NGSS Boschen, Savanna

- Science & engineering Practices
- Crosscutting concepts
- Content Standards→ Middle & High School





HS.Structure and Function

HS.Structure and Function

Students who demonstrate understanding can:

HS-LS1-1. Construct an explanation based on evidence for how the structure of DNA determines the structure of proteins which carry out the essential functions of life through systems of specialized cells. [Assessment Boundary: Assessment does not include identification of specific cell or tissue types, whole body systems, specific protein structures and functions, or the biochemistry of protein synthesis.]

HS-LS1-2. Develop and use a model to illustrate the hierarchical organization of interacting systems that provide specific functions within multicellular organisms. [Clarification Statement: Emphasis is on functions at the organism system level such as nutrient uptake, water delivery, and organism movement in response to neural stimuli. An example of an interacting system could be an artery depending on the proper function of elastic tissue and smooth muscle to regulate and deliver the proper amount of blood within the circulatory system.] [Assessment Boundary: Assessment does not include interactions and functions at the molecular or chemical reaction level.]

HS-LS1-3. Plan and conduct an investigation to provide evidence that feedback mechanisms maintain homeostasis. [Clarification Statement: Examples of investigations could include heart rate response to exercise, stomate response to moisture and temperature, and root development in response to waterlevels.] [Assessment Boundary: Assessment does not include the cellular processes involved in the feedback mechanism.]

The performance expectations above were developed using the following elements from the NRC document A Framework for K-12 Science Education:

Science and Engineering Practices

Developing and Using Models

Modeling in 9–12 builds on K–8 experiences and progresses to using, synthesizing, and developing models to predict and show relationships among variables between systems and their components in the natural and designed world.

 Develop and use a model based on evidence to illustrate the relationships between systems or between components of a system. (HS-LS1-2)

Planning and Carrying Out Investigations

Planning and carrying out in 9-12 builds on K-8 experiences and progresses to include investigations that provide evidence for and test conceptual, mathematical, physical, and empirical models.

 Plan and conduct an investigation individually and collaboratively to produce data to serve as the basis for evidence, and in the design: decide on types, how much, and accuracy of data needed to produce reliable measurements and consider limitations on the precision of the data (e.g., number of trials, cost, risk, time), and refine the design accordingly. (HS-LS1-3)

Constructing Explanations and Designing Solutions Constructing explanations and designing solutions in 9–12 builds

Disciplinary Core Ideas

LS1.A: Structure and Function

- Systems of specialized cells within organisms help them perform the essential functions of life. (HS-LS1-1)
- All cells contain genetic information in the form of DNA molecules. Genes are regions in the DNA that contain the instructions that code for the formation of proteins, which carry out most of the work of cells. (HS-LS1-1) (Note: This Disciplinary Core Idea is also addressed by HS-LS3-1.)
- Multicellular organisms have a hierarchical structural organization, in which any one system is made up of numerous parts and is itself a component of the next level. (HS-LS1-2)
- Feedback mechanisms maintain a living system's internal conditions within certain limits and mediate behaviors, allowing it to remain alive and functional even as external conditions change within some range. Feedback mechanisms can encourage (through positive feedback) or discourage (negative feedback) what is going on inside the living system. (HS-LS1-3)

Crosscutting Concepts

Systems and System Models

 Models (e.g., phy sical, mathematical, computer models) can be used to simulate systems and interactions including energy, matter, and information flows—within and between systems at different scales. (HS-LS1-2)

Structure and Function

 Investigating or designing new systems or structures requires a detailed examination of the properties of different materials, the structures of different components, and connections of components to reveal its function and/or solve a problem. (HS-LS1-1)

Stability and Change

 Feedback (negative or positive) can stabilize or destabilize a system. (HS-LS1-3)

Science & Engineering Practices



PRACTICE 1- Asking Questions

- Science: Explains Phenomenon
- Engineering: fulfills human need



Science & Engineering Practices





PRACTICE 2- Developing & Using Models

- Physical, clear, shared, conceptual, external model \rightarrow acts as an analogy of phenomena
- Science: Explains Phenomenon
- Engineering: analyze system



Science & Engineering Practices



PRACTICE 3-Planning/carrying out Investigations

- Data comes out of investigations
- Important aspects: (1) Questions (2) Variables (3) control
- Science: To answer questions we have developed
- Engineering: Test designs we have created





Science & Engineering Practices



COMPUTATIONAL THINKING

Computational Thinking \rightarrow (1) Models (2) Simulations



PRACTICE 5- Using mathematics & computational thinking

- Abstract study of: shape, quantities, structure
- Science: Allows us to represent variables in studies
- Engineering: Improves design



Mathematics→ (1) Quantities/Units (2) Relationships

Science & Engineering Practices



PRACTICE 6- Constructing explanations & designing solutions

- How are theories created? (E.g. Big Bang Theory, Black Hole, Natural Selection)
- Science: construct explanations
 - <u>Hypothesis:</u> plausible explanation for what we're observing
- Engineering: Design solution
 - $\circ \quad \underline{\text{Design}} \rightarrow \underline{\text{Create}} \rightarrow \underline{\text{Evaluate}} \rightarrow \underline{\text{Plan}}$





Science & Engineering Practices



PRACTICE 7- Engaging in Arguments from Evidence

- Arguments: Formal VS Informal
- Science: Gives us best explanation for how universe works
- Engineering: Gives us best <u>solution</u> for how universe works



Science & Engineering Practices

Formal

ASN SCIENCE

ABOUT ASM SCIENCE JOURNAL

Rapid online publication on ar

vers medical, engineering, earth, thematical, physical, chemical, logical and agricultural sciences well as ICT and material sciences

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ation of Compact Algorithms and Permutable Theory in Evaluating Computer Data

Informal

International Joint Conference on Artificial Intelligence

PRACTICE 8- Obtaining, evaluating, and communicating Info

How scientists take in info, make sense of it, and share it with rest of world Science: share explanations **Engineering:** share solutions







What are Crosscutting Concepts?

Ideas that bridge across a variety of science and engineering topics.

You can think of them as a type of glue that shows relationships between different ideas.

Crosscutting Concepts Concept 1- Patterns

- Lead to Classification
- Science: Initiate questions that create questions
- Engineering: Improve solutions



- Recognize patterns in nature and use that to organize and classify
- Express relationships between things based on observed patterns
- Identify patterns and analyze them

Crosscutting Concepts Concept 2- Cause & Effect

Cause Effect

What?

I needed an

umbrella.

Why?

It started

raining.



- Recognize that events have causes, sometimes simple and sometimes complex
- Construct the cause of an event & explain the unexpected
- Predict the effect of a cause
- Recognize and explain the reason the effect happens

- Innate in all humans
- Science: Allows us to explain causal relationships
- Engineering: Control caus & control effect



- Large scale vs small scale
- Science: Understand Phenomenon
- Engineering: Improve solution

3 Continuums: (1) Size (2) Time-span (3) Energy



- Understand the importance of scale and quantity
- Recognize what is relevant at different size, energy, and time scales
- Identify proportional relationships between different quantities as scale change





- Observe and track how energy and matter flows, into, out of, and within systems
- Analyze the flow of energy and matter and how it determines the system's behavior

Crosscutting Concepts Concept 6- Structure & Function

- How does form fit function?
 - Structure: What it's made up of
 - **Function:** how structure works
- Science: Understand phenomena
- Engineering: Improve Design



Crosscutting Concepts Concept 7- Stability & Change

- Equilibrium: internal system tends to stay the same (e.g. homeostasis)
 - <complex-block><complex-block>

- Feedback loops
 - **Positive +:** <u>moving way away</u> from a set point
 - Negative -: maintains stability in a system→ keeps us around a set point
 - Science: Explain patterns Engineering: Control system



- Consider and understand that conditions can affect stability
- Analyze factors that control rates of change
- Understand that conditions and factors are important for both designed and natural systems



Content Standards

<u>High School Standards</u>

- Structure & Function (3)
- Matter & Energy in Organisms and Ecosystems (5)
- Interdependent Relationships in Ecosystems (6)
- Inheritance and Variation of Traits (3)
- Natural Selection and Evolution (5)





Middle School Standards

- From Molecules to Organisms: Structure and Processes (8)
- Ecosystems: Interactions, energy, and Dynamics (5
- Heredity: Inheritance & Variation of Traits (2)
- Biological Evolution: Unity & Diversity (6)

Syllabus with Biblical Integration

Romans 1:20 (NIV) "For since the creation of the world God's invisible qualities—his eternal power and divine nature—have been clearly seen, being understood from what has been made, so that people are without excuse"

OVCA Course Philosophy:

Science is *knowledge* of *truths/facts* about the natural world around us. The study of science provides evidence for a powerful, Holy, and Sovereign Creator. The more we study science, the more we see God's divine order of creation (*Psalm 19*).

Genesis 1:1 (NIV)- "In the beginning, God created the heavens and the Earth. Now the earth was formless and empty, darkness was over the surface of the deep, and the Spirit of God was hovering over the waters.

Time: "In the beginning"	Matter: "and the Earth"
Work: "God created"	Energy: "and the Spirit of God"
Space : "the heavens"	Motion: "was hovering"

We can see that all aspects of the universe (time, matter, work, motion, space) can be found in the very first verse of the very first chapter of the Bible.

It is important that our students learn science to grow in their knowledge and understanding of who God is, while also navigating their curiosity of the world around them. By learning science, students

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Syllabus with Biblical Integration



can apply truths to universal questions such as, "who am I?", "Why am I here?", "How did I get here", and "how do I continue to believe in a creator when I am surrounded by facts?" Science will inevitably point to God. The Christian worldview allows you to use all evidenceAdditionally, science may also lead students into endless opportunities for future careers, education, hobbies, etc.

Science says that we need at least 4 basic <u>elements</u> to survive. Jesus tells us in the Bible that he is in fact these four things:

- Water → ... If anyone is thirsty, let him come to Me and drink. "He who believes in Me, as the Scripture said, 'From his innermost being will flow rivers of living water."....
 John 7:37-39
- Oxygen → And the LORD God formed man *of* the dust of the ground, and breathed into his nostrils the breath of life..." Genesis 2:7
- Food → Then Jesus declared, "I am the bread of life"..... John 6:35
- Light→ When Jesus spoke again to the people, he said, 'I am the light of the world...' John 8:12

I am looking forward to getting to know each of you and providing you with a challenging but rewarding science experience this year.

Cellular Transport









OBJECTIVE/LEARNING TARGET

- I can explain why homeostasis is important and describe the transport of materials through cell membranes
- I can predict the direction of the movement of water or solute through a selectively permeable membrane
- I can explain how the structure of the cell membrane contributes to its function





What are you giving your eyes to? What are you feeding on? What is your spiritual diet? Whatever we watch, listen to, read is what we are feeding on. And based on what we are feeding on is what we become. How does this affect us?



What Heart Issues Are You Dealing With?



Follow Up Question

Imagine the beaker to be our heart, and the clear water to be our soul, <u>compare & contrast</u> **diffusion** to the things that we may put in our heart that hide the **light** that the Lord has placed in us

 \rightarrow (Diffusion of a substance vs. Sin)



Follow Up Question 2

GOD IS LOVE

Now, imagine the beaker to be our heart, and the clear water to be our soul, <u>compare & contrast</u> <u>diffusion of a substance</u> to the diffusion of the <u>love</u> of God (1 John 4:8) → (Diffusion vs. Love of God)

Whoever does not love does not know God, because God is love.

1 John 4:8



Matthew 6:22-23

The eye is the lamp of the body. So, if your eye is healthy, your whole body will be full of light, but if your eye is bad, your whole body will be full of darkness. If then the light in you is darkness, how great is the darkness!

1 John 2:15-17

Do not love the world or the things in the world. If anyone loves the world, the love of the Father is not in him. For all that is in the world—the desires of the flesh and the desires of the eyes and pride in possessions—is not from the Father but is from the world. And the world is passing away along with its desires, but whoever does the will of God abides forever

2 Corinthians 4:6

For God, who said, "Let light shine out of darkness," made his light shine in our hearts to give us the light of the knowledge of God's glory displayed in the face of Christ.

Psalm 101: 2-4

I will ponder the way that is blameless. Oh when will you come to me? I will walk with integrity of heart within my house; I will not set before my eyes anything that is worthless. I hate the work of those who fall away; it shall not cling to me. A perverse heart shall be far from me; I will know nothing of evil.

1 John 1:9

If we confess our sins, he is faithful and just to forgive us our sins and to cleanse us from all unrighteousness.



1 Corinthians 10:31

So, whether you eat or drink, or whatever you do, do all to the glory of God.

Proverbs 4:23

Keep your heart with all vigilance, for from it flow the springs of life.



We need to rest **in God**, but we were actually made to work **for God**

Universal Design for Learning Guidelines



Provide Multiple Means of Engagement

Purposeful, motivated learners

Provide options for self-regulation

- Promote expectations and beliefs that optimize motivation
- + Facilitate personal coping skills and strategies
- + Develop self-assessment and reflection

Provide options for sustaining effort and persistence

- + Heighten salience of goals and objectives
- + Vary demands and resources to optimize challenge
- + Foster collaboration and community
- + Increase mastery-oriented feedback

Provide options for recruiting interest

- + Optimize individual choice and autonomy
- + Optimize relevance, value, and authenticity
- + Minimize threats and distractions



Provide Multiple Means of Representation

Resourceful, knowledgeable learners

Provide options for comprehension

- + Activate or supply background knowledge
- + Highlight patterns, critical features, big ideas, and relationships
- + Guide information processing, visualization, and manipulation
- + Maximize transfer and generalization

Provide options for language, mathematical expressions, and symbols

- + Clarify vocabulary and symbols
- + Clarify syntax and structure
- Support decoding of text, mathematical notation, and symbols
- + Promote understanding across languages
- + Illustrate through multiple media

Provide options for perception

- + Offer ways of customizing the display of information
- + Offeraltematives for auditory information
- + Offeralternatives for visual information



Provide Multiple Means of Action & Expression

Strategic, goal-directed learners

Provide options for executive functions

- Guide appropriate goal setting
- + Support planning and strategy development
- + Enhance capacity for monitoring progress

Provide options for expression and communication

- + Use multiple media for communication
- + Use multiple tools for construction and composition
- Build fluencies with graduated levels of support for practice and performance

Provide options for physical action

- Vary the methods for response and ravigation
- Optimize access to tools and assistive technologies



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