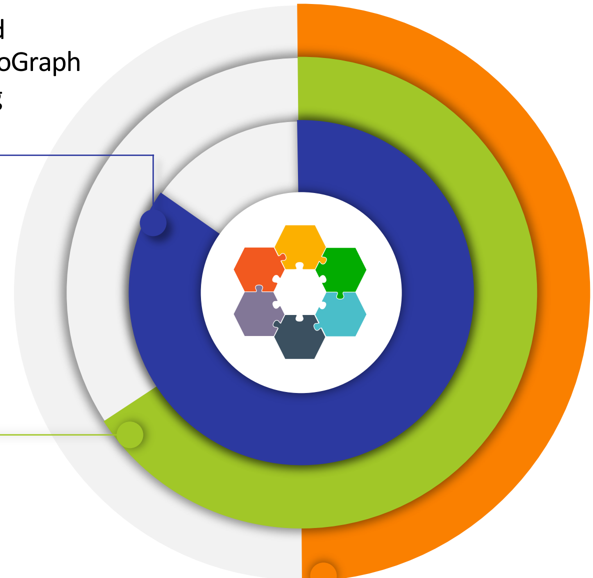
NGSS in BioGraph

Scheller Teacher Education Program education arcade

Graduate School of Education Penn GSE

NGSS in BioGraph Overview

BioGraph curriculum is closely aligned with science practices, and crosscutting concepts, and disciplinary core ideas in the NGSS. BioGraph curriculum gives multiple opportunities to *DO* science by building models of biological systems, planning and carrying out own investigation, and engaging in CER discussions.



Dimension 1: Science Practices

- Asking questions and defining problems
- Developing and using models
- Engaging in argument from evidence
- Planning and carrying out investigations
- Using mathematics and computational thinking
- Constructing explanations and designing solutions
- Analyzing and interpreting data

Dimension 2: Crosscutting Concepts

- Patterns
- Cause and effect
- Scale, proportion, and quantity
- Systems and system models
- Energy and matter
- Structure and function
- Stability and change

Dimension 3: Disciplinary Core Ideas

Epidemics	Evolution	Gene Regulation & Protein Synthesis	Enzyme	Modeling a Pond Ecosystem	Sugar Transport
Unit Focus Question: How are models a tool that scientist use to understand phenomena?	**Unit Focus Question:** How do genetic traits and the environment contribute to reproductive success?	**Unit Focus Question:** How the gene regulation system enables cells to respond to changes in their environment without direction from any centralized controller.	**Unit Focus Question:** How do enzymes react to chemical reactions?	**Unit Focus Question:** What makes a pond ecosystem long-lasting?	**Unit Focus Question:** How does the sugar you eat make its way into your body's cells?
HS-LS2-2	HS-LS1-1	HS-LS1-1	HS-LS1-2	HS-LS1-1	HS-LS1-2
HS-LS2-6	HS-LS1-3	HS-LS1-2	LS1.C	HS-LS2-2	LS1.C
HS-LS2-8	HS-LS2-8	HS-LS1-3		HS-LS2-6	
	HS-LS3-1			HS-LS2-7	
	HS-LS3-2			HS-LS2-8	
	HS-LS3-3				
	HS-LS4-2				
	HS-LS4-4				
	HS-LS4-5				

How to read a BioGraph NGSS Map

The maps are organized in a diagram with four main sections: (1) Learning objectives; (2) Dimensions 1: Science Practices; (3) Dimensions 2: Crosscutting Concepts; (3) Dimensions 3: Disciplinary Core Ideas. Texts for a red line illustrates its role in a map.

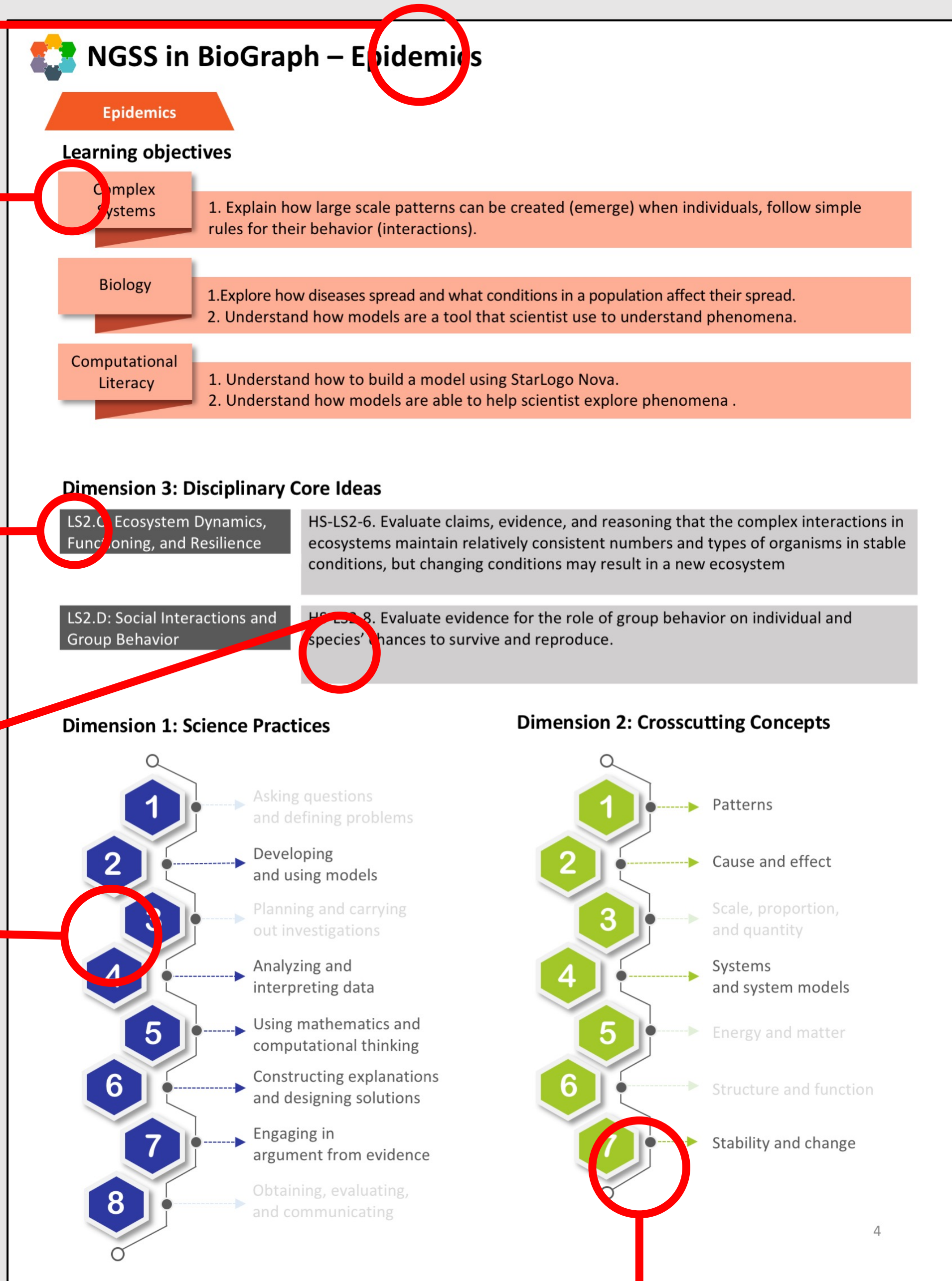
[A] Unit Title. BioGraph consist of six units.

[B] Unit learning objectives for complex systems and biology, and computational literacy.

[C] Disciplinary Core Ideas and it's code that matches with the unit.

[D] Performance Expectation (PE) and it's code.

[E] **Science Practices Number and Title:** Bold texts are the practices that align with the unit. Each unit aligns with different practices.



[F] **Crosscutting Concepts Number and Title:** Bold texts are the crosscutting concepts that align with the unit. Each unit aligns with different crosscutting concepts.

NGSS in BioGraph – Epidemics

Epidemics

Learning objectives

Complex Systems	1. Explain how large scale patterns can be created (emerge) when individuals, follow simple rules for their behavior (interactions).
Biology	1.Explore how diseases spread and what conditions in a population affect their spread. 2. Understand how models are a tool that scientist use to understand phenomena.
Computational Literacy	1. Understand how to build a model using StarLogo Nova. 2. Understand how models are able to help scientist explore phenomena .

Dimension 3: Disciplinary Core Ideas

LS2.C: Ecosystem Dynamics, Functioning, and Resilience	HS-LS2-6. Evaluate claims, evidence, and reasoning that the complex interactions in ecosystems maintain relatively consistent numbers and types of organisms in stable conditions, but changing conditions may result in a new ecosystem
LS2.D: Social Interactions and Group Behavior	HS-LS2-8. Evaluate evidence for the role of group behavior on individual and species' chances to survive and reproduce.

Dimension 1: Science Practices

1. Asking questions and defining problems
2. Developing and using models
3. Planning and carrying out investigations
4. Analyzing and interpreting data
5. Using mathematics and computational thinking
6. Constructing explanations and designing solutions
7. Engaging in argument from evidence
8. Obtaining, evaluating, and communicating

Dimension 2: Crosscutting Concepts

1. Patterns
2. Cause and effect
3. Scale, proportion, and quantity
4. Systems and system models
5. Energy and matter
6. Structure and function
7. Stability and change

NGSS in BioGraph - Evolution

Evolution

Learning objectives

Complex Systems

1. Recognize that a population as a whole does not intend to move toward an eventual outcome.
2. Use the example of the fish to explain how programmed behavior at the individual level results in a predictable outcome at the larger system or population level, even though the system-level behavior itself isn't programmed

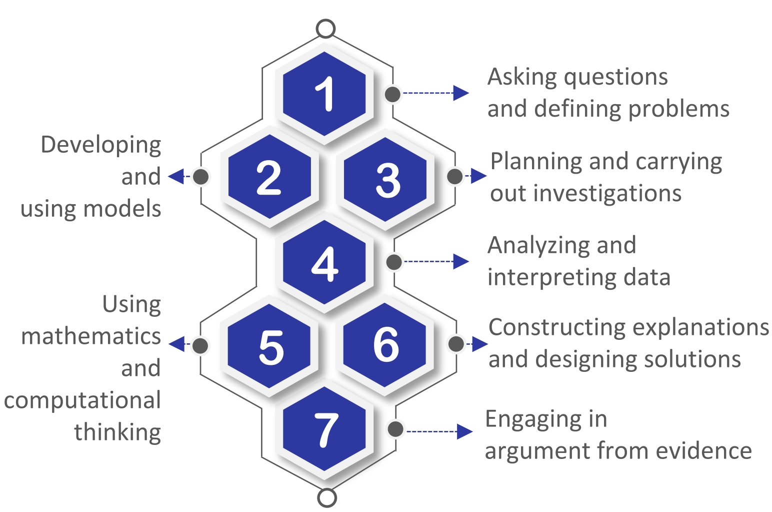
Biology

1. Explain why an individual cannot evolve, but a population can.
2. Compare and contrast how genetic drift and natural selection can result in a trait becoming more or less common in a population due to the differential reproduction of individuals in that population.
3. Recognize that the direction of evolution is influenced by both an individual's' traits and the environment in which they exist.

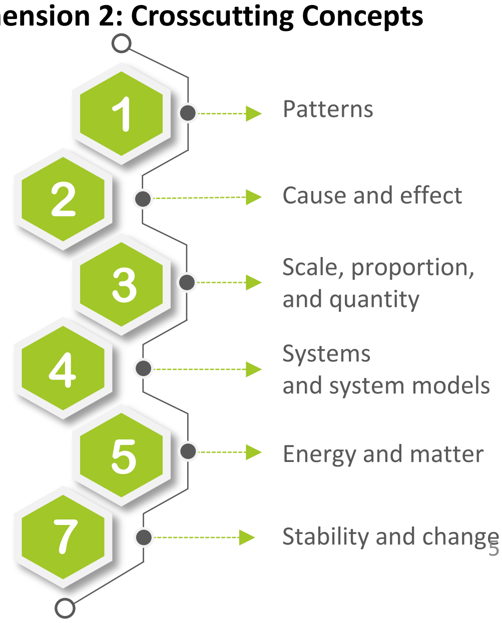
Dimension 3: Disciplinary Core Ideas

LS2.D: Social Interactions and Group Behavior	HS-LS2-8. Evaluate evidence for the role of group behavior on individual and species' chances to survive and reproduce.
LS3.A: Inheritance of Traits	HS-LS3-1. Ask questions to clarify relationships (….) characteristic traits passed from parents to offspring.
LS4.B: Natural Selection	HS-LS4-2. Construct an explanation based on evidence that the process of evolution primarily results from four factors: (1) the potential for a species to increase in number, (2) the heritable genetic variation of individuals in a species due to mutation and sexual reproduction, (3) competition for limited resources, and (4) the proliferation of those organisms that are better able to survive and reproduce in the environment.
LS4.C: Adaption	HS-LS4-4. Construct an explanation based on evidence for how natural selection leads to adaptation of populations.
	HS-LS4-5.Evaluate the evidence supporting claims that changes in environmental conditions may result in (1) increases in the number of individuals of some species, (2) the emergence of new species over time, and (3) the extinction of other species.

Dimension 1: Science Practices



Dimension 2: Crosscutting Concepts



NGSS in BioGraph - Gene Regulation & Protein Synthesis

Gene Regulation & Protein Synthesis

Learning objectives

Complex Systems

1. Describe how the gene regulation system (e.g. promoter, operator, repressor, RNA polymerase, etc.) enables cells to respond to changes in their environment without direction from any centralized controller.

Biology

1. Explain why regulation gene expression (the ability to turn on and off of genes in response to changes in the environment) is important to living organisms.
2. Describe the sequence of events that occurs to switch a gene from its normal ‘turned off’ state to its ‘turned on’ state (when it is building a specific protein to respond to a change in its environment).
3. Describe the sequence of events that occurs to switch a gene from its ‘turned of’ state back to its normal ‘turned off state.
4. Give an example of how a specific gene product, a protein, enables a cell to respond to an environmental change.

Dimension 3: Disciplinary Core Ideas

LS1.A: Structure and Function

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.

HS-LS1-2.Develop and use a model to illustrate the hierarchical organization of interacting systems that provide specific functions.

HS-LS1-3.Plan and conduct an investigation to provide evidence that feedback mechanisms maintain homeostasis.

Dimension 1: Science Practices

1. Asking questions and defining problems
2. Developing and using models
3. Planning and carrying out investigations
4. Analyzing and interpreting data
5. Using mathematics and computational thinking
6. Constructing explanations and designing solutions
7. Engaging in argument from evidence
8. Obtaining, evaluating, and communicating

Dimension 2: Crosscutting Concepts

1. Patterns
2. Cause and effect
3. Scale, proportion, and quantity
4. Systems and system models
5. Energy and matter
6. Structure and function
7. Stability and change

NGSS in BioGraph - Enzyme

Enzyme

Learning objectives

Complex Systems

1. Understand that enzymes and substrates interact with one another due to random (not directed) motion of molecules.

Biology

1. Recognize that enzymes speed up chemical reactions that take place in cells.
2. Explain the shapes of the reaction rate curves both with and without enzymes.

Dimension 3: Disciplinary Core Ideas

LS1.A: Structure and Function	HS-LS1-2.Develop and use a model to illustrate the hierarchical organization of interacting systems that provide specific functions within multicellular organisms.
LS1.C: Organization for Matter and Energy Flow in Organisms	

Dimension 1: Science Practices

1. Asking questions and defining problems
2. Developing and using models
3. Planning and carrying out investigations
4. Analyzing and interpreting data
5. Using mathematics and computational thinking
6. Constructing explanations and designing solutions
7. Engaging in argument from evidence
8. Obtaining, evaluating, and communicating

Dimension 2: Crosscutting Concepts

1. Patterns
2. Cause and effect
3. Scale, proportion, and quantity
4. Systems and system models
5. Energy and matter
6. Structure and function
7. Stability and change

NGSS in BioGraph – Sugar Transport

Sugar Transport

Learning objectives

Complex Systems

1. Random processes can lead to predictable results.

Biology

1. Understand that nutrients move from the intestine through the epithelial cells into the bloodstream.
2. Understand that there are different types of transport proteins. Some allow nutrients to flow (facilitated transport proteins/facilitated diffusion proteins). Others use energy to force nutrients to flow (active and co-transport proteins).
3. Random processes can lead to predictable results.

Dimension 3: Disciplinary Core Ideas

LS1.A: Structure and Function

HS-LS1-2.Develop and use a model to illustrate the hierarchical organization of interacting systems that provide specific functions within multicellular organisms.

LS1.C: Organization for Matter and Energy Flow in Organisms

Dimension 1: Science Practices

1. Asking questions and defining problems
2. Developing and using models
3. Planning and carrying out investigations
4. Analyzing and interpreting data
5. Using mathematics and computational thinking
6. Constructing explanations and designing solutions
7. Engaging in argument from evidence
8. Obtaining, evaluating, and communicating

Dimension 2: Crosscutting Concepts

1. Patterns
2. Cause and effect
3. Scale, proportion, and quantity
4. Systems and system models
5. Energy and matter
6. Structure and function
7. Stability and change

NGSS in BioGraph – Modeling a Pond Ecosystem

Modeling a Pond Ecosystem

Learning objectives

Complex Systems	1. Recognize that ecosystems are made up interacting, interdependent agents (organisms) and their environment. .
Biology	1. Understand that ecological systems are formed from the balanced interactions of producers and consumers (plant and animals). When these interactions become unbalanced (e.g. a species of producer grows too fast or too slowly) ecological systems may change or cease to exist.
Computational Literacy	1. Know that it is possible to build models of biological systems. These models can be used as tools to understand and test ideas about the world .

Dimension 3: Disciplinary Core Ideas

(Need update)

Dimension 1: Science Practices

1. Asking questions and defining problems
2. Developing and using models
3. Planning and carrying out investigations
4. Analyzing and interpreting data
5. Using mathematics and computational thinking
6. Constructing explanations and designing solutions
7. Engaging in argument from evidence
8. Obtaining, evaluating, and communicating

Dimension 2: Crosscutting Concepts

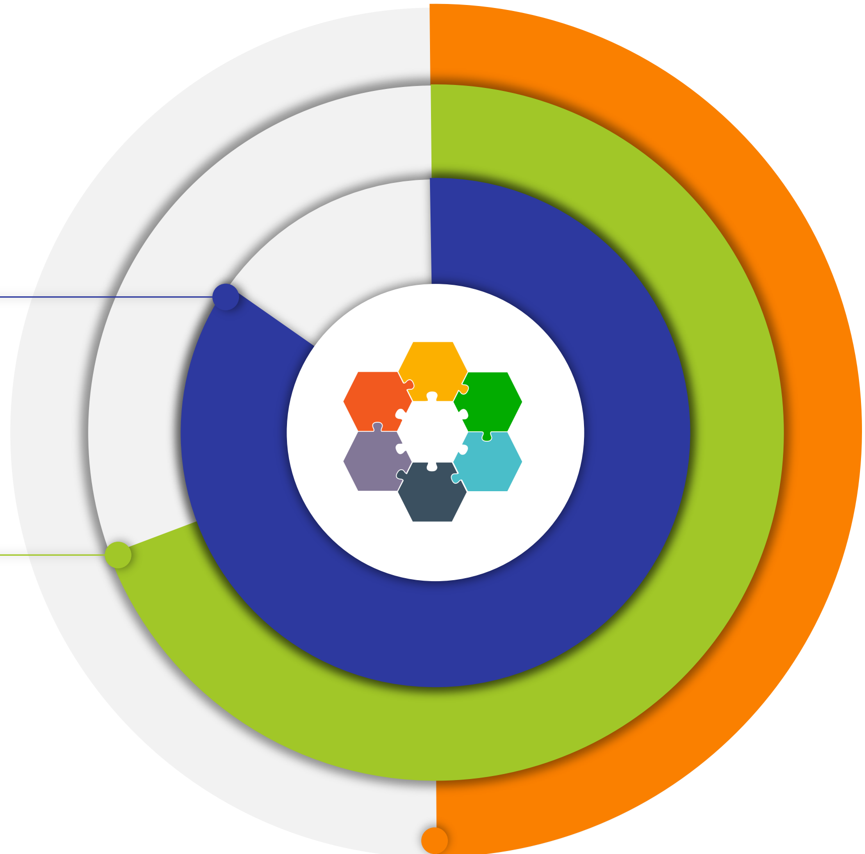
1. Patterns
2. Cause and effect
3. Scale, proportion, and quantity
4. Systems and system models
5. Energy and matter
6. Structure and function
7. Stability and change

NGSS & Three Dimensions


Dimension 1:
Practices
Dimension 2:
Crosscutting Concepts
Dimension 3:
Disciplinary Core Ideas

Dimension 1: Practices

1. Asking questions and defining problems
2. Developing and using models
3. Planning and carrying out investigations
4. Analyzing and interpreting data
5. Using mathematics and computational thinking
6. Constructing explanations and designing solutions
7. Engaging in argument from evidence
8. Obtaining, evaluating, and communicating



Dimension 1: Practices

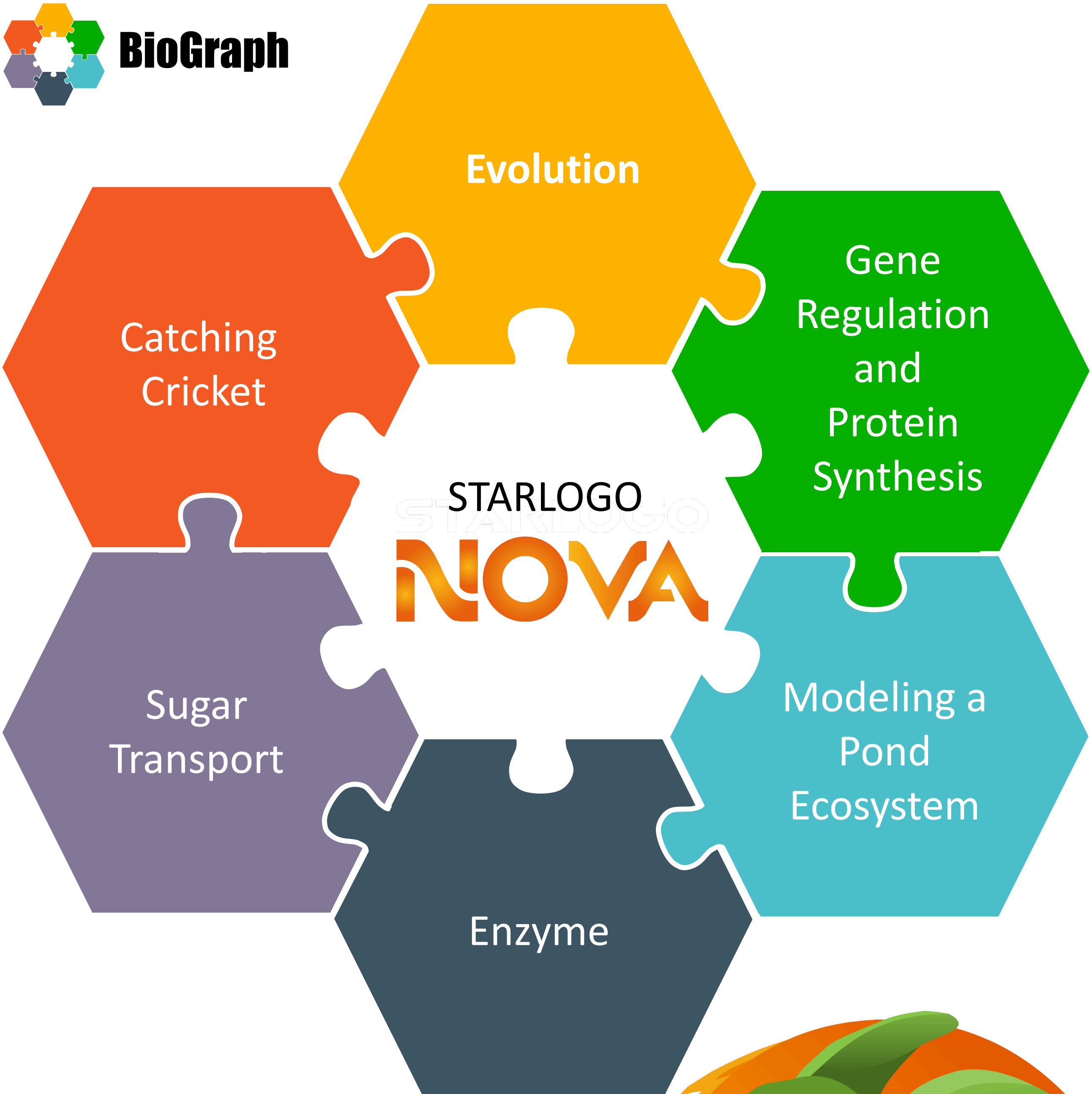
Dimension 3: Disciplinary Core Ideas

Dimension 2: Crosscutting Concepts

1. Patterns
2. Cause and effect
3. Scale, proportion, and quantity
4. Systems and system models
5. Energy and matter
6. Structure and function
7. Stability and change

Dimension 3: Disciplinary Core Ideas

BioGraph


Evolution
Catching Cricket
Gene Regulation and Protein Synthesis
STARLOGO
NOVA
Sugar Transport
Modeling a Pond Ecosystem
Enzyme