# Inquiry-Based Science and Rare Diseases

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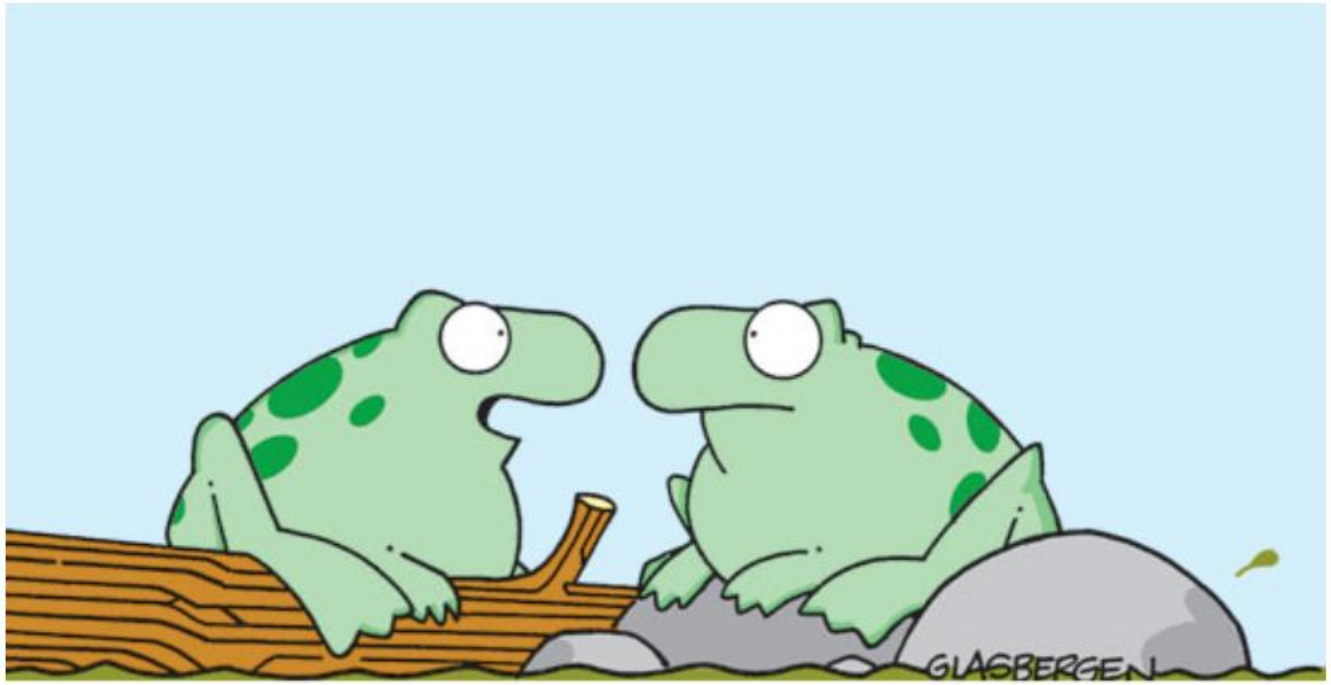
https://tinyurl.com/HeidiCOABE2019




"Looks aren't everything. It's what's inside you that really matters. A biology teacher told me that."

http://www.uft.org/editorial-cartoons/looks-arent-everything

# Objectives

**After completing this workshop, participants will have:**

- explored the use of inquiry-based science lessons for facilitating learning and stimulating student interest.
- examined the application of scientific concepts to a real-life scenario involving a rare disease.

# Characteristics of a rare disease, aka an "orphan disease"

**over 6000** rare diseases worldwide

affects **fewer than 200,000** people at any given time in the U.S. (about 1 in 1,500)


can affect more people but "no reasonable expectation exists that the costs of developing or distributing a drug can be recovered from the sale of the drug in the United States" (**Orphan Drug Act of 1983**)

disorders and symptoms **vary not only from disease to disease** but also **from patient to patient**

# Characteristics of a rare disease, aka an "orphan disease"

80% of rare diseases have identified **genetic origins**; others are the result of **infections** (bacterial or viral), and **environmental** causes

50% of rare diseases affect children

common **symptoms can hide underlying rare diseases** leading to misdiagnosis and delaying treatment

Rare diseases may become common, and common diseases may become rare.


https://www.rarediseaseday.org/

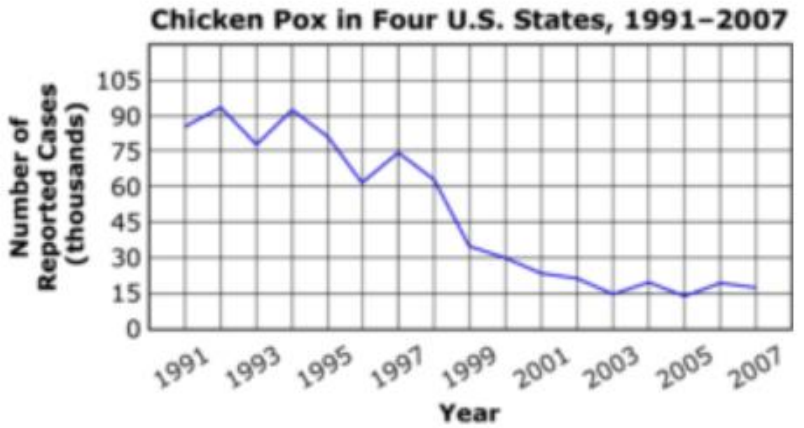
# Why is this relevant to adult education?

# It's not just about the science test…

- Students need to understand **science concepts**, know how to **read graphs and charts** displaying scientific data, and **use reasoning** to interpret science information."
- measurement of essential reasoning skills (e.g., analysis, evaluation, and inference) applied in scientific context
- The science content topics describe key concepts that are relevant to the lives of our students.
- measures ability to apply principles of scientific inquiry

# Sample GED® Science question

- This question asks you to use the data presented in the graph to support a given conclusion about a vaccine and its relationship to chicken pox.
- Varicella is a virus that causes the disease chicken pox. Medications are used to treat the symptoms of fever and discomfort associated with chicken pox. In 1995, a varicella vaccine was made available to people in the United States.
- The graph shows the number of chicken pox cases reported in four U.S. states from 1991. 2007.

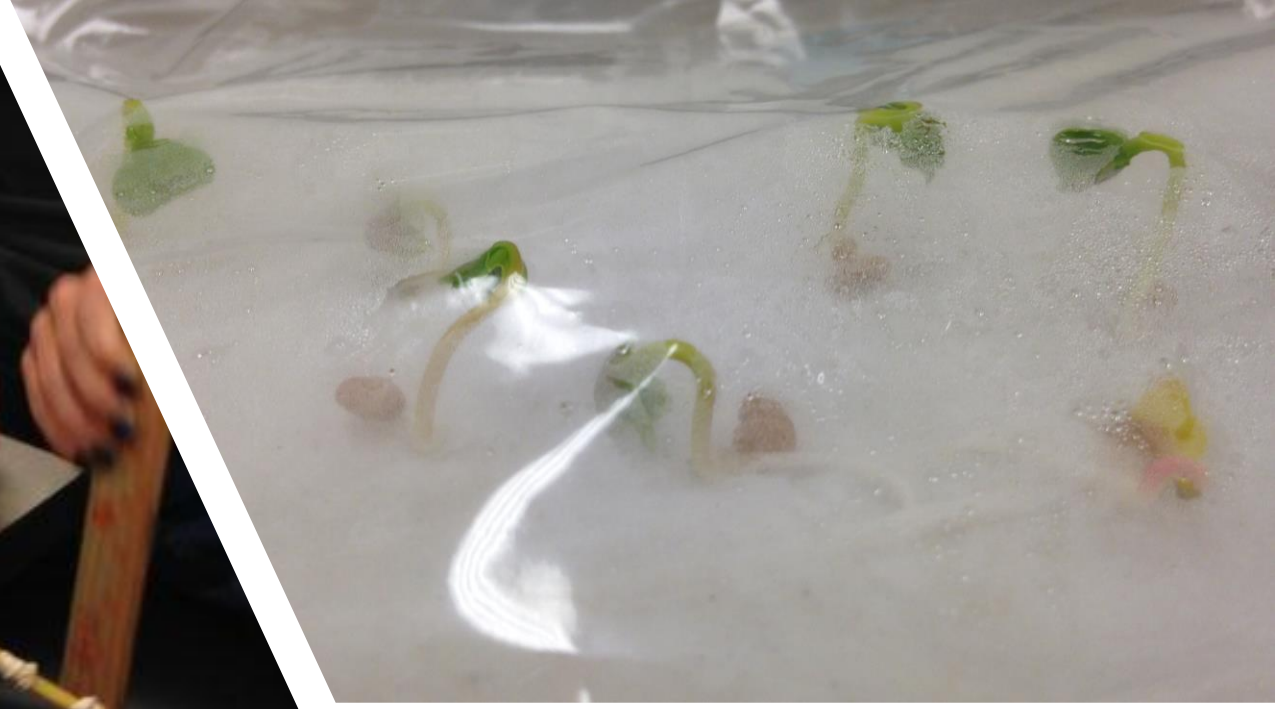


Source: U.S. Centers for Disease Control and Prevention

# What resource can help meet these requirements in a real-world context?

# National Institutes of Health (NIH) Curriculum Supplements

- 16 titles divided across elementary, middle, and high school levels
- lessons on the science behind selected health topics
- combine cutting-edge biomedical discoveries with state-of-the-art instructional practices
- consistent with National Science Education Standards and are aligned to state education standards
- promote critical thinking, teamwork, and problem-solving and communication skills
- incorporate real scientific data to engage and challenge students



# Two Main Objectives

To help (ABE) students understand :

- that studying rare diseases is not only important to the people affected by the diseases, but it also contributes to understandings that researchers can apply to other, more-common diseases or, more generally, to how the body works.
- the process of scientific inquiry through studying rare diseases.


https://science.education.nih.gov/MiddleSchool/RareDiseasesAndScientificInquiry

**Constructivist** theory of learning

Students are **active** thinkers

Students **need time** to:

- express their current thinking;
- interact with objects, organisms, substances, and equipment;
- reflect on their thinking by writing; and
- make connections between their learning experiences and the real world.

5 phases of active learning: Engage, **Explore**, Explain, Elaborate, Evaluate

**Inquiry-based experiences**

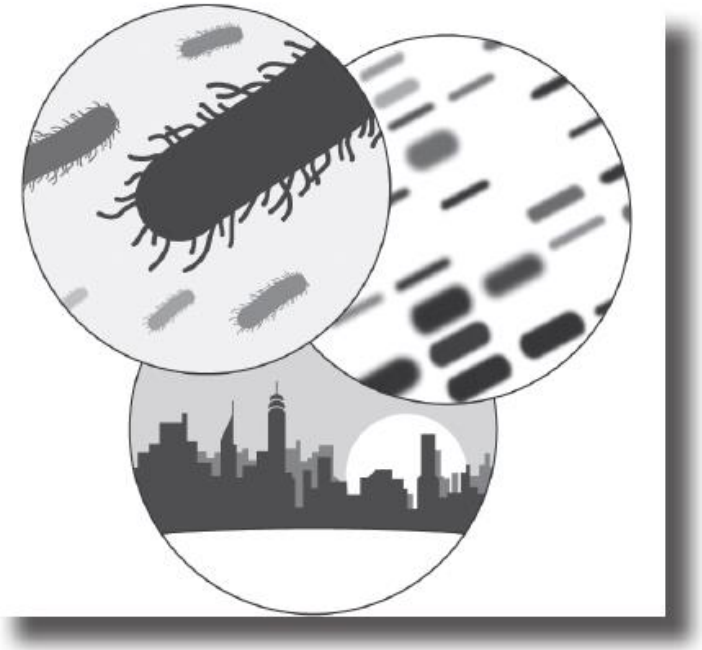
**student-centered** teaching practices

# Biological Sciences Curriculum Study (BSCS)

# 5E Instructional Model

# Lesson 2

## What Causes Rare Diseases?



## Explore

## New Visits to the Infirmary, Week 1

| Soldier | Barracks | What's wrong? |
|---|---|---|
| 1 | A | Sore, red, itchy eyes |
| 2 | D | Sore toe |
| 3 | A | Sore, red, itchy eyes |
| 4 | A | Sore, red, itchy eyes |
| 5 | G | Sore throat |
| 6 | A | Sore, red, itchy eyes |
| 7 | E | Skin rash |
| 8 | A | Sore, red, itchy eyes |
| 9 | F | Cut on left leg |
| 10 | G | Sore throat |
| 11 | I | Shortness of breath |
| 12 | A | Sore, red, itchy eyes |
| 13 | H | Sore toe |
| 14 | G | Sore throat |
| 15 | E | Skin rash |
| 16 | G | Sore throat |
| 17 | G | Sore throat |
| 18 | B | Ankle pain |
| 19 | G | Sore throat |
| 20 | D | Sore toe |
| 21 | C | Sore toe |

Which of these is most likely to be responsible for what's happening at the post?

## 3 general causes of disease:

- Genetics (heredity)
- Infectious agents
- Exposure to environmental toxins

You can order 2 different tests.

## Test 1

Looks for infection by bacterial species A, B, and C. These species are associated with common infections for pinkeye and sore throats as well as infections resulting from cuts and abrasions.

## Test 2

Looks for bacterial infections associated with skin rashes caused by Rocky Mountain spotted fever or Lyme disease. Test 2 also looks for exposure to poison ivy (not caused by bacteria).

# New Visits to the Infirmary, Week 1

| Soldier | Barracks | What's wrong? | Test ordered | Test results | Diagnosis | Treatment |
|---|---|---|---|---|---|---|
| 1 | A | Sore, red, itchy eyes | Test 1 | + for bacteria C | Pink eye | Antibiotic eye drops |
| 2 | D | Sore toe | Test 1 | + for bacteria A | Blister from boots | Dressing |
| 3 | A | Sore, red, itchy eyes | Test 1 | + for bacteria C | Pink eye | Antibiotic eye drops |
| 4 | A | Sore, red, itchy eyes | Test 1 | + for bacteria C | Pink eye | Antibiotic eye drops |
| 5 | G | Sore throat | Test 1 | + for bacteria A | Strep throat | Antibiotic |
| 6 | A | Sore, red, itchy eyes | Test 1 | + for bacteria C | Pink eye | Antibiotic eye drops |
| 7 | E | Skin rash | Test 2 | + for Poison ivy | Poison ivy | Skin cream |
| 8 | A | Sore, red, itchy eyes | Test 1 | + for bacteria C | Pink eye | Antibiotic eye drops |
| 9 | F | Cut on left leg | No tests | | | Stitches |
| 10 | G | Sore throat | Test 1 | + for bacteria A | Strep throat | Antibiotic |
| 11 | I | Shortness of breath | No tests | | Asthma | Inhaler |
| 12 | A | Sore, red, itchy eyes | Test 1 | + for bacteria C | Pink eye | Antibiotic eye drops |
| 13 | H | Sore toe | Test 1 | + for bacteria A | Blister from boots | Dressing |
| 14 | G | Sore throat | Test 1 | + for bacteria A | Strep throat | Antibiotic |
| 15 | E | Skin rash | Test 2 | + for Poison ivy | Poison ivy | Skin cream |
| 16 | G | Sore throat | Test 1 | + for bacteria A | Strep throat | Antibiotic |
| 17 | G | Sore throat | Test 1 | + for bacteria A | Strep throat | Antibiotic |
| 18 | B | Ankle pain | No tests | X ray | No break | Bandage |
| 19 | G | Sore throat | Test 1 | + for bacteria A | Strep throat | Antibiotic |
| 20 | D | Sore toe | Test 1 | - for all bacteria | Blister from boots | Dressing |
| 21 | C | Sore toe | Test 1 | + for bacteria A | Blister from boots | Dressing |

# Follow-up on Week 1 Infirmary Visits

## Summary of Patients' Responses to Treatments from Week 1:

- Six soldiers from barracks A with pink eye tested positive for infection by bacterial species C. They were treated with eye drops containing antibiotics. In all cases the infection has cleared up.
- Six soldiers from barracks G with sore throats tested positive for infection by bacterial species A. They were treated with antibiotics. Although two soldiers returned to the infirmary, all are responding to the antibiotics and the infections have largely disappeared.
- Four soldiers developed blisters from wearing new boots. Three of the four tested positive for infection by bacterial species A and the fourth soldier tested negative for species A, B, and C.
- Two soldiers from barracks E tested positive for exposure to poison ivy. They were treated with steroid cream and the skin rashes are disappearing.
- One soldier, who was short of breath, was diagnosed as having asthma and was prescribed an inhaler and her symptoms eased.
- One soldier received a cut on the left leg which was closed with stitches. He has no evidence of infection.
- One soldier twisted his ankle. X-rays were negative. The ankle was bandaged and the soldier has been assigned to light duty

## Return Visits to the Infirmary from Week 1 Soldier Visits

| Soldier | Barracks | What's wrong? | Test c |
|---|---|---|---|
| 2 | D | Lower leg is red and swollen, nausea | |
| 16 | G | Sore throat | |
| 19 | G | Sore throat | |

## New Visits to the Infirmary, Week 2

| Soldier | Barracks | What's wrong? | Test c |
|---|---|---|---|
| 1 | G | Sore throat | |
| 2 | A | Sore throat | |
| 3 | E | Cut on head | |
| 4 | G | Sore throat | |
| 5 | G | Sore throat | |
| 6 | B | Skin rash | |
| 7 | G | Sore throat | |
| 8 | D | Ankle pain | |
| 9 | A | Sore throat | |
| 10 | B | Sore toe | |
| 11 | F | Skin rash | |

## Necrotizing Fasciitis (Flesh-Eating Bacteria)

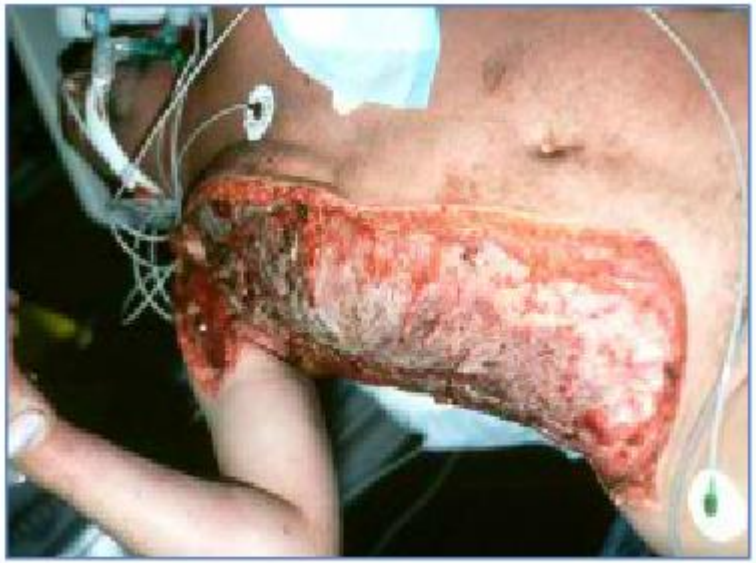
**What is it?**
Flesh-eating disease is a bacterial infection that destroys skin and fat tissue. The disease is very rare. The odds of getting it are about 1 in 100,000. However, it is very serious. About 2 out of 10 people who get this infection die from it.

**What causes it?**
The disease can be caused by different species of bacteria, including the one that causes strep throat. The bacteria enter the body through open wounds where they interact with the immune system to produce the disease. Flesh-eating disease is rare because the immune system of most people will stop the infection before it becomes serious.

**What are the symptoms?**
The skin reddens, becomes swollen, and is painful to the touch. Other symptoms include nausea, vomiting, and diarrhea. The symptoms start suddenly, may get better for a day or two, then quickly worsen. If not treated, the disease may result in organ failure and death.

**How is it treated?**
Patients with flesh-eating disease need immediate hospital care. Treatment involves antibiotics and surgery to remove diseased tissue and stop the spread of the disease.

**Early infection**



**Late infection**

# In the news

May 19, 2019

https://www.wrbl.com/news/local-news/fort-benning-basic-trainee-battles-life-threatening-flesh-eating-bacteria/1860009821

https://www.eurekalert.org/pub_releases/2019-02/hm-rft021419.php

# In the news

https://www.wral.com/flesh-eating-bacteria-nearly-killed-wake-forest-widow-robbed-during-husband-s-funeral/18273289/

PUBLIC RELEASE: 18-FEB-2019

## Researchers find trigger that turns strep infections into flesh-eating disease

*Discovery may also help scientists develop childbed fever vaccine*

HOUSTON METHODIST

## Flesh-eating bacteria nearly killed Wake Forest widow robbed during husband's funeral

March 20, 2019

# In the news

May 16, 2012

https://youtu.be/LZpUl346Nxo

# Revisiting the Objectives

**After completing this workshop, participants will have:**

- explored the use of inquiry-based science lessons for facilitating learning and stimulating student interest.
- examined the application of scientific concepts to a real-life scenario involving a rare disease.

# Q&A and Resources

- You can find this PPT, including links to the videos, on the Google Drive at https://tinyurl.com/HeidiCOABE2019
- More science resources also can be found on the Drive.
- I also included some quizzes I made for the *Rare Diseases & Scientific Inquiry* resource.
- Any questions?
- Feel free to reach out to me at the information on my card should you need anything.