and a glass of milk (Vitamin D).



Resources

English	Spanish
Vitamins. The National Library of Medicine	Vitaminas. Biblioteca Nacional de Medicina
Vitamins and Minerals	



A Cornucopia of Symptoms Concept Cards

nutrients/ nutrientes

Essential chemical substances found in food that the body needs to live, grow, function, and repair itself.

Sustancias químicas esenciales que se encuentran en los alimentos y que el cuerpo necesita para vivir, crecer, funcionar y repararse.



Fish is a source of many important nutrients, including protein, vitamins, and minerals.



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Concept Card

enriched/ enriquezido(a)

Improving the quality, value, or nutrient content of something by adding desirable ingredients, enhancing features, or restoring lost nutrients.

Mejorar la calidad, el valor o el contenido nutricional de algo mediante la adición de ingredientes deseables, la mejora de sus características o la restitución de nutrientes perdidos.



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INGREDIENTS: Enriched unbleached flour (wheat flour, malted barley flour, ascorbic acid [dough conditioner], niacin, reduced iron, thiamin mononitrate, riboflavin, folic acid), sugar, degermed yellow cornmeal, salt, leavening (baking soda, sodium acid pyrophosphate), soybean oil, honey powder, natural flavor.

CONTAINS: Wheat.

May contain milk, eggs, soy and tree nuts.

The drink is enriched with vitamin C.

Concept Card

diet/dieta

The food and drink a person or animal consumes regularly.

Los alimentos y bebidas que una persona o animal consume regularmente.



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A balanced diet is essential for healthy growth.

Concept Card

niacin/niacina

Also called vitamin B3. Niacin helps the body turn food into energy. It also supports healthy skin, digestion, and brain function.

También llamada vitamina B3. La niacina ayuda al cuerpo a convertir los alimentos en energía. Además, favorece la salud de la piel, la digestión y la función cerebral.



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Consumption of properly prepared tortillas helps meet daily niacin requirements.

Concept Card

deficiency/
deficiencia

A lack, shortage, or insufficiency of something necessary, such as nutrients (vitamins/minerals) in the body, resources, or required skills.



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Falta, escasez o insuficiencia de algo necesario, como nutrientes (vitaminas/minerales) en el cuerpo, recursos o habilidades requeridas.



Iron deficiency led to anemia

Concept Card

Teacher Page

Summary

This activity will take students back in time to solve a mystery occurring in the southern United States. Students will take on the role of a *Chief Health Inspector* to investigate and analyze the information provided to determine that the illness going around is pellagra. They will use skills in deduction, investigation, problem-solving, and teamwork to determine the cause of the cornucopia of symptoms folks are experiencing. To support student engagement, there are worksheets for elementary, middle, and high school students to guide them through the activity.

NGSS Standards

Key Concepts: Metabolic processes - how the body uses macronutrients, Resource management - analyzing the causes of food insecurity and malnutrition, Data analysis - interpreting data sets on



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malnutrition statistics to determine trends, Nutrient deficiency - the impact of lacking specific nutrients on an organism's growth, Metabolic pathways - evaluating how different diets impact energy output and health, health literacy - applying science practices to analyze nutrition labels and develop healthy eating behaviours.

MS-LS1-3. System Interaction - Develop a model to describe how food is broken down and absorbed to provide energy to the body, and how that system interacts with others (e.g., the cardiovascular system for transport)

MS-LS1-7. Energy in Cells - Use a model to illustrate that cellular respiration is a chemical process in which food molecules (nutrients) and oxygen are broken down to transfer energy, which is essential for understanding energy deficiencies.

HS-LS1-6: Matter and Energy in Organisms - Construct an explanation for how carbon, hydrogen, and oxygen from sugar molecules (food) can combine with other elements to form amino acids and other large carbon-based molecules, which are essential for preventing malnutrition.

HS-LS1-7: Cellular Respiration - Use a model to illustrate that cellular respiration breaks down bonds in food molecules and creates new compounds, transferring energy, which is critical to understanding energy deficiency.

Lesson Objectives

1. Students will investigate evidence and think critically about the information provided to solve the mystery of what's causing the symptoms.
2. Students will collaborate to share ideas and solve the problem.

Lesson Procedure

1. Read through the Language Booster and have students explore the concept cards. Introduce the vocabulary to ensure understanding of the terminology used on the cards.
2. Watch the Introduction Scenario in the video with the class to set the scene.
3. Group students and have them collect their materials for investigation.
4. Explore Part 1 - The Cases. Complete worksheet – look for patterns in diet and lifestyle.
5. Discuss with group members what more information they need. Provide groups with the next set of information, Part 2 - the Healthy Community Members.



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6. Groups will then analyze Part 3 - Conflicting Opinions, where students will examine reports completed by other medical professionals to gain more information about what could be causing the *cornucopia of symptoms*.
7. Groups develop a hypothesis.
8. The last step is to present their hypotheses to the class.

Additional Resources on Pellagra

SMILE Videos on Pellagra

- College Students and Pellagra
- College of Health and Nutrition Prof

Joseph Goldbergers Research on the Prevention of Pellagra:

- [Joseph Goldberger's research on the prevention of pellagra.](#) - The James Lind Library

Blues Song "Cornbread, Meat, and Black Molasses":

- <https://www.jameslindlibrary.org/wp-data/uploads/2010/05/cornbread-meat-and-black-molasse.mp3>

Additional Info about Blues Song:

- <https://www.jameslindlibrary.org/articles/pellagra-and-the-blues-song-cornbread-meat-and-black-molasses/>

Pellagra in Alabama Resources:

- <https://library.uab.edu/locations/reynolds/collections/regional-history/pellagra/scourge-of-the-south>