

Key: Yellow highlight = required component

Ebola and cell signaling (←put your title here!)

Subject Area(s) (Select from [TE subject areas](#))

Associated Unit n/a

Associated Lesson n/a

Activity Title Ebola and cell signaling

Header

<p style="text-align: center;">Image 1 Image file: ____? ADA Description: ____? <i>(Write as if describing the image to a blind person; do not repeat any caption content.)</i> Source/Rights: Copyright © ____? Caption: ____?</p>
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Grade Level 12 (7-12)

Activity Dependency

Time Required 45 minutes

Group Size 15-20

Expendable Cost per Group US \$0.01 (pack of dollar store balloons)

Summary

This lesson looks at some misconceptions about cell signaling, including an interactive demonstration using inflated balloons as signals and the students as the cells, with their hands functioning as receptors. Misconceptions are corrected with the help of the balloon demonstration and a short video animation showing the role of cell signaling in the body's stress response. The importance of cell signaling is highlighted by looking at the recent scientific breakthrough in understanding of how the Ebola virus disrupts the cell signaling process of the body's immune response. Some context and background information is provided to supplement students' present understanding about the Ebola virus and the current outbreak. The students also engage in a class discussion about the medical ethics of using experimental treatments on large populations of humans.

Engineering Connection

Understanding of cell signaling mechanisms are critical in the development of new technologies for disease prevention and control. This is particularly important in determining how the Ebola virus blocks the cellular immune response and for creating an effective vaccine.

Engineering Category = 1

Choose the category that best describes this activity's amount/depth of engineering content:

1. Relating science and/or math concept(s) to engineering
2. Engineering analysis or partial design
3. Engineering design process

Keywords

Educational Standards (List 2-4)

Source, year, standard number(s)/letter(s), grade band and text (its unique ID# is optional)

[State STEM Standard](#) (required)

- Subchapter C. High School (9-12)
 - Biology (9-11)
 - Science concepts. The student knows that biological systems work to achieve and maintain balance. The student is expected to: (9-11)

Current Standard:

- investigate and analyze how organisms, populations, and communities respond to external factors; (9-11)

- Subchapter C. High School (9-12)
 - Biology (9-11)
 - Science concepts. The student knows that biological systems work to achieve and maintain balance. The student is expected to: (9-11)

Current Standard:

- summarize the role of microorganisms in both maintaining and disrupting the health of both organisms and ecosystems; and (9-11)

- Science concepts. The student knows that cells are the basic structures of all living things with specialized parts that perform specific functions and that viruses are different from cells. The student is expected to: (9-11) _

Current Standard:

- compare the structures of viruses to cells, describe viral reproduction, and describe the role of viruses in causing diseases such as human immunodeficiency virus (HIV) and influenza.

- Scientific processes. The student uses critical thinking, scientific reasoning, and problem solving to make informed decisions within and outside the classroom. The student is expected to: (9-11)

Current Standard:

- communicate and apply scientific information extracted from various sources such as current events, news reports, published journal articles, and marketing materials;

Current Standard:

- evaluate the impact of scientific research on society and the environment; (9-11)
(no curriculum aligned)

[ITEEA Standard](#) (required)

The Nature of Technology (K-12) [...show](#)
(546 lessons/activities/units aligned)

- Standard 1. Students will develop an understanding of the characteristics and scope of technology. (K-12) [...show](#)
(175 lessons/activities/units aligned)

- In order to comprehend the scope of technology, students should learn that: (K-12) [...show](#)
(163 lessons/activities/units aligned)

Current Standard:

- J. The nature and development of technological knowledge and processes are functions of the setting. (9-12)

The Nature of Technology (K-12) [...show](#)
(546 lessons/activities/units aligned)

- Standard 2. Students will develop an understanding of the core concepts of technology. (K-12) [...show](#)
(140 lessons/activities/units aligned)

- In order to comprehend the core concepts of technology, students should learn that: (K-12) [...show](#)
(139 lessons/activities/units aligned)

Current Standard:

- DD Quality control is a planned process to ensure that a product, service, or system meets established criteria. (9-12)
- W. Systems thinking applies logic and creativity with appropriate compromises in complex real-life problems. (9-12)
- X. Systems, which are the building blocks of technology, are embedded within larger technological, social, and environmental systems. (9-12)

[NGSS Standard](#) (strongly recommended)

[CCSS Standard](#) (strongly recommended)

Pre-Requisite Knowledge

Learning Objectives

After this activity, students should be able to:

- **Understand the importance of cell signaling in disease treatment and vaccine development**

Materials List

Each group needs:

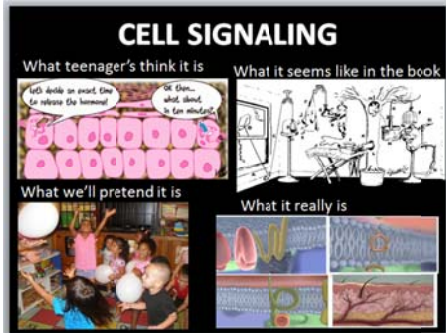
- n/a

To share with the entire class:

- 4 balloons

Introduction / Motivation

Show students a “meme” of cell signaling and have a discussion of their present understanding of cell signaling and why it’s important for organism functioning:



Show the students an example video or a Rube Goldberg machine to communicate the concept of a signal cascade.

Vocabulary / Definitions

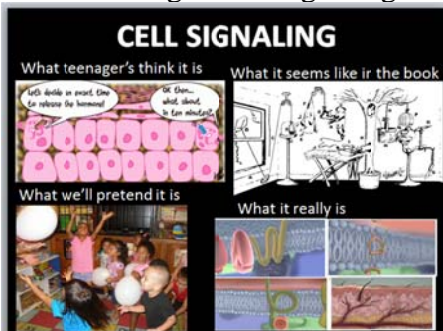
Word	Definition
Cell signaling	part of a complex system of communication that governs basic cellular activities and coordinates cell actions. The ability of cells to perceive and correctly respond to their microenvironment is the basis of development, tissue repair, and immunity as well as normal tissue homeostasis.
Cell surface Receptor	specialized integral membrane proteins that take part in communication between the cell and the outside world
Channel protein	allows the transport of specific substances across a cell membrane.
Signal cascade	occurs when an extracellular signaling molecule activates a specific receptor located on the cell surface or inside the cell. In turn, this receptor triggers a biochemical chain of events inside the cell, creating a response
Ebola virus	one of five known viruses within the genus <i>Ebolavirus</i> . Four of the five known ebolaviruses, including EBOV, cause a severe and often fatal hemorrhagic fever in humans and other mammals, Its genome is a single-stranded RNA approximately 19,000 nucleotides long. It encodes seven structural proteins: nucleoprotein (NP), polymerase cofactor (VP35), (VP40), GP, transcription activator (VP30), VP24, and RNA-dependent RNA polymerase(L).

Procedure

Background

Before the Activity

- Show students a “meme” of cell signaling and have a discussion of their present understanding of cell signaling and why it’s important for organism functioning:



With the Students

1. Show the students a short video clip of a Rube Goldberg machine to demonstrate the concept of a signal cascade.
2. Complete the “receptor vs. response” activity to help students understand how cell signaling works.
 - a. Start with some balloons in the front of the class.
 - b. Share the game rules:
 - c. Rule 1: if you make contact with the balloon and skipped breakfast → stand up
 - d. Rule 2: if you make contact with the balloon and got less than 8 hours of sleep → turn to face the back of the room
 - e. Rule 3: if you make contact with the balloon and haven’t finished your homework → raise your hand
 - f. Do all that apply and if you make contact again return to your original position, repeat the above rules after the 3rd contact
3. After the activity, discuss with the students what part of the activity represented the signal (the balloon), the receptor (students hand), and the response (standing, turning or hand raising).
4. Discuss how the activity has some similarities and differences with real cell signaling; examples:
 - a. Similarity: some signals may cause different responses in different cells (i.e. some student may raise their hands AND stand up while others will have a different combination of responses)
 - b. Similarity: cell signals may function to turn a response “on” or “off” (students alternate between response and returning to their original positions)
 - c. Difference: signals often attach themselves or even enter a cell
5. Show students a short video clip of the cell signal and cascading response that produces a “stress” response or sweating and raised body hair (<http://learn.genetics.utah.edu/content/cells/cellcom/>).
6. Discuss the recent Ebola virus outbreak and determine students present understanding of the disease’s mechanism.
7. Provide an explanation of the history and functioning of the virus (http://www.washingtonpost.com/posttv/world/how-the-ebola-virus-works/2014/08/01/257d57d4-19c3-11e4-88f7-96ed767bb747_video.html).
8. Have students read about the recent development in understanding of Ebola structure and function (<http://www.sciencedaily.com/releases/2014/08/140813130044.htm>).
9. Finally foster a class discussion of the medical ethics of using new, but relatively untested vaccines on patients infected in the current outbreak.

Image Insert Image # or Figure # here (use Figure # if referenced in text)

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Attachments

<http://learn.genetics.utah.edu/content/cells/cellcom/>

http://www.washingtonpost.com/posttv/world/how-the-ebola-virus-works/2014/08/01/257d57d4-19c3-11e4-88f7-96ed767bb747_video.html

<http://www.sciencedaily.com/releases/2014/08/140813130044.htm>

Safety Issues

- n/a

Troubleshooting Tips

Investigating Questions

Assessment

Pre-Activity Assessment

Descriptive Title: Why is cell signaling important?

Activity Embedded Assessment

Descriptive Title: How is the balloon activity similar and different from real cell signals?___?

Post-Activity Assessment

Descriptive Title: Should Ebola patients be given experimental drugs and vaccines even if they haven't been approved by the FDA?

Activity Extensions

Activity Scaling

- For lower grades, ___?
- For higher grades, ___?

Additional Multimedia Support

References

Other

Redirect URL

Contributors

Rose Sobel

Supporting Program

GK-12 program, College of Engineering, University of Houston

Acknowledgements

Classroom Testing Information