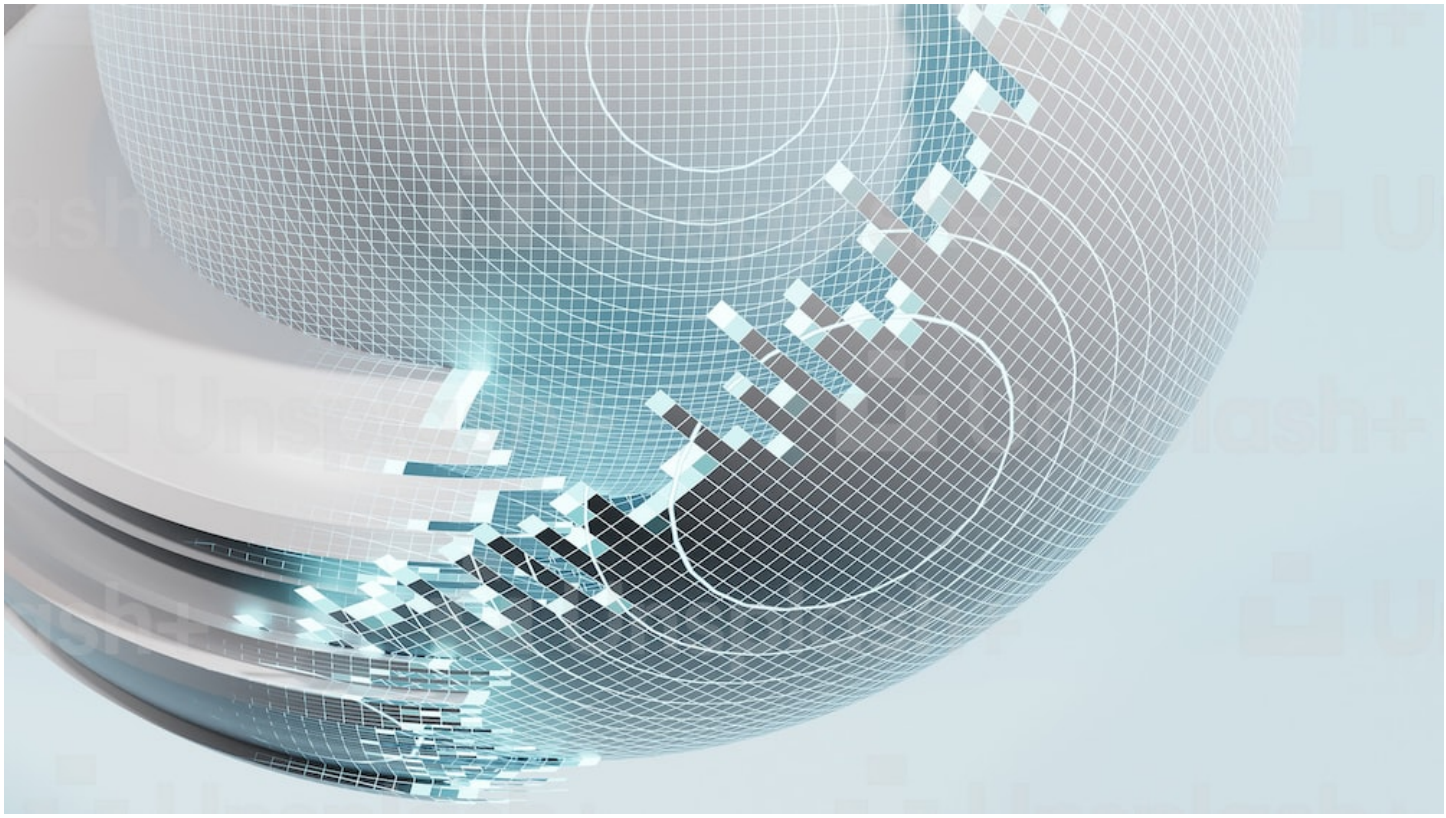
So it's a System



https://unsplash.com/s/photos/system

NISD GT Process Standards

GT Process Standards provide guidance on what GT students should know, understand, and do as part of GT program services. Each lesson makes a connection to specific standards; however, teachers are encouraged to incorporate every standard where applicable.

I. Creative Thinking
Ability to look at problems or situations from a unique perspective through the use of imagination and/or innovative ideas

II. Critical Thinking
Ability to demonstrate clear, rational, open-minded thinking, informed by evidence

III. Depth & Complexity
Ability to dig deeper into a concept and to understand that concept with greater complexity

IV. Scholarly Inquiry & Research
Ability to interpret information that leads to new understandings and connects to the world beyond the classroom

V. Effective Communication
Ability to convey new learning through the use of written, spoken, and technological media

VI. Leadership & Responsibility
Demonstrates initiative, task commitment, and the elements of compromise and diplomacy

Language of the Discipline

system

heap

parts

connect

rules

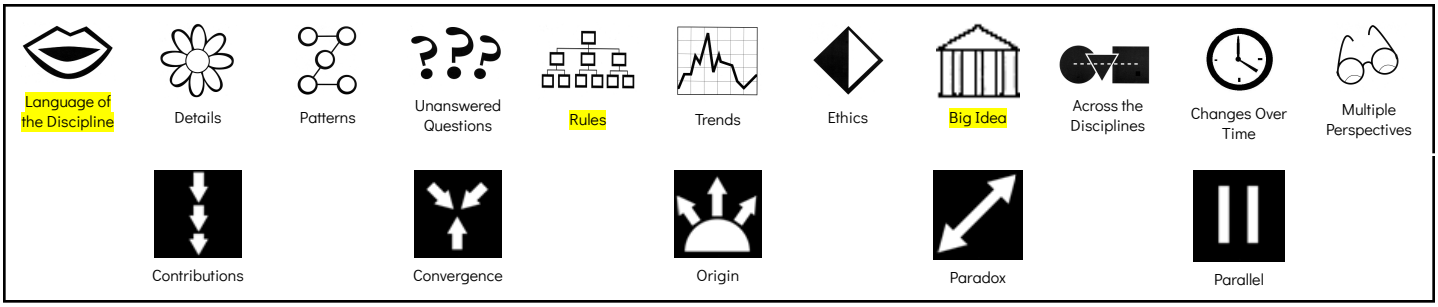
big idea

engineer

Scholarly Habits

- Scholars utilize varied resources
- Scholars exhibit curiosity
- Scholars demonstrate academic humility
- Scholars save ideas
- Scholars ponder the big idea
- Scholars see from different perspectives
- Scholars are always prepared
- Scholars display perseverance
- Scholars set goals
- Scholars take intellectual risks

Depth and Complexity & Content Imperatives



Thinking like a Disciplinarian

Thinking like an ***engineer*** (someone who invents, designs, analyzes, builds, and tests machines, systems, or structures. Engineers want to know how and why things work).

Universal Generalizations

- Systems have parts that work to complete a task
- Systems are composed of subsystems
- Part of systems are interdependent upon one another and form symbiotic relationships
- A system may be influenced by other systems
- Systems interact
- Systems follow rules

Essential Questions

- What is a system?
- How are the parts of a system related to the entire system?
- How are system models used to predict and understand real world situations?

Supported TEKS

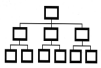
Science

3.1A, 4.1A, 5.1A (Scientific and engineering practices. The student asks questions, identifies problems, and plans and safely conducts classroom, laboratory, and field investigations to answer questions, explain phenomena, or design solutions using appropriate tools and models. The student is expected to ask questions and define problems based on observations or information from text, phenomena, models, or investigations)
3.1B, 4.1B, 5.1B (Scientific and engineering practices. The student asks questions, identifies problems, and plans and safely conducts classroom, laboratory, and field investigations to answer questions, explain phenomena, or design solutions using appropriate tools and models. The student is expected to use scientific practices to plan and conduct descriptive investigations and use engineering practices to design solutions to problems)
3.2A 4.2A, 5.2A (Scientific and engineering practices. The student analyzes and interprets data to derive meaning, identify features and patterns, and discover relationships or correlations to develop evidence-based arguments or evaluate designs. The student is expected to identify advantages and limitations of models such as their size, scale, properties, and materials)
3.2B, 4.2B, 5.2B (Scientific and engineering practices. The student analyzes and interprets data to derive meaning, identify features and patterns, and discover relationships or correlations to develop evidence-based arguments or evaluate designs. The student is expected to analyze data by identifying any significant features, patterns, or sources of error)
3.2D, 4.2D, 5.2D (Scientific and engineering practices. The student analyzes and interprets data to derive meaning, identify features and patterns, and discover relationships or correlations to develop evidence-based arguments or evaluate designs. The student is expected to: (D) evaluate a design or object using criteria.)
3.3A, 4.3A, 5.3A (Scientific and engineering practices. The student develops evidence-based explanations and communicates findings, conclusions, and proposed solutions. The student is expected to develop explanations and propose solutions supported by data and models)
3.3B, 4.3B, 5.3B (Scientific and engineering practices. The student develops evidence-based explanations and communicates findings, conclusions, and proposed solutions. The student is expected to: communicate explanations and solutions individually and collaboratively in a variety of settings and formats)
3.3C, 4.3C, 5.3C (Scientific and engineering practices. The student develops evidence-based explanations and communicates findings, conclusions, and proposed solutions. The student is expected to listen actively to others' explanations to identify relevant evidence and engage respectfully in scientific discussion)
3.4A. 4.4A, 5.4A (Scientific and engineering practices. The student knows the contributions of scientists and recognizes the importance of scientific research and innovation for society. The student is expected to explain how scientific discoveries and innovative solutions to problems impact science and society)
3.5A. 4.5A, 5.5A (Recurring themes and concepts. The student understands that recurring themes and concepts provide a framework for making connections across disciplines. The student is expected to identify and use patterns to explain scientific phenomena or to design solutions)
3.5C, 4.5C, 5.5C (Recurring themes and concepts. The student understands that recurring themes and concepts provide a framework for making connections across disciplines. The student is expected to: use scale, proportion, and quantity to describe, compare, or model different systems)
3.5D, 4.5D, 5.5D (Recurring themes and concepts. The student understands that recurring themes and concepts provide a framework for making connections across disciplines. The student is expected to examine and model the parts of a system and their interdependence in the function of the system)
3.5F, 4.5F, 5.5F (Recurring themes and concepts. The student understands that recurring themes and concepts provide a framework for making connections across disciplines. The student is expected to explain the relationship between the structure and function of objects, organisms, and systems)
3.5G, 4.5G, 5.5G (Recurring themes and concepts. The student understands that recurring themes and concepts

provide a framework for making connections across disciplines. The student is expected to explain how factors or conditions impact stability and change in objects, organisms, and systems)

RLA

3.1A, 4.1A, 5.1A (Developing and sustaining foundational language skills: listening, speaking, discussion, and thinking--oral language. The student develops oral language through listening, speaking, and discussion. The student is expected to listen actively, ask relevant questions to clarify information, and make pertinent comments)
3.1C, 4.1C, 5.1C (Developing and sustaining foundational language skills: listening, speaking, discussion, and thinking--oral language. The student develops oral language through listening, speaking, and discussion. The student is expected to speak coherently about the topic under discussion, employing eye contact, speaking rate, volume, enunciation, and the conventions of language to communicate ideas effectively)
3.1D, 4.1D, 5.1D (Developing and sustaining foundational language skills: listening, speaking, discussion, and thinking--oral language. The student develops oral language through listening, speaking, and discussion. The student is expected to work collaboratively with others by following agreed-upon rules, norms, and protocols)
3.1E (Developing and sustaining foundational language skills: listening, speaking, discussion, and thinking--oral language. The student develops oral language through listening, speaking, and discussion. The student is expected to develop social communication such as conversing politely in all situations)
3.4, 4.4, 5.4 (Developing and sustaining foundational language skills: listening, speaking, reading, writing, and thinking--fluency. The student reads grade-level text with fluency and comprehension. The student is expected to use appropriate fluency (rate, accuracy, and prosody) when reading grade-level text.)
3.6E,4.6E, 5.6E (Comprehension skills: listening, speaking, reading, writing, and thinking using multiple texts. The student uses metacognitive skills to both develop and deepen comprehension of increasingly complex texts. The student is expected to make connections to personal experiences, ideas in other texts, and society)
3.6F, 4.6F, 5.6F (Comprehension skills: listening, speaking, reading, writing, and thinking using multiple texts. The student uses metacognitive skills to both develop and deepen comprehension of increasingly complex texts. The student is expected to make inferences and use evidence to support understanding)
3.6G, 4.6G, 5.6G (Comprehension skills: listening, speaking, reading, writing, and thinking using multiple texts. The student uses metacognitive skills to both develop and deepen comprehension of increasingly complex texts. The student is expected to evaluate details read to determine key ideas)
3.7F, 4.7F, 5.7F (Response skills: listening, speaking, reading, writing, and thinking using multiple texts. The student responds to an increasingly challenging variety of sources that are read, heard, or viewed. The student is expected to respond using newly acquired vocabulary as appropriate)

# Instructional Plan	# Date:
Heaps vs. Systems (1 week)	
Objectives: Students will understand... • the difference between a system and a heap. • the rules that define a system.	
Learning Experiences	**Resources/Materials**
Let's Get Curious (Slide 2) Ants Ingenious Survival Method During Flood | Supers... **What is a system? (Slide 4)** Ask students to define a system. • What do they think of when they hear the word "system"? • Have students brainstorm different examples and nonexamples of systems. Lead students to develop their own definition of a system. **Skill Focus: Rules (Slide 5)** Tell students that you will help them further understand the definition of a system and define Rules of a System. Show the Rules icon. Remind students that rules can be laws, expectations, standards and methods in a given field. **Skill Focus: Big Idea (Slides 6-8)** Tell students we will also be introducing some big ideas under our topic of study this year, which is the Science of Systems. • Give students bag #1. As they examine the contents ask if "based on your definition of a system, does this bag contain a system?" Encourage students to share their reasoning and justify their answers. Share with students that the items of the bag are a "heap." (Slide 7) • Give students bag #2. As they examine the contents ask, "Is this a system?" Encourage students to share their reasoning and justify their answers. Prompt students to turn the items into a system. Remind students that a system is 2 or more parts that interact to form a whole and have a purpose. (Slide 8)	BI_Heaps vs. Systems Lesson Slides Teacher reference: From Byrdseed TV Introducing a Universal Theme: Systems   Materials: You will need two bags of objects per group. Bag #1, suggested items could include: popsicle stick, scissors, book and a bandaid Bag #2, suggested items could include: legos with lego wheels, paper airplane pieces, or any easy snap together toy

System vs Heap (Slide 9)
Discuss the differences between a heap vs system. Use the contents of both bags to highlight the differences. (Slide 8)

What are Systems? (Slide 10)
Watch the PBS video "What are Systems?" linked on slide 10. Encourage students to add more systems to their brainstorming list based on their new understandings.

PBS video (2:30 min)

Systems Test (Slide 11)
Students will select one of the systems from their brainstorm list and test that system against the System Test chart. Have students share their findings.

- Tell students these are the "rules" for making something a system. Remind students that with Rules there are consequences for breaking them. For example: removing your stomach from your body has consequences! It must be part of the system.

CI_Is it a System? Test

Generalizations (Slide 12)
Show students the generalizations for this year and take time to discuss each of the generalizations. Explain to students that every lesson we do this year will tie back to proving one or more of these statements.

Introduce Engineer Skill Station (Slides 13-14)
Tell students as engineers they will need to work together to solve a problem. Review expectations for the Engineer Station.

- What tools are available?
- Tour of Engineer supplies
- What does it look like?
  - All students working, using materials appropriately, working on a specific task, respecting others...
- What does it sound like?
  - Appropriate voice level, collaborating with others, encouraging comments only
- What does it feel like?
  - A bit of a challenge- that's okay! Trying things that might work or might not
- What means you were successful?
  - Focused the entire work time, improvements made to original idea (even if it was another "failed attempt")

Systems Engineer Challenge (Slide 15) Students will now work with a partner to practice skills in the Engineer Station using systems. Students will look at the materials in the Engineer station and brainstorm ways these items can be turned into a system. Remind students that they MUST keep in mind the rules of a system. ex: If we take 1 piece away and it does not change how it works, then it is not a system. • Students will choose 1 idea and use the materials to create that example of a system. Students will need to follow directions on their Systems Engineer Page and answer the reflection questions.	DI_Systems Engineer Challenge Pa...

Reflection/Metacognition (Slide 16)

1. Looking at the system you created in Engineer, what outside factors would most likely cause your system to fall apart?
2. How much change would there be in your system if pieces were put in a different place?
3. Which generalization statement does your system model prove and how?
4. Are there any other parts that could be added to your system that would improve it?