Earth Systems

https://www.space.com/54-earth-history-composition-and-atmosphere.html

Science of Systems
Grade Level: Intermediate

Strand: Earth Systems
Skill Focus: Depth & Complexity

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

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

Language of the Discipline

Earth science

oceanography

geology

meteorology

astronomy

hydrographer

underwater mapping

marine biologist

fulminologist

atmospheric scientist

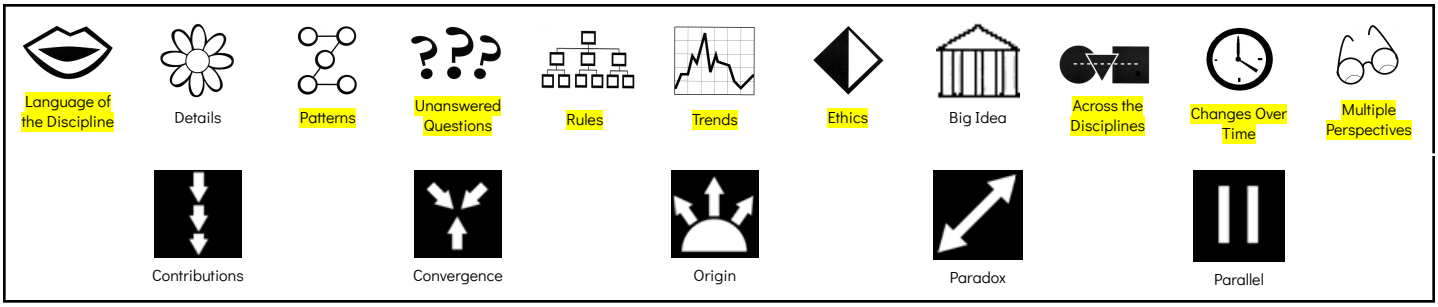
stellar astronomer

galactic astronomer

sedimentologist

paleontologist

Depth and Complexity & Content Imperatives



Thinking like a Disciplinarian

Thinking like an ***oceanographer*** (a scientist that deals with the physical and biological properties and phenomena of the sea).
Thinking like a ***geologist*** (a scientist that deals with the earth's physical structure and substance, its history, and the processes that act on it).
Thinking like a ***meteorologist*** (a scientist concerned with the processes and phenomena of the atmosphere, especially as a means of forecasting the weather).
Thinking like an ***astronomer*** (a scientist that deals with celestial objects, space, and the physical universe as a whole).
Thinking like a ***hydrographer*** (an oceanographer who surveys and charts bodies of water, such as seas, lakes, and rivers).
Thinking like a ***marine biologist (***a scientist who studies biological oceanography and the associated fields of chemical, physical, and geological to understand marine organisms).
Thinking like a ***fulminologist*** (a meteorologist who studies the causes of lightning and thunder and their after-effects).
Thinking like an ***atmospheric scientist*** (a meteorologist who studies tornadoes and has the technology to forecast and track tornado outbreaks).
Thinking like a ***stellar astronomer*** (an astronomer who studies the life cycle and structure of stars, both individuals and populations).
Thinking like a ***galactic astronomer*** (an astronomer who studies our Milky Way galaxy and all its contents).
Thinking like a ***sedimentologist*** (a geologist who examines certain rock types, but usually soil from a variety of areas).
Thinking like a ***paleontologist*** (a geologist who studies or is an expert in the branch of science concerned with fossil animals and plants).

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

3.7, 4.7. 5.7 (know that Earth consists of natural resources and its surface is constantly changing)
5.7A (explore the processes that led to the formation of sedimentary rocks and fossil fuels)
3.7B (investigate rapid changes in Earth's surface such as volcanic eruptions, earthquakes, and landslides
4.7B (observe and identify slow changes to Earth's surface caused by weathering, erosion, and deposition from water, wind, and ice)
5.7B (recognize how landforms such as deltas, canyons, and sand dunes are the result of changes to Earth's surface by wind, water, or ice)
3.8, 4.8, 5.8 (know that there are recognizable patterns in the natural world and among objects in the sky)
3.8A (observe, measure, record and compare day-to-day weather changes in different locations at the same time that include air temperature, wind direction and precipitation)
4.8A (measure, record, and predict changes in weather)
5.8A (differentiate between weather and climate)
3.8B (describe and illustrate the Sun as a star composed of gases that provides light and thermal energy)
3.8C (construct models that demonstrate the relationship of the Sun, Earth, and Moon, including orbits and positions)
4.8C (collect and analyze data to identify sequences and predict patterns of change in shadows, seasons, and the observable appearance of the Moon over time)
3.8D (identify the plants of Earth's solar system and their position in relation to the sun)

Social Studies

3.3A (describe similarities and differences in the physical environment, including climate, landforms, natural resources, and natural hazards)
3.4C (identify, create, and interpret maps of places that contain map elements)
3.13B, 5.22B (describe the impact of scientific breakthroughs and new technology)
4.20A, 5.24A (apply mapping elements, including grid systems, legend, symbols, scales, and compasses roses, to create and interpret maps)
3.16, 4.22, 5.26 (uses problem solving and decision making skills, working independently and with others)

RLA

3.1A, 4.1A, 5.1A (listen actively, ask relevant questions to clarify information, and make pertinent comments)
3.1C, 4.1C, 5.1C (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 (work collaboratively with others by following agreed-upon rules, norms, and protocols)
3.6E,4.6E, 5.6E (make connections to personal experiences, ideas in other texts, and society)
3.6F, 4.6F, 5.6F (make inferences and use evidence to support understanding)
3.7F, 4.7F, 5.7F (respond using newly acquired vocabulary as appropriate)

Math

3.1A, 4.1A, 5.1A (apply mathematics to problems arising in everyday life, society, and the workplace)
3.1B, 4.1B, 5.1B (use a problem-solving model that incorporates analyzing given information, formulating a plan or strategy, determining a solution, justifying the solution and evaluating the problem-solving process and the reasonableness of the solution)

# Instructional Plan	# Date:
Earth Systems (4 weeks)	
Objectives: Students will understand... • that the Earth is composed of many systems and is a part of many systems. • the different branches of Earth Science and how they form a system.	
Learning Experiences	**Resources/Materials**
Week 1 (Slide 2) **Skill Stations (Slide 3)** **Let's Get Curious (Slide 4)** Deep Diving in Underwater Meteorites Caves • What do you notice? • What do you wonder? **Scholarly Habits (Slide 5)** Discuss the Pondering Ideas scholarly habit (scholars think about what they're learning and know that quality thoughts take time to develop), Academic Humility (scholars have a thirst for knowledge and understand that there is always more to learn), AND Different Perspectives (scholars look beyond themselves and understand that we do not have to agree). Throughout the lesson, remind students to ponder ideas. **Toilet Paper Timeline (Slide 7-9)** Geological Time Scale (Slide 7) will give students an idea of the extent of geological time and the key events that happened mainly in the past 600 million years. • In an open area, roll out the 200 sheets of toilet paper, explain to students that this will represent all the time that the Earth has been around. One end is the moment the Earth was formed, and the other is right now. • Pass out labels and allow students to work together to determine where those events fall in Earth's timeline. Provide no other guidance (no scale, no years) • After students are finished, start at the beginning of the timeline and discuss their findings and provide clarity. Use the teacher key to put the labels at the	BI_Earth Systems Lesson Slides Byrdseed.tv Puzzlements (teacher reference) CI_Toilet Paper Timeline Materials Needed: 1 roll of toilet paper per class (200 sheets), printed time markers

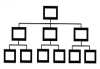
appropriate spot on the toilet paper. Allow time to discuss and share their thoughts.

Continue the Geological Time Scale discussion by viewing the Four Ways to Understand the Earth's Age clip (Slide 8). This video will help students make more connections to understand how old the Earth actually is.

Allow time for students to reflect (Slide 9) *Think back to the toilet paper timeline. What surprised you most about the history of the Earth?* Facilitate a class discussion.

Earth Science Introduction (Slides 10)
Introduce the topic of Earth Science. Earth science includes all fields of natural science related to the planet Earth. Explain that the Earth is composed of many systems AND is a part of many systems. For our purposes, we will separate Earth Science into 4 categories: geology, oceanography, meteorology, and astronomy.

Think Like a Disciplinarian (Slide 11-14)
Students will now brainstorm and think through each discipline. Beginning with Geology, ask students to make a list of all systems that geologists could study. Give about 3 minutes for students to silently brainstorm, and then lead a class discussion for students to add to their lists. Continue the same process with oceanography, meteorology, and astronomy.



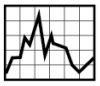
Earth Science Evidence (Slide 15)
Take students outside to look for evidence of Earth Science. They will collect one item (smaller than a hand) to bring inside for the next activity.

Components of Creativity Review (Slides 16-20)
Briefly review the four components of creativity, FFOE.

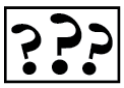
Christoph Nieman's Object Transformation (Slides 21-30)
Go through each of Christoph Nieman's object transformations. Discuss how Nieman demonstrated each of the four components of creativity with his creations.

Object Transformation (Slides 31-34)
Discuss the Transformation Rubric (Slide 31). If a student receives an excessive number of comments in the left

category, their score would fall in the Novice/Apprentice range. If they mostly met the targeted criteria, their score would fall in the Practitioner range. And if they achieved most of the targeted areas but also exceeded them in some ways, their score would fall in the Expert range. Students will now complete their own Object Transformation (Slide 32) with their evidence of Earth Science from slide 15. Remind students to purposely plan how they will incorporate each of the components of creativity. **Reflection (Slides 33-34)** Ask students to reflect on their learning. ● *Consider the components of creativity. Do you think creativity is a system? Why or why not?* After explaining the reflection question, display slide 34 for students to do a systems test of creativity and answer the reflection. Give students time to share and defend their position.	DI_Transformation Rubric
<u>Week 2 (Slide 36)</u> **Skill Stations (Slide 37)** **Let's Get Curious (Slide 38)** Laramie, WY Tornado Cam ● What do you notice? ● What do you wonder? **Scholarly Habits (Slide 39)** Discuss the Pondering Ideas scholarly habit (scholars think about what they're learning and know that quality thoughts take time to develop), Academic Humility (scholars have a thirst for knowledge and understand that there is always more to learn), AND Different Perspectives (scholars look beyond themselves and understand that we do not have to agree). Throughout the lesson, remind students to ponder ideas. **Introduce Earth Science Disciplinarian Stations (Slides 41-49)** There are eight stations for students to explore some of the disciplines of Earth Science. You may choose to do all or some, but should do at least 1 per discipline. These stations could be done in small groups OR as a whole group activity.	EI_Earth Science Disciplinarian Sta... Slides include detailed instructions for each station. Please make sure to familiarize yourself with each station before class.

 **Think Like a Hydrographer (Slide 42):** Create a map of the ocean floor. Reflection Question: How is hydrography related to other branches of science, social studies, math, and language arts?	Hydrographer Station Materials Needed: shoebox, clay, wooden skewers, graph paper
 **Think Like a Marine Biologist (Slide 43):** View Aquarium of the Pacific Livestreams. Reflection Question: What controversies exist regarding marine biology?	
 **Think Like a Fulminologist (Slide 44):** Make your own lightning. Reflection Question: Do you notice more strikes in the Northern or Southern Hemisphere? What does that tell you about lightning and thunderstorms?	Fulminologist Station Materials Needed: Styrofoam tray, masking tape, aluminum pie tin FI_Make Your Own Lightning
 **Think Like an Atmospheric Scientist (Slide 45):** Watch a TedEd video on tornadoes, and explore weather tools on the NOAA. Reflection Question: There is a specific pattern for tornado formation. Why is this pattern so valuable?	
 **Think Like a Stellar Astronomer (Slide 46):** Learn about and explore several constellations. Then create your own constellations. Reflection Question: How does the perspective about constellations of ancient people differ from our perspective today?	Stellar Astronomer Station Materials: constellation cards, flashlight, star stickers, chalk markers GI_Constellation Cards.pdf
 **Think Like a Galactic Astronomer (Slide 47):** Create and paint your own galaxy. Reflection Question: How has our understanding of galaxies changed over time?	Galactic Astronomer Station Materials: circle template, white acrylic paint, watercolors, paintbrush, coarse salt, watercolor paper HI_Galaxy Watercolor Template.pdf
 **Think Like a Sedimentologist (Slide 48):** Create eggshell geodes. Reflection Question: How might a geologist describe the details of geodes using language of the	Sedimentologist Station Materials: 4 egg shells, 1 ¾ cup Borax powder, 5 plastic cups, food coloring, hot plate or coffee

discipline?



Think Like a Paleontologist (Slide 49): Make fossils using coffee grounds. Reflection Question: What unanswered questions regarding fossils are necessary for us to gain a better understanding of Earth Science?

Week 3 (Slide 51)

Skill Stations (Slide 52)

Let's Get Curious (Slide 53)
Fiercest Ocean Predators

- What do you notice?
- What do you wonder?

Scholarly Habits (Slide 54)
Discuss the Pondering Ideas scholarly habit (scholars think about what they're learning and know that quality thoughts take time to develop), Academic Humility (scholars have a thirst for knowledge and understand that there is always more to learn), AND Different Perspectives (scholars look beyond themselves and understand that we do not have to agree). Throughout the lesson, remind students to ponder ideas.

Earth Science Disciplinarian Stations (55-56)
Continue stations.

Week 4 (Slide 58)

Skill Stations (Slide 59)

Let's Get Curious (Slide 60)
Gigapixels of Andromeda

- What do you notice?
- What do you wonder?

Scholarly Habits (Slide 61)
Discuss the Pondering Ideas scholarly habit (scholars think about what they're learning and know that quality thoughts take time to develop), Academic Humility (scholars have a thirst for knowledge and understand that there is always

maker/tea kettle
Incredible Egg Geode - Sick Science! #...

Paleontologist Station Materials: used coffee grounds, cold coffee, flour, salt, wax paper, mixing boil, items for impressions (seashells, leaves, dinosaur toys, etc)

more to learn), AND Different Perspectives (scholars look beyond themselves and understand that we do not have to agree). Throughout the lesson, remind students to ponder ideas. **Earth Science Disciplinarian Stations (Slides 62-63)** Continue stations. **Ask a Disciplinarian (Slides 64)** Students will work in a group to construct an email to one of the disciplinarians they've discussed. Students could ask any Unanswered Questions about their field. They should work to apply additional depth/complexity icons into their questions.	

Reflection/Metacognition
Reflection questions are embedded in the lesson, especially in the Think Like a Disciplinarian stations.

Extension
Have students research a real-life disciplinarian and have students write to that specific disciplinarian. The teacher can decide whether or not to send an email to the disciplinarian.