Honeycutt Science ™

Review of State Standards

Activity 30

Physical Science

Matter and Its Interactions

Structure and Properties of Matter:

- Each atom has a charged substructure consisting of a nucleus, which is made of protons and neutrons, surrounded by electrons.
- The periodic table orders elements horizontally by the number of protons in the atom's nucleus and places those with similar chemical properties in columns. The repeating patterns of this table reflect patterns of outer electron states.

Matter and Its Interactions

HS-PS1-1 Structure and Properties of Matter

Oklahoma says :

Each atom has a charged substructure consisting of a nucleus, which is made of protons and neutrons, surrounded by electrons.

Honeycutt says:

Atoms have protons, neutrons and electrons.

The nucleus of an atom has protons and neutrons.

The electrons rotate around the nucleus.

The electrons move around in the "electron cloud."

Important words: Atom - Nucleus – Proton - Neutron - Electron - Electron Cloud

Matter and Its Interactions

HS-PS1-1 Structure and Properties of Matter

Oklahoma says:

The periodic table orders elements horizontally by the number of protons in the atom's nucleus and places elements with similar chemical properties in columns.

Honeycutt says:

The periodic table organizes all of the known elements.

The period table uses numbers 1 through 118 for the elements.

Each element has its own number. It is called the atomic number.

The atomic number is the number of an atom's protons.

Important words: Periodic table - element - 118 - atomic number - number of protons

Matter and Its Interactions

HS-PS1-1 Structure and Properties of Matter

Oklahoma says:

The periodic table orders elements horizontally by the number of protons in the atom's nucleus and **places elements with similar chemical properties in columns.**

Honeycutt says:

The periodic table has columns.

Columns are the elements (*in boxes*) stacked on top of each other.

Elements in the same column have similar chemical properties.

For example, Na and K are in the same column. They are similar.

Important words: Periodic table - element – atomic number – number of protons

Matter and Its Interactions

HS-PS1-1 Structure and Properties of Matter

Oklahoma says:

The repeating patterns of this table reflect patterns of outer electron states.

Honeycutt says:

Each element is in a box. The boxes are in rows and columns.

Elements in a column react similarly in a chemical change.

Elements in the same row have the same number of shells.

All electrons together in an atom are called the electron cloud.

Important words: Rows – columns – react similarly – chemical change – shell – cloud

Matter and Its Interactions

HS-PS1-2 Chemical Reactions

Chemical Reactions:

- The fact that atoms are conserved, together with knowledge of the chemical properties of the elements involved, can be used to describe and predict chemical reactions.

Chemistry

Matter and Its Interactions

HS-PS1-2 Chemical Reactions

Oklahoma says:

The fact that atoms are conserved, together with knowledge of the chemical properties of the elements involved, can be used to describe and predict chemical reactions.

Honeycutt says:

Chemistry is sometimes sort-of like math.

Chemistry has equations. Chemical equations need to be balanced.

Balanced sort-of means equal. (#atoms stays the same…conserved)

Students learn to predict reactions and balance chemistry equations.

Important words: Equations – balanced – equal – conserved – reaction

Matter and Its Interactions

HS-PS1-5 Chemical Reactions

Chemical Reactions:

- Chemical processes, their rates, and whether or not energy is stored or released can be understood in terms of the collisions of molecules and the rearrangements of atoms into new molecules, with consequent changes in the sum of all bond energies in the set of molecules that are matched by changes in kinetic energy.

Chemistry

Matter and Its Interactions

HS-PS1-5 Chemical Reactions

Oklahoma says:

Chemical processes, their rates, and whether or not energy is stored or released can be understood in terms of the collisions of molecules and the rearrangements of atoms into new molecules, with consequent changes in the sum of all bond energies in the set of molecules that are matched by changes in kinetic energy.

Honeycutt says:

The rate (or, speed) of a chemical process varies on several factors.

For example, heat can influence some chemical processes.

Heat is a form of kinetic energy. Heat is often produced or absorbed.

Some processes produce heat, other processes can absorb heat.

Important words: Rate – heat – kinetic energy – produced – absorbed

Matter and Its Interactions

HS-PS1-5 Chemical Reactions

Oklahoma says:

Chemical processes, their rates, and whether or not energy is stored or released **can be understood in terms of the collisions of molecules and the rearrangements of atoms into new molecules,** with consequent changes in the sum of all bond energies in the set of molecules that are matched by changes in kinetic energy.

Honeycutt says:

Chemical processes are when atoms combine or separate.

Atoms make up molecules. Atoms can have a (+) or (-) charge.

When atoms have a charge they are called an ion.

Atoms, molecules, and ions are rearranged in a chemical change.

Important words: Chemical process – atoms – molecules – ion – chemical change.

Matter and Its Interactions

HS-PS1-5 Chemical Reactions

Oklahoma says:

Chemical processes, their rates, and whether or not energy is stored or released can be understood in terms of the collisions of molecules and the **rearrange**ments of **atoms into new molecules, with consequent changes in the sum of all bond energies in the set of molecules that are matched by changes in kinetic energy.**

Honeycutt says:

Energy is required to bond atoms together – or to separate them.

The total amount of energy in & due to a reaction does not change …

But, energy might be absorbed or given off based on the reaction.

Energy absorbed *or* produced include light, heat, motion, and sound.

Important words: Bond – absorb – produce – light – heat – motion – sound

Motion and Stability: Forces and Interactions

HS-PS2-1 Forces and Motion

Forces and Motion:

- Newton's second law accurately predicts changes in the motion of macroscopic objects.

Physics

Motion and Stability: Forces and Interactions

HS-PS2-1 Forces and Motion

<u>Oklahoma says:</u>

Newton's second law accurately predicts changes in the motion of macroscopic objects.

Honeycutt says:

Sir Isaac Newton was an Englishman who lived from 1642 –1726.

He liked math & science. He watched objects move and stay still.

From those observations he came up with three laws of motion.

The 2nd law helps predict changes of things in motion and at rest.

Important words: Newton – observation - laws of motion – 2nd law – motion – rest

Motion and Stability: Forces and Interactions

HS-PS2-2 Forces and Motion

Forces and Motion:

- Momentum is defined for a particular frame of reference; it is the mass times the velocity of the object.
- If a system interacts with objects outside itself, the total momentum of the system can change; however, any such change is balanced by changes in the momentum of objects outside the system.

Physics

Motion and Stability: Forces and Interactions

HS-PS2-2 Forces and Motion

Oklahoma says:

Momentum is defined for a particular frame of reference; it is the mass times the velocity of the object.

If a system interacts with objects outside itself, the total momentum of the system can change; however, any such change is balanced by changes in the momentum of objects outside the system

Honeycutt says:

Calculate momentum by multiplying an object's (mass * velocity).

Mass is a measure of the amount of matter something has.

Velocity is time taken to move an object *divided by* displacement.

Displacement is the distance between to specific points.

Important words: Momentum – mass – velocity – time – displacement

Motion and Stability: Energy

HS-PS2-2 Forces and Motion

Oklahoma says:

Momentum is defined for **a particular frame of reference**; it is the mass times the velocity of the object.

If a system interacts with objects outside itself, the total momentum of the system can change; however, any such change is balanced by changes in the momentum of objects outside the system

Honeycutt says:

In college, Einstein's relativity concepts help clarify Newton's laws.

Newton' Laws apply only to ordinary matter (things with mass).

Light is kinetic energy but has no mass – relativity helps explain this.

Einstein explained that light behaves as both a particle and a wave.

Important words: Ordinary matter – mass – kinetic – relativity - particle – wave

Motion and Stability: Forces and Interactions

HS-PS2-2 Forces and Motion

Oklahoma says:

Momentum is defined for a particular frame of reference; it is the mass times the velocity of the object.

If a system interacts with objects outside itself, the total momentum of the system can change; however, any such change is balanced by changes in the momentum of objects outside the system

Honeycutt says:

A system is a portion of the universe chosen for studying.

You can think of things as being "inside" or "outside" of a system.

A planet can be a system. The liquid in a glass can be a system.

A system's momentum is constant - *unless messed with from outside*.

Important words: System – momentum – constant

Motion and Stability: Forces and Interactions

HS-PS2-3 Defining and Delimiting Engineering Problems:

Defining and Delimiting Engineering Problems:

Criteria and constraints also include satisfying any requirements set by society, such as taking issues of risk mitigation into account, and they should be quantified to the extent possible and stated in such a way that one can tell if a given design meets them.

Physics

Motion and Stability: Forces and Interactions

HS-PS2-3 Defining and Delimiting Engineering Problems:

Oklahoma says:

Criteria and constraints also include satisfying any requirements set by society, such as taking issues of risk mitigation into account, and they should be quantified to the extent possible and stated in such a way that one can tell if a given design meets them.

Honeycutt says:

Many adults use physics to do their work – especially engineers.

Designing and making things can be done in many different ways.

Engineers quantify pros *(benefits)* & cons (*risk*) in their decisions.

Thinking through needs, benefits, and risk improves decisions.

Important words: Designing – quantify – needs – benefits – risk

Motion and Stability: Forces and Interactions

HS-PS2-5 Types of Interactions

Types of Interactions:

- Forces at a distance are explained by fields (gravitational, electric, and magnetic) permeating space that can transfer energy through space.
- Magnets or electric currents cause magnetic fields; electric charges or changing magnetic fields cause electric fields.

Motion and Stability: Forces and Interactions

HS-PS2-5 Types of Interactions

Oklahoma says:

Forces at a distance are explained by fields (gravitational, electric, and magnetic) permeating space that can transfer energy through space.

Honeycutt says:

Some forces can act on objects from a distance.

A force is a push or a pull which is easily demonstrated and felt.

Three of these forces are gravity, electric fields, and magnetic.

Each of these forces can travel through space and transfer energy.

Important words: Force – gravity – electric fields – magnetic – transfer energy.

Motion and Stability: Forces and Interactions

HS-PS2-5 Types of Interactions

Oklahoma says:

Magnets or electric currents cause magnetic fields; electric charges or changing magnetic fields cause electric fields.

Honeycutt says:

Magnets and electric currents are very much related to each other.

Magnetic fields and electric fields are caused by similar things.

Magnets or electric currents cause magnetic fields.

Electric charges or changing magnetic fields cause electric fields.

Important words: Magnet, magnetic field – electric current, charge, field

Motion and Stability: Energy

HS-PS3-1 Definitions of Energy

Definitions of Energy

- Energy is a quantitative property of a system that depends on the motion and interactions of matter and radiation within that system. That there is a single quantity called energy is due to the fact that a system's total energy is conserved, even as, within the system, energy is continually transferred from one object to another and between its various possible forms.

Physics

Motion and Stability: Energy

HS-PS3-1 Definitions of Energy

Oklahoma says:

Energy is a quantitative property of a system that depends on the motion and interactions of matter and radiation within that system. That there is a single quantity called energy is due to the fact that a system's total energy is conserved, even as, within the system, energy is continually transferred from one object to another and between its various possible forms

Honeycutt says:

Energy is a number that can be expressed in joules.

The number of joules of a particular system depends to two things.

Motion and interaction of matter contribute to the total energy.

Radiation within the system contributes to the total energy.

Important words: joules – motion – interaction – total energy – radiation

Motion and Stability: Energy

HS-PS3-1 Definitions of Energy

Oklahoma says:

Energy is a quantitative property of a system that depends on the motion and interactions of matter and radiation within that system. **That there is a single quantity called energy is due to the fact that a system's total energy is conserved, even as, within the system, energy is continually transferred from one object to another and between its various possible forms**

Honeycutt says:

There a lot of different categories and forms of energy.

But, each different types can be transformed into the other types.

When added all together within a system, the total does not change.

This math concept is part of the "conservation of energy."

Important words: Transformed – conservation of energy

Motion and Stability: Energy

HS-PS3-1 Conservation of Energy and Energy Transfer

Conservation of Energy and Energy Transfer:

- Conservation of energy means that the total change of energy in any system is always equal to the total energy transferred into or out of the system.
- Energy cannot be created or destroyed, but it can be transported from one place to another and transferred between systems.
- Mathematical expressions, which quantify how the stored energy in a system depends on its configuration (e.g. relative positions of charged particles, compression of a spring) and how kinetic energy depends on mass and speed, allow the concept of conservation of energy to be used to predict and describe system behavior.
- The availability of energy limits what can occur in any system.

Motion and Stability: Energy

HS-PS3-1 Conservation of Energy and Energy Transfer

Oklahoma says:

Conservation of energy means that the total change of energy in any system is always equal to the total energy transferred into or out of the system.

Honeycutt says:

There are many different types of energy. *Even so …*

All energy is either kinetic (moving) or potential energy (stored).

While energy can transform, it cannot be destroyed or created.

Examples are radiant, chemical, nuclear, elastic & gravitational.

Important words: Laws of conservation – transform – not destroyed/created

Motion and Stability: Energy

HS-PS3-1 Conservation of Energy and Energy Transfer

Oklahoma says:

Conservation of energy means that the total change of energy in any system is always equal to the total energy transferred into or out of the system.

Honeycutt says:

Physics has several “laws of conservation.”

Theses laws are for isolated systems *(not messed with from outside)*.

If energy comes into or out of a system, that system is not isolated.

Energy change in a system equals energy coming in or going out.

Important words: Laws of conservation – isolated systems – energy change

Motion and Stability: Energy

HS-PS3-1 Conservation of Energy and Energy Transfer

Oklahoma says:

Energy cannot be created or destroyed, but it can be transported from one place to another and transferred between systems.

Honeycutt says:

Energy can’t be created. Energy can’t be destroyed.

Energy can be transported from one place to another.

Energy can be transferred between systems.

Energy can be converted from one type into a different type.

Important words: Energy – systems – transported – transferred – converted

Motion and Stability: Energy

HS-PS3-1 Conservation of Energy and Energy Transfer

Oklahoma says:

Mathematical expressions, which quantify how the stored energy in a system depends on its configuration (e.g. relative positions of charged particles, compression of a spring) and how kinetic energy depends on mass and speed, **allow the concept of conservation of energy to be used to predict and describe system behavior.**

Honeycutt says:

Math is important in physics.

Math helps scientists predict and calculate changes in a system.

Conservation of energy is an important concept in physics.

Math formulas are useful for these predictions and descriptions.

Important words: Conservation – math formulas – predications – descriptions

Motion and Stability: Energy

HS-PS3-1 Conservation of Energy and Energy Transfer

Oklahoma says:

Mathematical expressions, which **quantify** how the **stored energy in a system** depends on its configuration (e.g. relative positions of charged particles, compression of a spring) and how kinetic energy depends on mass and speed, allow the concept of conservation of energy to be used to predict and describe system behavior.

Honeycutt says:

An example of a mathematical expression is $W = F*d*(\cos(\theta))$

Some math expressions in physics are simple, others are not.

Energy is quantified by expressing it as a number of joules.

A joule is $\frac{1kg * m^2}{s^2}$. Stored energy is measured in joules.

Important words: Energy – quantified – stored energy – joules

Motion and Stability: Energy

HS-PS3-1 Conservation of Energy and Energy Transfer

Oklahoma says:

Mathematical expressions, which **quantify** how the **stored energy in a system** depends on its configuration (e.g. relative positions of charged particles, compression of a spring) and how kinetic energy depends on mass and speed, allow the concept of conservation of energy to be used to predict and describe system behavior.

Honeycutt says:

Students should always keep the unit of measure with a number.

The joule is a unit of measure. It is the main measure unit for energy.

In every-day life, we encounter other units of measure for energy.

For example: calories, kWh, & BTU can be converted to joules.

Important words: Unit of measure – calories – kWh – BTU - joule

Motion and Stability: Energy

HS-PS3-1 Conservation of Energy and Energy Transfer

Oklahoma says:

Mathematical expressions, which quantify how the **stored energy in a system depends on its configuration (e.g. relative positions of charged particles, compression of a spring)** and how **kinetic energy depends on mass and speed,** allow the concept of conservation of energy to be used to predict and describe system behavior.

Honeycutt says:

Stored energy in a system depends on its configuration.

An example of configuration is the compression of a spring.

Kinetic energy depends on mass and speed.

Math can help quantify stored energy.

Important words: Stored energy – compression – mass – speed.

Motion and Stability: Energy

HS-PS3-1 Conservation of Energy and Energy Transfer

Oklahoma says:

The availability of energy limits what can occur in any system.

Honeycutt says:

A "system" in science often refers to a closed system.

Energy can be added-to or removed from a system from outside it.

Any system being evaluated has a specific "amount" of energy.

That amount of energy puts a limit on what can take place there.

Important words: System – energy – limit

Energy

HS-PS3-2 Definitions of Energy

Definitions of Energy:

- At the macroscopic scale, energy manifests itself in multiple ways, such as in motion, sound, light, and thermal energy.
- These relationships are better understood at the microscopic scale, at which all of the different manifestations of energy can be modeled as a combination of energy associated with the motion of particles and energy associated with the configuration (relative position of the particles). In some cases the relative position energy can be thought of as stored in fields (which mediate interactions between particles). This last concept includes radiation, a phenomenon in which energy stored in fields moves across space.

Energy

HS-PS3-2 Definitions of Energy

Oklahoma says:

At the macroscopic scale, energy manifests itself in multiple ways, such as in motion, sound, light, and thermal energy.

Honeycutt says:

"Macroscopic" sometimes means being *visible to the naked eye*.

"Manifests" means *shows up or can be observed as*.

Energy can be observed – sometimes without using equipment.

Energy can be observed as motion, sound, light and thermal energy.

Important words: Macroscopic – motion – sound – light – thermal energy

Energy

HS-PS3-2 Definitions of Energy

Oklahoma says:

These relationships are better understood at the microscopic scale, at which all of the different manifestations of energy can be modeled as a combination of energy associated with the motion of particles and energy associated with the configuration (relative position of the particles).

Honeycutt says:

Models can represent an idea, object, process, or a system.

Energy is often observed macro scale but modeled at the *micro scale*.

Models at the microscopic scale are useful when explaining energy.

Energy is often better understood with the use of models.

Important words: Models – macro scale – micro scale.

Energy

HS-PS3-2 Definitions of Energy

Oklahoma says:

These relationships are better understood at the microscopic scale, at which all of the different manifestations of energy **can be modeled as a combination of energy associated with the motion of particles and energy associated with the configuration (relative position of the particles).**

Honeycutt says:

Relationships of energy in a system can be modeled.

Such models can illustrate energy due to *particles in motion*.

They can also illustrate energy from a *configuration of particles*.

Such models show relationships of these various types of energy.

Important words: Relationships – particles in motion – configuration of particles

Energy

HS-PS3-2 Definitions of Energy

Oklahoma says:

In some cases the relative position energy can be thought of as stored in fields (which mediate interactions between particles). This last concept includes radiation, a phenomenon in which energy stored in fields moves across space.

Honeycutt says:

Understanding the electromagnetic spectrum helps describe energy.

Sometimes *"EM"* is used to abbreviate "*electromagnetic spectrum*."

EM is all wavelengths & frequencies of electromagnetic radiation.

The wavelengths go from extremely short to extremely long.

Important words: Electromagnetic spectrum – wavelengths – frequencies

https://www.iaea.org/Publications/Factsheets/English/radlife

Energy

HS-PS3-2 Definitions of Energy

Oklahoma says:

In some cases the relative position energy can be thought of as stored in fields (which mediate interactions between particles). This last concept includes radiation, a phenomenon in which energy stored in fields moves across space.

Honeycutt says:

“Radiation" is a broad term including light and radio waves.

A lot of radioactive material is naturally occurring.

Radiation from outer space is called cosmic radiation or cosmic rays.

Other radiation is “man-made” … like in nuclear power plants.

Important words: Radiation – light – radio waves – naturally occurring – man-made

Energy

HS-PS3-2 Definitions of Energy

Oklahoma says:

In some cases the relative position energy can be thought of as stored in fields (which mediate interactions between particles). This last concept includes radiation, a phenomenon in which energy stored in fields moves across space.

Honeycutt says:

Radiation includes ionizing & non-ionizing types.

In everyday language “radiation” usually refers to ionizing types.

The electromagnetic spectrum’s high frequency portion is ionizing

X-rays are an example of high frequency, ionizing radiation.

Important words: ionizing – non-ionizing – high frequency – X-rays

Energy

HS-PS3-2 Definitions of Energy

Oklahoma says:

In some cases the relative position energy can be thought of as stored in fields (which mediate interactions between particles). This last concept includes radiation, a phenomenon in which energy stored in fields moves across space.

Honeycutt says:

High frequency, ionizing radiation includes: *alpha*, *beta*, *gamma*.

Alpha (α) radiation is from atoms like uranium breaking down.

Beta (β) radiation comes from the decay of an atom’s nucleus. *(C^{14})*

Gamma (γ) radiation is high-frequency electromagnetic radiation.

Important words: alpha – beta – gamma – electromagnetic radiation

Energy

HS-PS3-2 Definitions of Energy

Oklahoma says:

In some cases the relative position energy can be thought of as stored in fields (which mediate interactions between particles). This last concept includes radiation, a phenomenon in which energy stored in fields moves across space.

Honeycutt says:

The electromagnetic spectrum’s low frequencies are non-ionizing.

Thermal radiation (heat) is an example of non-ionizing radiation.

Thermal energy is random movement of atoms/molecules in matter.

Thermal energy “makes” thermal radiation (like from campfires).

Important words: non-ionizing – thermal radiation – heat

Energy

HS-PS3-3 Energy

Interdependence of Science, Engineering, and Technology:

Modern civilization depends on major technological systems. Engineers continuously modify these technological systems by applying scientific knowledge and engineering design practices to increase benefits while decreasing costs and risks.

Physics

Energy

HS-PS3-3 Energy

Oklahoma says:

Modern civilization depends on major technological systems. Engineers continuously modify these technological systems by applying scientific knowledge and engineering design practices to increase benefits while decreasing costs and risks.

Honeycutt says:

There is a long list of technology innovations over modern history …

e.g., printing press, the combustion engine, & semi-conductors.

Engineers and others invent and improve these with their knowledge.

In doing so, they think also think about decreasing risks and cost.

Important words: innovations – knowledge – benefits – risk – cost

Energy

HS-PS3-4 Energy

Conservation of Energy and Energy Transfer:

Uncontrolled systems always evolve toward more stable states—that is, toward more uniform energy distribution (e.g., water flows downhill, objects hotter than their surrounding environment cool down).

Energy

HS-PS3-4 Energy

<u>Oklahoma says:</u>

Uncontrolled systems always evolve toward more stable states—that is, toward more uniform energy distribution (e.g., water flows downhill, objects hotter than their surrounding environment cool down).

Honeycutt says:

College physics classes will introduce a new word … "entropy."

The 2nd law of thermodynamics says entropy increases over time.

Entropy measures randomness & randomness increases over time.

Example: hot soup's heat spreads out into the air over time.

Important words: Entropy – thermodynamics – randomness

Wave Properties:

The wavelength and frequency of a wave are related to one another by the speed of travel of the wave, which depends on the type of wave and the medium through which it is passing.

Waves

HS-PS4-1 Waves and Their Applications in Technologies for Information Transfer

Oklahoma says:

The wavelength and frequency of a wave are related to one another by the speed of travel of the wave, which depends on the type of wave and the medium through which it is passing.

Honeycutt says:

Types of waves are electro-magnetic and physical:

- *e.g.*, Radio, microwave, light, ultraviolet, x-ray, gamma, & nuclear.
- *e.g.*, Longitude, transverse & surface – these go through a medium

All have length, frequency, and speed (*dependent on the medium*).

Important words: Length – frequency – speed – medium

Waves

Wave Properties:

Information can be digitized (e.g., a picture stored as the values of an array of pixels); in this form, it can be stored reliably in computer memory and sent over long distances as a series of wave pulses.

Waves

HS-PS4-2 Waves and Their Applications in Technologies for Information Transfer

Oklahoma says:

Information can be digitized (e.g., a picture stored as the values of an array of pixels); in this form, it can be stored reliably in computer memory and sent over long distances as a series of wave pulses.

Honeycutt says:

Natural waves are analog – continuous with smooth fluctuations.

Computers and a lot of technology uses digital information instead.

Analog waves can be digitized – then converted back, if needed.

This techniques especially helps when using computer technology.

Important words: Fluctuations – digital – digitized – converted – computer

Electromagnetic Radiation:

When light or longer wavelength electromagnetic radiation is absorbed in matter, it is generally converted into thermal energy (heat).

Shorter wavelength electromagnetic radiation (ultraviolet, X-ray s, gamma rays) can ionize atoms and cause damage to living cells.

Photoelectric materials emit electrons when they absorb light of a high- enough frequency.

Waves

HS-PS4-4 Waves and Their Applications in Technologies for Information Transfer

Oklahoma says:

When light or longer wavelength electromagnetic radiation is absorbed in matter, it is generally converted into thermal energy (heat).

Honeycutt says:

Matter can absorb visible light, infrared waves, & radio waves.

When long electromagnetic waves are absorbed they convert to heat.

Example: a black shirt absorbs visible light – turning light into heat.

Example: heat from a stove or charcoal is invisible infrared light.

Important words: Matter – absorb – visible – infrared – radio waves – heat

Waves

HS-PS4-4 Waves and Their Applications in Technologies for Information Transfer

Oklahoma says:

Shorter wavelength electromagnetic radiation (ultraviolet, X-ray s, gamma rays) can ionize atoms and cause damage to living cells.

Honeycutt says:

Waves shorter than visible light are ultraviolet, x-rays, gamma rays.

These waves can cause damage to living cells through ionization.

Ionization is when atoms/molecules gain or lose a charge.

Ionized cells in living things either die, repair themselves, or mutate.

Important words: Ultraviolet – x-rays – gamma rays – ionized cells – mutate

Waves

HS-PS4-4 Waves and Their Applications in Technologies for Information Transfer

Oklahoma says:

Photoelectric materials emit electrons when they absorb light of a high- enough frequency.

Honeycutt says:

The photoelectric effect is a phenomenon in physics.

It can happen when a photon hits an electron on a metal surface.

College students study this in physics & quantum chemistry.

This helps explain (Einstein's) concept of wave-particle duality.

Important words: photoelectric effect – phenomenon – quantum – duality