TGC Fellow Unit Template *

Prepared by: Angela Osuji School/Location: Clara Barton Open School, Minneapolis, MN

Subject: Science. **Grade**: 6-8 (Ages12-14). **Unit Title**: Natural Systems. **Time Needed**: 6 weeks (55min/period.

Unit Summary: Using Gaudelli's 5 Domains on Global Education as framework, students will develop global competency as they explore Natural Systems. They will learn that thinking about things as systems means looking for how every part relates to others They understand that the sustainability and balance of natural systems is affected by interactions within the environment. They become globally aware, develop multiple perspectives, communicate ideas and take action as they apply systems thinking to make sense of the natural world.

Stage 1 Desired Results

ESTABLISHED GOALS:

G1. NGSS-MS-LS2-1: Analyze and interpret data to provide evidence for the effects of resource availability on organisms and populations of organisms in an ecosystem.

G2. NGSS-MS-LS2-2: Construct an explanation that predicts patterns of interactions among organisms across multiple ecosystems.

G3. NGSS-MS-LS2-3: Develop a model to describe the cycling of matter and flow of energy among living and nonliving parts of an ecosystem.

G4.NGSS-MS-LS2-4: Construct an argument supported by empirical evidence that changes to physical or biological components of an ecosystem affect populations.

G5. NGSS-MS-LS2-5: **Evaluate competing design solutions for maintaining biodiversity and ecosystem services**

G6.NGSS-MS-ETS1-1: Define the criteria and constraints of a design problem with sufficient precision to ensure a successful solution, taking into account relevant **scientific principles and potential impacts on people and the natural environment that**

Transfer

Students will be able to independently use their learning to…(real world purpose)

T1: Describe and evaluate the benefits and limitations of science and scientific applications, as well as their effect on life and society.

T2: Examine critical scientific concepts, engage in scientific reasoning, and apply the processes of scientific inquiry to understand the world and explore possible solutions to global problems.

T3: Demonstrate concern for the environment and commitment to sustainable development.

T4: Apply their understanding of systems and the 5 domains (personal, locational, temporal, issues and action) to a problem of visible global significance—environmental sustainability.

Meaning

UNDERSTANDINGS

Students will understand that…

U1: A system is a group of parts working together to accomplish a task.

U2: If parts of the system do not function, the system does not.

U3: Systems (man-made and natural) are linked in some way to make an overall functioning whole, and are necessarily dependent on each other in order to function properly.

U4: Designed and Natural systems exist in the world.

ESSENTIAL QUESTIONS

E1: What is a system and in what ways are the organisms in an ecosystem interconnected?

E2: How and why do organisms interact with their environment and what are the effects of these interactions?

E3: How do organisms interact with the living and nonliving environments to obtain matter and energy?

E4: What impacts, both positive and negative, have humans had on our ecosystems and what responsibility do humans have in keeping a balanced ecosystem?

may limit possible solutions GLOBAL COMPETENCY: **G7.GC-SKILLS-1**: Investigate the world beyond their immediate environment, framing significant problems and conducting well-crafted and age-appropriate research. **G8.GC-SKILLS-2:** Recognize perspectives, others' and their own, articulating and explaining such perspectives thoughtfully and respectfully. **G9.GC-SKILLS-3:** Communicate ideas effectively with diverse audiences, bridging geographic, linguistic, ideological, and cultural barriers. RESOURCES: **Minnesota State Science Standards** 1. Designed and natural systems exist in the world. These systems consist of components that act within the system and interact with other systems (6.1.3.1.1). 2. Energy can be transformed within a system or transferred to other systems or the environment. (6.2.3.2.1) 3. The flow of energy and the recycling of matter are essential to a stable ecosystem. (7.4.2.2.1) 4. In order to maintain and improve their existence humans interact with and influence Earth systems. (8.3.4.1.2) **National Science Education Standards** 1. 5-8: Content Standard A: Science as	U5: These systems consist of components that act within the system and interact with other systems. U6: Natural systems include a variety of organisms that interact with one another in several ways. U7: Matter cycles through an ecosystems and energy flows through an ecosystem. Matter and Energy are conserved.	
	Acquisition	
	Students will know… (Content) that K1: Designed and natural systems exist in the world. These systems consist of components that act within the system and interact with other systems. K2: Water, which covers the majority of the Earth's surface, circulates through the crust, oceans and atmosphere in what is known as the water cycle. K3: In order to maintain and improve their existence humans interact with and influence Earth systems K4: Land and water use practices affect natural processes and that natural processes interfere and interact with human systems. K5: In any ecosystem, organisms and populations with similar requirements for food, water, oxygen, or other resources may compete with each other for limited resources, access to which consequently constrains their growth and reproduction.	*Students will be able to… (Skills)* S1: Identify and classify systems by examining the functions of the subsystems and whole systems. S2: Explain the relationship of every part of a system to the others in systems thinking . S2: Describe a system in terms of its subsystems and parts, as well as its inputs. S3: Compare and contrast a school system to an ecosystem. S4: Effectively argue with evidence the case that the school system is a subsystem of the global system. S5: Analyze the effect of biotic and abiotic factors on a number of organisms in an ecosystem. S6: Work collaboratively as a group to analyze the impact, both positive and negative, humans have on an environment using Gaudelli's 5 Domains of reference on Global Education. S7: Design solutions for addressing an ecosystem issue of their choice. S8: Design and construct a model of an ecosystem using a multimedia or digital learning platform of

Inquiry 2. 5-8: Content Standard D: Earth and Space Science: Structure of the Earth System 3. 5-8: Content Standard F: Science in Personal and Social Perspectives **Next Generation Science Standards** **Disciplinary Core Ideas (DCI)** MS-PS 3: Energy MS- LS2: Ecosystems: Interactions, Energy, and Dynamics MS-ESS2-Earth's Systems **Cross Cutting Concepts (CCC):** Systems and System Models, Energy and Matter, Stability and Change **Science and Engineering Practices**: All 8 Practices.	**K6:** Transfers of matter into and out of the physical environment occur at every level within an ecosystem. K7: Ecosystems are dynamic in nature; their characteristics can vary over time. Disruptions to any physical or biological component of an ecosystem can lead to shifts in all its populations. K8: Biodiversity describes the variety of species found in Earth's terrestrial and oceanic ecosystems. The completeness or integrity of an ecosystem's biodiversity is often used as a measure of its health.	their choice. S9: Develop a repository of online resources focused on Natural systems (example create a Pinterest with a minimum of three boards and pin articles, video clips, among others). S10: Develop a model to describe the cycling of matter and flow of energy among living and nonliving parts of an ecosystem.

Stage 2 - Evidence

Assessment	Evaluation Criteria (Learning Target or Student Will Be Able To)
Assessments **FOR** Learning: (ex: kwl chart, exit ticket, observation, draft, rehearsal) 1. Identify systems and parts of a system 2. Brainstorm ideas, notes, writing prompts are recorded in the Interactive Science Notebook and referenced throughout the unit. 3. Identify areas on a global map that have high rates of carbon emissions. Use the EPA website	Learning Targets: 1. I can identify parts of a system 2. I can compare and contract designed systems and natural systems 3. I can identify the parts of an ecosystem 4. I can trace the flow of matter in an ecosystem 5. I can describe where energy is changed and stored in a food web. 6. I can analyze the effect of biotic and abiotic factors on the number of organisms in a Minnesota ecosystem 7. I can analyze the impact of human activities on an ecosystem Formative Assessments from Page Keely's Uncovering Students Ideas • Is it a system? (Physical Science and Unifying Themes Assessment Probes. Vol.1, #11) • Is it a Consumer? (Uncovering Student Ideas in Life Science: Vol.1, #14 • No More Plants (Uncovering Student Ideas in Life Science: Vol.1, #17

	• Ecosystem Circles (Uncovering Student Ideas in Life Science: Vol.1, #16 • Extended Response—Human and Black Bear Interactions. • Quick writes-Writing on key concepts • Unit Benchmark test used as Pre-Assessment
Assessment **OF** Learning: (ex: performance task, project, final paper) AOL 1: Students will analyze and interpret data to provide evidence for the effects of resource availability on organisms and populations of organisms in an ecosystem. AOL 2: Students will develop a model to describe the cycling of matter and flow of energy among living and nonliving parts of an ecosystem.	• End of Unit Assessment. • Unit Test • Project Presentation. • Interactive Notebook check • Benchmark Assessment.

Stage 3 – Learning Plan

Summary of Key Learning Events and Instruction (Make this a useful outline or summary of your unit, your daily lesson plans will be separate)

Week One: Exploring Systems and Systems Thinking, Systems across disciplines, Global Systems and 5 Gaudelli's 5 domains.

In this lesson, students will develop the understanding that the natural world is too complex to comprehend all at once, that systems and thinking about things as systems means looking for how every part relates to others. The output from one part of a system (which can include material, energy, or information) can become the input to other parts. Such feedback can serve to control what goes on in the system as a whole. Systems thinking provide an interdisciplinary cross cutting concept for students to make sense of the natural world. Thinking things as systems will help them develop a global perspective, considering that the Earth as a system composed of interactions among the lithosphere, atmosphere, hydrosphere and biosphere. They examine their body as a system as they begin to develop a sense of identity. Through research, class discussions and readings and incorporating Gaudelli's 5 domains, they examine how their multidimensional identity makes it possible for them to exist and interact in all places simultaneously and how that is directly related to global systems.

Week Two: Exploring designed and natural systems

In this lesson, students develop the understanding that designed and natural systems exist in the world. These systems consist of components that act within the system and interact with other systems. They have boundaries, components, resource flow (input and output) and feedback. Through guide inquiry, they create a list of designed systems and natural systems; identify the input-process-output.

Week Three: Investigating Patterns of Interaction in an Ecosystem

Students develop the understanding that patterns show cause and effect in an ecosystem. They study the biotic and abiotic components of the ecosystem. They study the hierarchal structure that exists; groups of the same organisms (species) form populations, different populations interact to form communities, communities live within an ecosystem, and all of the ecosystems on Earth make up the biosphere.

Week Four: Examining cycling of matter and flow of energy in an ecosystem

In this lesson, students examine the food chain and food web. As the construct mathematical and graphical models, they develop an understanding that the cycling of matter and the flow of energy within ecosystems occur through interactions among different organisms and between organisms and the physical environment. All living systems need matter and energy to survive, thrive and reproduce.

Week Five: Investigating the effects of changes in population on an ecosystem

In this lesson, students investigate how small changes in one part of a system might cause large changes in population. Through inquiry, they develop the understanding that ecosystems are dynamic in nature; their characteristics fluctuate over time, depending on changes in the environment and in the populations of various species.

Week Six: Natural Systems Capstone Project: Student groups will work on their Natural Systems project incorporating Global Competency and Presentation.

**adapted from Understanding by Design Model*

TGC FELLOWS UBD Lesson Template

Lesson Title: Is it A System Subject: Sciencen6-8 Prepared by: Angela Osuji

Materials Needed: Mechanical Pencils, Various communication tools, Virtual Lab of human body Systems, Readings on Identity, Science Interactive notebook, Model of a cell, Model of a school, Aquarium-as a model aquatic ecosystem, model of a circuit/circuit diagram.

Global Competency: Investigate the world beyond their immediate environment, framing significant problems and conducting well-crafted and age-appropriate research.

Where is the lesson going? (Learning Target or SWBAT)	Learning Target • I can identify parts of a system • I can identify the parts of an ecosystem

Hook (10mins)	**T**ailored Differentiation:
Pre- Assessment • Ask students to write down words they know that includes system e.g. school system, monetary system. • Is it a system? (Physical Science and Unifying Themes Assessment Probes. Vol.1, #11). The purpose of this assessment probe is to elicit students' ideas about systems. The probe is designed to find out whether students can recognize that things with parts that interact or influence each other are systems.	Plan for compacting material/information for advanced students Do mixed ability grouping for student groups. Accept multiple representations of evidence of learning. Do Cloze reading for ELL students.
Equip: (20mins)	
Activity: Students work in small groups to examine one of the items provided. They take apart the items and begin to isolate and identify the components, input-process-output and feedback mechanism. As the work, they are addressing the questions: what are the parts of	

the system? What are the inputs and outputs? What does the whole system do that the individual parts cannot do?	
Rethink and revise: (15mins)	
1) Students review and modify their earlier responses to the 'Is it a Systems' Assessment Probe based on the information from the Activity completed. 2) Teacher elaborates based on information from the assessment probe incorporating the some ideas from the probe.	
Evaluate:	
Student groups will answer these questions are part of their exit ticket. Each group picks one to answer. They write the responses on a large poster and 1. Based on what you know about systems, explain why the ecosystem is a "system." 2. Choose three parts of the ecosystem and describe their functions. 3. Now, choose one part of the ecosystem and describe how it affects other parts of the ecosystem. 4. Describe how a school system and an ecosystem are *similar*. 5. Describe how a school system and ecosystem are *different*. 6. We discussed how a school system is actually a subsystem of a larger educational system. Is the ecosystem also a subsystem of a larger system? How so? 7. To enhance your understanding about systems, you should now compare and contrast a school system to a different system—the digestive system, ecosystem, solar systems.	

Notes: If lesson exceeds the time for the day, group presentation and gallery work can take place the following day.	Organization: Plan to bring bicycle to class. Schedule for computer carts for virtual field trip. Plan to show students Dr. Gaudelli's Global Competency video. Bring articles on Identity development-Cultural, biological and Global. Bring Posters for Gallery Work.