Light at Work

Research how light becomes a medical measurement

PHY.4.12 "Enrichment: Research uses of the electromagnetic spectrum or photoelectric effect."

NAME _____ DATE _____

1 READ AND MARK

Read it twice

YOUR JOB Underline a claim about how the device uses light, circle a claim about how light becomes an electrical signal, and number two claims from different sources that you could combine to explain how the device works.

What Can a Finger Clip Measure?

1. At a crowded clinic, a nurse clips a pulse oximeter onto a patient's finger. Its screen estimates the percentage of hemoglobin carrying oxygen, called oxygen saturation. To investigate how this tool works, start with a research question: How can light passing through a finger reveal information about blood? A page about pulse oximeters from the U.S. Food and Drug Administration (FDA) says the device sends red and infrared light through the finger and measures the light reaching a detector. Both kinds of light belong to the electromagnetic spectrum. The detector does not count oxygen molecules; it measures transmitted light.

2. For a second source, the U.S. Department of Energy's *Solar Photovoltaic Technology Basics* explains how incoming light transfers energy to electrons in a semiconductor. A photodiode in the finger clip uses a related process: absorbed photons create mobile electric charges, producing a signal. This is an internal photoelectric effect. Oxygen-rich and oxygen-poor hemoglobin absorb red and infrared light differently. As blood pulses through the finger, the device compares changes in the two light signals and uses calibration to estimate oxygen saturation. The two sources connect a use of the electromagnetic spectrum with the physics of turning light into an electrical measurement.

3. Research also means checking what a claim leaves out. The FDA warns that pulse oximeter readings can be less accurate under some conditions, including poor circulation, movement, nail polish, and differences in skin pigmentation. A reading is an estimate, not a guarantee that a patient has enough oxygen. For a report on this technology, record the title and publisher of each source and separate what each source supports. A health agency can explain the device's use and limitations; a physics source can help explain how light produces an electrical signal. Compare sources before making a claim about reliability.

2 ANSWER WITH EVIDENCE

Use the passage

1. What does the FDA source tell you about how the device uses the electromagnetic spectrum? Name the light it uses and what the detector measures.

2. How does the Department of Energy source help explain the photodiode, even though that source discusses solar cells?

3. Use information from both sources to answer the passage's research question: How can light passing through a finger reveal information about blood?

4. A report claims, 'A pulse oximeter reading is always accurate.' How would you revise this claim using the FDA information in the passage?

3 YOUR TURN

Your own words

Using a library book, textbook, or reliable websites, research a use of the electromagnetic spectrum or photoelectric effect other than pulse oximetry. In 70 to 100 words, name two sources from different publishers, report a finding from each, explain how the physics enables the use, and identify one limitation or safety concern supported by a source.

Light at Work

PART 1 · READ AND MARK

Underline a claim about how the device uses light, circle a claim about how light becomes an electrical signal, and number two claims from different sources that you could combine to explain how the device works. Accept any marking that follows this job and points at the right text.

PART 2 · ANSWERS

#	QUESTION	ANSWER
1	What does the FDA source tell you about how the device uses the electromagnetic spectrum? Name the light it uses and what the detector measures.	**It sends red and infrared light through a finger. The detector measures the light that reaches it.**
2	How does the Department of Energy source help explain the photodiode, even though that source discusses solar cells?	**It explains that light transfers energy to electrons in a semiconductor. A photodiode uses a related process in which absorbed photons create mobile charges and an electrical signal.**
3	Use information from both sources to answer the passage's research question: How can light passing through a finger reveal information about blood?	**Red and infrared light pass through the finger, and a photodiode turns the light reaching it into electrical signals. Because hemoglobin absorbs the two kinds of light differently, the device can compare the signals to estimate oxygen saturation.**
4	A report claims, 'A pulse oximeter reading is always accurate.' How would you revise this claim using the FDA information in the passage?	**A pulse oximeter reading is an estimate. It can be less accurate with poor circulation, movement, nail polish, or differences in skin pigmentation.**

PART 3 · YOUR TURN (SAMPLE ANSWER)

Solar panels use an internal photoelectric effect to produce electricity. In *Solar Photovoltaic Technology Basics*, the U.S. Department of Energy explains that sunlight gives energy to electrons in semiconductor cells, allowing electrical current to flow. NASA Science's *The Electromagnetic Spectrum* explains that visible light is one part of the electromagnetic spectrum. Together, these sources show how incoming electromagnetic radiation can drive electrical current in a solar cell. A limitation follows from the energy source described by the Department of Energy: a panel cannot generate solar electricity when sunlight is absent.

For Part 3, accept any accurate use other than pulse oximetry if the response names two sources from different publishers, reports a finding from each, connects the physics to the use, and supports its limitation or safety concern. A stated limitation may be a sound inference from a source's explanation.