Kognity NGSS (High School): Detailed outline template

Links for your convenience:

- Writing Manual
- Author Brief

Guiding Questions/Tips:

- You are focusing on splitting the subtopic idea (provided by reviewers) into sections/subsections. Note that 5 section templates exist in this planning document. We anticipate roughly 1 section per "E". However, you may choose to break the content up differently. For a reminder of the Kognity structure, see p.4 in the Writing Manual.
- How will your Anchoring Phenomenon drive this learning journey?
    - What activities and questions will help students to meet the PEs?
    - Have you included sufficient opportunities for inquiry?
    - How will you progress through the 5Es?
- Is the content relevant to all students (diverse, engaging, inclusive)?
- Please indicate where you might bring in extra literacy support;
- **This is a plan only. No need to write out your ideas and exercises in full** – we ask authors to do this at manuscript-writing stage.
    - However, please give an idea of the kind of content (if you want to use third party content, such as a video or simulation, please include a link to the source) and activities you want to include. These ideas will be shared with the rest of the team, to stimulate feedback and discussion.
- For investigations/activities/simulations, please include a link to any inspiration or a brief description of the content you envisage.
- See the green italics for guidance/examples.

Subtopic plan: Basics

Topic and subtopic info	
Topic Name:	Nuclear Processes
Subtopic Name:	Evidence of Plate Tectonics
Link to topic plan:	
Brief explanation of how subtopic connects to the anchoring phenomenon	Do Earth's moon and other planets in our solar system show evidence of tectonics?
Running list of anticipated media requests: (art, interactives, videos, etc.) *Please keep a running list of required media for the art team.*	https://www.edumedia-sciences.com/en/curriculum/1395-1-develop-and-use-a-model-of-the-earth-sun-moon-system-to-describe-the-cyclic-patterns-of-lunar-phases-eclipses-of-the-sun-and-moon-and-seasons *https://www.edumedia-sciences.com/en/media/71-lunar-eclipse* *https://www.edumedia-sciences.com/en/media/216-sun-earth-moon* *https://www.edumedia-sciences.com/en/media/537-4-seasons-1* *https://www.edumedia-sciences.com/en/media/606-moon-phases* *https://scied.ucar.edu/learning-zone/earth-system/biogeochemical-cycles* *https://www.amnh.org/exhibitions/permanent/planet-earth/why-is-the-earth-habitable/earth-cycles* https://www.lpi.usra.edu/education/explore/shaping_the_planets/tectonism/ *https://www.nationalgeographic.org/media/plate-tectonics/*

	https://pnsn.org/outreach/about-earthquakes/plate-tectonics https://pubs.usgs.gov/gip/dynamic/understanding.html https://earthsky.org/space/plate-tectonics-not-needed-for-alien-life/ https://chem.libretexts.org/Courses/Valley_City_State_University/Chem_122/Chapter_9%3A_Nuclear_Chemistry/9.2%3A_Radioactive_Decay http://www.geo.mtu.edu/KeweenawGeoheritage/MiTEP_ESI-1/Radioactive.html https://www.livescience.com/15084-radioactive-decay-increases-earths-heat.html https://chem.libretexts.org/Courses/Furman_University/CHM101%3A_Chemistry_and_Global_Awareness_(Gordon)/05%3A_Basics_of_Nuclear_Science/5.07%3A_Calculating_Half-Life https://www.nist.gov/how-do-you-measure-it/how-do-you-measure-age-things https://www.science.org/content/article/no-star-no-problem-radioactivity-could-make-otherwise-frozen-planets-habitable https://www.space.com/54-earth-history-composition-and-atmosphere.html https://solarsystem.nasa.gov/planets/earth/in-depth/ https://www.nationalgeographic.org/encyclopedia/plate-tectonics/ https://www.livescience.com/46593-how-earth-formed-photo-timeline.html http://thebritishgeographer.weebly.com/plate-tectonic-theory.html https://earthobservatory.sg/faq-on-earth-sciences/why-seafloor-so-recent-and-continental-crust-s

	o-old *https://www.lpi.usra.edu/education/explore/shaping_the_planets/tectonism/* *https://www.space.com/27059-jupiter-moon-europa-plate-tectonics.html*

Section 1: Cyclic Patterns of Earth's Materials and Energy

Please begin each section with an **Introduction subsection** and end each section with a **Reflection subsection**. Feel free to include as many content subsections as you want in between. We recommend 4-5 subsections. Use the color coded guide on p. 5 of the writing manual to support your filling in of the sections.

Overview		
Standard(s) covered:	**HS-ESS1-5**	**Evidence of Plate Tectonics** Evaluate evidence of the past and current movements of continental and oceanic crust and the theory of plate tectonics to explain the ages of crustal rocks.
DCI(s) covered:	**PS1.C: Nuclear Processes** Nuclear processes, including fusion, fission, and radioactive decays of unstable nuclei, involve release or absorption of energy. The total number of neutrons plus protons does not change in any nuclear process. **ESS1.C: The History of Planet Earth** Continental rocks, which can be older than 4 billion years, are generally much older than the rocks of the ocean floor, which are less than 200 million years old. **ESS2.B: Plate Tectonics and Large-Scale System Interactions** Plate tectonics is the unifying theory that explains the past and current movements of the rocks at Earth's surface and provides a framework for understanding its geologic history.	

CCC(s) covered:	**Patterns -** Empirical evidence is needed to identify patterns	
SEP(s) covered:	**Engaging in Argument from Evidence -** Evaluate evidence behind currently accepted explanations or solutions to determine the merits of arguments.	
	Vocab words included: *Lunar phases* *Solar Eclipse* *Lunar Eclipse* *Plate Tectonics* *Water cycle* *Carbon cycle* *Nitrogen cycle* *Oxygen cycle*	Do Earth's moon and other planets in our solar system show evidence of tectonics?
Introduction subsection	*Engage*	
	The purpose of this subsection is to introduce the E and spark the students' curiosity. *Do Earth's moon and other planets in*	**Tie to previous work:** *Review middle school standards MS-ESS1 and MS-ESS2:* • *Describe the cyclic patterns of lunar phases, eclipses of the sun and moon, and seasons.*

	our solar system show evidence of tectonics? *Do cyclic patterns on Earth help explain plate tectonics?* **What instructions will be provided for teachers here (to be included in a separate part of the resource)?** *Sources for information on cyclic patterns of lunar phases, eclipses of the sun and moon, and seasons; cycling of Earth's materials and the flow of energy.*	• *Describe the cycling of Earth's materials and the flow of energy that drives this process.* *As a whole class recall what you know about the topics above.* **General Notes/Activities:** *Break into groups of two or three to compose at least 3 questions about the place of the Earth in the universe including Earth's cyclic patterns.* *Some of these questions could include:* • *Distinguish between a lunar eclipse and a solar eclipse.* • *Describe the alignments necessary for an eclipse to occur* • *Link the alternating seasons on Earth to the Earth's inclination on its orbit.* • *Understand the effect of Earth's inclination on the duration of daylight.* • *Display the Sun/Moon/Earth configuration for each phase of the moon.* • *Review and outline the processes in the four main cyclic patterns on Earth: the water cycle, the carbon cycle, the nitrogen cycle, and the oxygen cycle.* *The following are helpful websites for your research:* *https://www.edumedia-sciences.com/en/media/71-lunar-eclipse* *https://www.edumedia-sciences.com/en/media/216-sun-earth-moon* *https://www.edumedia-sciences.com/en/media/537-4-seasons-1* *https://www.edumedia-sciences.com/en/media/606-moon-phases* *https://scied.ucar.edu/learning-zone/earth-system/biogeochemical-cycles* *https://www.amnh.org/exhibitions/permanent/planet-earth/why-is-the-earth-habitable/earth-cycles* • *After composing your questions in groups, return as a whole class and combine your questions.* • *Use the questions to create a Jeopardy game that you will play as a whole class.*

Content subsection	*Explore*	
	What will the purpose of this section be? *Do Earth's moon and other planets in our solar system show evidence of tectonics?* *What evidence is needed to confirm plate tectonics on other planets?* **What instructions will be provided for teachers here (to be included in a separate part of the resource)?** *Sources of information on the presence of plate tectonics on other planets.*	**General Notes/Activities:** *Video: https://www.nationalgeographic.org/media/plate-tectonics/* • *Watch the video above. Take notes and record questions.* • *Share your questions with the rest of the class.* • *Discuss as a whole class.* *Break into groups of 2 or 3 and choose from among the Moon and other planets. Choose one to research.* • *Connect what you are learning to the driving question for the planet you chose to research:* Do Earth's moon and other planets in our solar system show evidence of tectonics? • *Can you find evidence of tectonic activity on Mars, Venus, and Mercury?* • *Can you find pictures as evidence of tectonic activity?* • *Share your research with the whole class.* *You will find more videos and textual information at this website:* *https://pnsn.org/outreach/about-earthquakes/plate-tectonics*
Content subsection	*Explain*	

<table>
<tr><td></td><td>What will the purpose of this section be?
Do Earth's moon and other planets in our solar system show evidence of tectonics?

What instructions will be provided for teachers here (to be included in a separate part of the resource)?
Sources of information on present-day ongoing plate tectonic activity on Earth.</td><td>General Notes/Activities:

After each group has presented their research to the whole class, break up into groups of 2 or 3 again.
• Develop a rubric for the research that you did on your planet.
• Evaluate the research of each team according to the rubric.
• Evaluate how each team followed the rubric and answered the questions they posed for themselves.

Use this website: https://pubs.usgs.gov/gip/dynamic/understanding.html to research how current plate and crustal movements on Earth can be measured using satellite-based methods.
• Discuss the advantages of this type of measurement.
• How can this type of measurement benefit scientists in predicting earthquakes and volcanoes?</td></tr>
<tr><td>Content subsection</td><td colspan="2">Elaborate</td></tr>
<tr><td></td><td>What will the purpose of this section be?
Do Earth's moon and other planets in our solar system show evidence of tectonics?

What instructions will be provided</td><td>General Notes/Activities:
What evidence can you find that supports your opinion of whether Earth's moon and other planets show evidence of tectonics.

Use this website which could present a different argument from other information you have gathered:
https://earthsky.org/space/plate-tectonics-not-needed-for-alien-life/</td></tr>
</table>

	for teachers here (to be included in a separate part of the resource)? *Sources of information on the presence of plate tectonics on other planets.*	*How does the information in this website compare with photos of other planets that seem to show evidence of tectonic activity?* *Divide into two debate teams to present two different opinions about tectonic activity on other planets.*
Reflection subsection	**Reflection and summary**	
	The purpose of this subsection is reflection and self-evaluation. **What instructions will be provided for teachers here (to be included in a separate part of the resource)?**	**Activity:** *The main activity will be an open-text entry box, where you can record your reflections (and will be able to submit them to your teacher).* *Questions for the students:* • *What have you learnt so far?* • *What questions do you have now?* • *What connections can you make between plate tectonics and the age of rocks on the Earth and beneath the ocean?*

Section 2: Nuclear Processes

Please begin each section with an **Introduction subsection** and end each section with a **Reflection subsection**. Feel free to include as many content subsections as you want in between. We recommend 4-5 subsections. Use the color coded guide on p. 5 of the writing manual to support your filling in of the sections.

Overview		
Standard(s)	**HS-ESS1-5**	**Evidence of Plate Tectonics** Evaluate evidence of the past and current movements of continental and oceanic

covered:		crust and the theory of plate tectonics to explain the ages of crustal rocks.
DCI(s) covered:	**PS1.C: Nuclear Processes** Nuclear processes, including fusion, fission, and radioactive decays of unstable nuclei, involve release or absorption of energy. The total number of neutrons plus protons does not change in any nuclear process. **ESS1.C: The History of Planet Earth** Continental rocks, which can be older than 4 billion years, are generally much older than the rocks of the ocean floor, which are less than 200 million years old. **ESS2.B: Plate Tectonics and Large-Scale System Interactions** Plate tectonics is the unifying theory that explains the past and current movements of the rocks at Earth's surface and provides a framework for understanding its geologic history.	
CCC(s) covered:	**Patterns - 1** Empirical evidence is needed to identify patterns	
SEP(s) covered:	**Engaging in Argument from Evidence - 7** Evaluate evidence behind currently accepted explanations or solutions to determine the merits of arguments.	
	Vocab words included: *Fusion* *Fission* *Decay* *Radiometric Dating* *Half-life* *Carbon-14*	**Driving question(s):** Do Earth's moon and other planets in our solar system show evidence of tectonics?
Introduction subsection	*Engage*	
	The purpose of this subsection is to	**Tie to previous work:**

	introduce the E and spark the students' curiosity. *Do Earth's moon and other planets in our solar system show evidence of tectonics?* **What instructions will be provided for teachers here (to be included in a separate part of the resource)?** *Sources of information on how nuclear processes are used to determine the age of elements on Earth.* *Sources of information on how nuclear processes give off heat.*	*In the previous lesson, you learned about fission, fusion and radioactive decay. As a whole class recall the definitions of these concepts including the three types of radioactive decay.* **General Notes/Activities:** *Video:* *https://chem.libretexts.org/Courses/Valley_City_State_University/Chem_122/Chapter_9%3A_Nuclear_Chemistry/9.2%3A_Radioactive_Decay* *Scroll down through this website until you find the video on how to make a cloud chamber.* *The purpose of this cool experiment is to indirectly view radioactive decay.* *In groups of 2 or 3, use the websites below and any others you can find to help answer this question:* *How are nuclear processes related to plate tectonics?* *http://www.geo.mtu.edu/KeweenawGeoheritage/MiTEP_ESI-1/Radioactive.html* *https://www.livescience.com/15084-radioactive-decay-increases-earths-heat.html*
Content subsection	*Explore*	

	What will the purpose of this section be? *Do Earth's moon and other planets in our solar system show evidence of tectonics?* **What instructions will be provided for teachers here (to be included in a separate part of the resource)?** *Sources of information on radiometric dating.*	**General Notes/Activities:** *Video on "How Does Radiocarbon Dating Work? Scroll down through the website below to the video above.* *https://chem.libretexts.org/Courses/Furman_University/CHM101%3A_Chemistry_and_Global_Awareness_(Gordon)/05%3A_Basics_of_Nuclear_Science/5.07%3A_Calculating_Half-Life* *Scientists use the radiometric dating of uranium and other radioactive elements to determine the age of landforms on the Earth and in the oceans of the Earth. How do nuclear processes function in determining the age of an object?* *Research how radiometric dating works:* • *Why is an element radioactive?* • *What happens to carbon-14 when it undergoes radioactive decay?* • *As carbon-14 decays, what atom does it turn into?* • *What is the half-life of carbon-14 and how does that help determine the age of objects on Earth and objects from space?* *A helpful website:* *https://www.nist.gov/how-do-you-measure-it/how-do-you-measure-age-things* *Create a google slide presentation of your answers.* • *You may illustrate your answers above with graphics and text.* • *Share your presentations with the rest of your class.*
Content subsection	*Explain*	

	What will the purpose of this section be? *Do Earth's moon and other planets in our solar system show evidence of tectonics?* **What instructions will be provided for teachers here (to be included in a separate part of the resource)?** *Sources of information on whether radioactive decay is a universal phenomenon.*	**General Notes/Activities:** *Returning to the driving question: Do Earth's moon and other planets in our solar system show evidence of tectonics?* *In groups of 2 or 3 students research:* • *Does radioactive decay occur on planets other than Earth?* • *You can use this website and others to help answer your question: https://www.science.org/content/article/no-star-no-problem-radioactivity-could-make-otherwise-frozen-planets-habitable* • *What evidence can you present that radioactive decay occurs on planets other than Earth?* • *Is there evidence of plate tectonics on other planets?* • *Share your findings with the rest of the class.*
Content subsection	*Elaborate*	
	What will the purpose of this section be? Do Earth's moon and other planets in our solar system show evidence of tectonics? **What instructions will be provided for teachers here (to be included in a separate part of the resource)?** *Sources of information on whether radiometric dating can be used on other planets.*	**General Notes/Activities:** Reflect on how to answer our driving question: *Do Earth's moon and other planets in our solar system show evidence of tectonics?* • *Is radiometric dating possible on other planets or the Moon?* • *What is required in order to use radiometric dating to discover the age of objects on other planets?* • *For example, is the half-life of carbon-14 the same on other planets as it is on Earth?* • *Can you identify any empirical evidence in support of your answer?* *Share your thoughts and reflections with the class as a whole.*

Reflection subsection	Reflection and summary	
	The purpose of this subsection is reflection and self-evaluation. **What instructions will be provided for teachers here (to be included in a separate part of the resource)?**	**Activity:** *Record your reflections in the open-text entry box and submit them to your teacher.* *Questions:* • *What have you learnt so far?* • *What questions do you have now?* • *Can you make connections between radioactivity, heat, and plate tectonics?* • *Can you apply the connections to Earth's landforms?* • *Can you identify evidence of plate tectonics on other planets?*

Section 3: The History of our Home Planet Earth

Please begin each section with an **Introduction subsection** and end each section with a **Reflection subsection**. Feel free to include as many content subsections as you want in between. We recommend 4-5 subsections. Use the color coded guide on p. 5 of the writing manual to support your filling in of the sections.

Overview		
Standard(s) covered:	**HS-ESS1-5**	**Evidence of Plate Tectonics** Evaluate evidence of the past and current movements of continental and oceanic crust and the theory of plate tectonics to explain the ages of crustal rocks.
DCI(s) covered:	**PS1.C: Nuclear Processes** Nuclear processes, including fusion, fission, and radioactive decays of unstable nuclei, involve release or absorption of energy. The total number of neutrons plus protons does not change in any nuclear process. **ESS1.C: The History of Planet Earth**	

	Continental rocks, which can be older than 4 billion years, are generally much older than the rocks of the ocean floor, which are less than 200 million years old. **ESS2.B: Plate Tectonics and Large-Scale System Interactions** Plate tectonics is the unifying theory that explains the past and current movements of the rocks at Earth's surface and provides a framework for understanding its geologic history.	
CCC(s) covered:	**Patterns - 1** Empirical evidence is needed to identify patterns	
SEP(s) covered:	**Engaging in Argument from Evidence - 7** Evaluate evidence behind currently accepted explanations or solutions to determine the merits of arguments.	
	Vocab words included: *Solar nebulae* *Continental Crust* *Oceanic Crust* *Crustal Rocks* *Subduction Zone* *Lithosphere* *Asthenosphere* *Mantle* *Divergent Boundary* *Mid Ocean Ridge* *Convergent Boundary* *Transform Boundary* *Empirical evidence*	**Driving question(s):** *Do Earth's moon and other planets in our solar system show evidence of tectonics?*
Introduction subsection	*Engage*	

	The purpose of this subsection is to introduce the E and spark the students' curiosity. Do Earth's moon and other planets in our solar system show evidence of tectonics? **What instructions will be provided for teachers here (to be included in a separate part of the resource)?** *Sources of information on plate tectonics, sources of heat, and radioactive decay.*	**Tie to previous work:** *You are gathering information on the relationship among radioactive decay, heat, and plate tectonics. As a whole class discuss what you are learning about this relationship.* **General Notes/Activities:** *Think about what you know so far.* • *Can plate tectonics occur without heat?* • *Does radioactive decay produce heat?* • *Are there other sources of heat on Earth?*
Content subsection	*Explore*	
	What will the purpose of this section be? *Do Earth's moon and other planets in our solar system show evidence of tectonics?* **What instructions will be provided for teachers here (to be included in a separate part of the resource)?** *Sources of information on the origins of planet Earth.*	**General Notes/Activities:** In answer to the questions above, you will expand your knowledge by learning more about the history of the origins of our planet Earth. Use the websites below and any others to answer the questions below. *https://www.space.com/54-earth-history-composition-and-atmosphere.html* *https://solarsystem.nasa.gov/planets/earth/in-depth/* • *When and how did the Earth form?* • *Is it possible that all the planets in the solar system are composed of the same materials?* • *Is Earth's atmosphere similar in its composition to the atmosphere of other planets in our solar system?* • *Are the materials of which the Earth's moon is composed the same as those of the*

		Earth? • *Do the other terrestrial planets, have a central core, a rocky mantle, and a solid crust like Earth?* • *Describe why the upper mantle of the Earth is constantly moving.*
Content subsection	*Explain*	
	What will the purpose of this section be? Do Earth's moon and other planets in our solar system show evidence of tectonics? **What instructions will be provided for teachers here (to be included in a separate part of the resource)?** *Sources of information on the specifics of plate tectonics including boundaries, zones, volcanoes, and earthquakes.*	**General Notes/Activities:** *Video:* *https://www.nationalgeographic.org/encyclopedia/plate-tectonics/* • *What occurs at divergent plate boundaries?* • *What is the mid ocean ridge?* • *Is there empirical evidence anywhere on Earth of the mid-ocean ridge?* • *What is a convergent plate boundary?* • *What is a subduction zone?* • *How was the Himalayan Mountain range formed?* • *Is there empirical evidence of the mid-ocean ridge on the island of Cyprus?* • *How are plate tectonics responsible for volcanoes and earthquakes?*
Content subsection	*Elaborate*	

	What will the purpose of this section be? Do Earth's moon and other planets in our solar system show evidence of tectonics? **What instructions will be provided for teachers here (to be included in a separate part of the resource)?** *Sources of information on the origins of Earth's moon.*	**General Notes/Activities:** *https://www.livescience.com/46593-how-earth-formed-photo-timeline.html* *The website above presents more information about the early history of our planet Earth. As you read about the theory of the formation of Earth's moon:* • *Does the theory support the idea that the composition of both celestial bodies are related?* • *Can you make assumptions about the existence of plate tectonics on the moon?* • *How is the moon different from Earth?* • *How is the moon similar to Earth?*
Reflection subsection	**Reflection and summary**	
	The purpose of this subsection is reflection and self-evaluation. **What instructions will be provided for teachers here (to be included in a separate part of the resource)?**	**Activity:** *You can record your reflections in the open-text entry box that you can submit to your teacher.* *Questions for the students:* • *Do you understand the theory of plate tectonics?* • *Do you understand how radioactive decay plays a part in plate tectonics?* • *Do you think plate tectonics exist on other planets in our solar system? If so, why?*

Section 4: Plate Tectonics and the Ages of Crustal Rock

Please begin each section with an **Introduction subsection** and end each section with a **Reflection subsection**. Feel free to include as many content subsections as you want in between. We recommend 4-5 subsections. Use the color coded guide on p. 5 of the writing manual to support your filling in of the sections.

Overview		
Standard(s) covered:	**HS-ESS1-5**	**Evidence of Plate Tectonics** Evaluate evidence of the past and current movements of continental and oceanic crust and the theory of plate tectonics to explain the ages of crustal rocks.
DCI(s) covered:	**PS1.C: Nuclear Processes** Nuclear processes, including fusion, fission, and radioactive decays of unstable nuclei, involve release or absorption of energy. The total number of neutrons plus protons does not change in any nuclear process. **ESS1.C: The History of Planet Earth** Continental rocks, which can be older than 4 billion years, are generally much older than the rocks of the ocean floor, which are less than 200 million years old. **ESS2.B: Plate Tectonics and Large-Scale System Interactions** Plate tectonics is the unifying theory that explains the past and current movements of the rocks at Earth's surface and provides a framework for understanding its geologic history.	
CCC(s) covered:	**Patterns - 1** Empirical evidence is needed to identify patterns	
SEP(s) covered:	**Engaging in Argument from Evidence - 7** Evaluate evidence behind currently accepted explanations or solutions to determine the merits of arguments.	
	Vocab words included: *Pangea* *Continental Drift* *Convection* *Thermal vent*	**Driving question(s):** *Do Earth's moon and other planets in our solar system show evidence of tectonics?*
Introduction	*Engage*	

<table>
<tr><td>subsection</td><td colspan="2"></td></tr>
<tr><td></td><td>The purpose of this subsection is to introduce the E and spark the students' curiosity.
Do Earth's moon and other planets in our solar system show evidence of tectonics?

What instructions will be provided for teachers here (to be included in a separate part of the resource)?
Sources of information on Pangea, Alfred Wegener, the theory of Continental Drift</td><td>Tie to previous work:
You have reviewed and gained information about the cyclic patterns on Earth, the nuclear processes of atoms, and the theory of plate tectonics. As you synthesize this information, can you make connections about how the theory of plate tectonics explains the ages of crustal rocks on Earth and on the ocean floor.
General Notes/Activities:
Website:
http://thebritishgeographer.weebly.com/plate-tectonic-theory.html
Scroll down until you reach the video "Continental Drift."

This video explains the theory held by a scientist, Alfred Wegener, about continental drift. Wegener's theory included the idea that the seven continents that exist on Earth today were originally one gigantic supercontinent called Pangea.

As you watch this video, answer questions:
• What caused Pangea to break apart?
• What is the underlying phenomenon that accounts for continental drift?
• How is continental drift related to plate tectonics?
• Is the phenomenon that accounts for continental drift and plate tectonics a phenomenon that you can witness elsewhere on Earth?</td></tr>
<tr><td>Content subsection</td><td colspan="2">Explore</td></tr>
<tr><td></td><td>What will the purpose of this section be?
Do Earth's moon and other planets in</td><td>General Notes/Activities:
Website:
http://thebritishgeographer.weebly.com/plate-tectonic-theory.html</td></tr>
</table>

	our solar system show evidence of tectonics? **What instructions will be provided for teachers here (to be included in a separate part of the resource)?** *Sources of information on the model of the Earth's core.*	*Return to this website and scroll down to the video:* *"A Massive Model of the Earth's Core."* *As you watch this video, be aware:* ● *Scientists often develop models to help them study phenomena that are difficult or impossible to research in reality.* ● *How has the model of the Earth's core informed scientists?* ○ *What is this model made of?* ○ *Is it an accurate model of the phenomena that occur in the Earth's core?* ○ *What are the advantages of using the model to understand the phenomena in the Earth's core?* ● *What conclusions do the scientists make about the fluctuating magnetic field on Earth?* ● *What conclusions do the scientists make about the nature of the activity in Earth's core?*
Content subsection	*Explain*	
	What will the purpose of this section be? Do Earth's moon and other planets in our solar system show evidence of tectonics?	**General Notes/Activities:** *Recall what you know about heat and convection currents.* ● *How does convection explain plate tectonics?* ● *What is the source of heat that supplies convection currents?* ● *In addition to the heat of the inner core of Earth, what else contributes to the production of heat?*

	What instructions will be provided for teachers here (to be included in a separate part of the resource)? *Sources of information on the model of the Earth's core.*	
Content subsection	*Elaborate*	
	What will the purpose of this section be? Do Earth's moon and other planets in our solar system show evidence of tectonics? **What instructions will be provided for teachers here (to be included in a separate part of the resource)?** *Sources of information on the ages of Earth's rocks and thermal vents.*	**General Notes/Activities:** *Use the website:* **https://earthobservatory.sg/faq-on-earth-sciences/why-seafloor-so-recent-and-continental-crust-so-old** *to answer some questions about the ages of crustal rock.* • *Why are the crustal rocks on the surface of the Earth older than the crustal rocks on the ocean floor?* • *Where are the oldest continental rocks found and why are they found there?* • *Where is the oldest part of the seafloor located and why is it located there?* • *What are hydrothermal vents and where are they found?*
Reflection subsection	**Reflection and summary**	
	The purpose of this subsection is reflection and self-evaluation. **What instructions will be provided for teachers here (to be included in a**	**Activity:** *Record your reflections in an open-text entry box that you can submit to your teacher.* *Questions for the students:* • *What have you learnt so far?* • *What specific questions do you have now about the cyclic patterns on Earth, how*

	separate part of the resource)?	*nuclear processes affect plate tectonics, the formation of Earth and other celestial bodies, and the ages of crustal rocks?* • *What connections can you make between what you have learned so far and our driving question:*

Section 5: Plate Tectonics, a Universal Phenomenon?

Please begin each section with an **Introduction subsection** and end each section with a **Reflection subsection**. Feel free to include as many content subsections as you want in between. We recommend 4-5 subsections. Use the color coded guide on p. 5 of the writing manual to support your filling in of the sections.

Overview		
Standard(s) covered:	**HS-ESS1-5**	**Evidence of Plate Tectonics** Evaluate evidence of the past and current movements of continental and oceanic crust and the theory of plate tectonics to explain the ages of crustal rocks.
DCI(s) covered:	**PS1.C: Nuclear Processes** Nuclear processes, including fusion, fission, and radioactive decays of unstable nuclei, involve release or absorption of energy. The total number of neutrons plus protons does not change in any nuclear process. **ESS1.C: The History of Planet Earth** Continental rocks, which can be older than 4 billion years, are generally much older than the rocks of the ocean floor, which are less than 200 million years old. **ESS2.B: Plate Tectonics and Large-Scale System Interactions** Plate tectonics is the unifying theory that explains the past and current movements of the rocks at Earth's surface and provides a framework for understanding its geologic history.	
CCC(s) covered:	**Patterns - 1**	

	Empirical evidence is needed to identify patterns	
SEP(s) covered:	**Engaging in Argument from Evidence - 7** Evaluate evidence behind currently accepted explanations or solutions to determine the merits of arguments.	
	Vocab words included: *Venus* *Mars* *Jupiter* *Europa*	**Driving question(s):** *Do Earth's moon and other planets in our solar system show evidence of tectonics?*
Introduction subsection	*Engage*	
	The purpose of this subsection is to introduce the E and spark the students' curiosity. Do Earth's moon and other planets in our solar system show evidence of tectonics? **What instructions will be provided for teachers here (to be included in a separate part of the resource)?** *Sources of information of plate tectonic activity on planets other than Earth.*	**Tie to previous work:** *You have incorporated much information into understanding the phenomenon of plate tectonics. This information can help you hypothesize an answer to the driving question: Do Earth's moon and other planets in our solar system show evidence of tectonics?* • *Is an hypothesis valid if there is no empirical evidence to support it?* • *Is an hypothesis valid if there is not enough empirical evidence to support it?* **General Notes/Activities:** *Reexamine the photos you found of the surfaces of planets. Given what you are learning:* • *Discuss whether these pictures are conclusive proof of tectonic activity on the planets. Why or why not?*
Content	*Explore*	

subsection		
	What will the purpose of this section be? Do Earth's moon and other planets in our solar system show evidence of tectonics? **What instructions will be provided for teachers here (to be included in a separate part of the resource)?** *Sources of information on the composition and ages of planets other than Earth.*	**General Notes/Activities:** **Using the Website:** *Visit the website:* *https://www.lpi.usra.edu/education/explore/shaping_the_planets/tectonism/* *Answer questions that you find in the website above:* • *Do Venus and Mars have hot interiors?* • *Do Mars and Earth's moon have hot interiors?* • *Do these planets show evidence of deformation on their surfaces?* • *Is this deformation conclusive proof of current tectonic activity? Why or why not?* • *What is an important characteristic of tectonic activity on a planet?*
Content subsection	*Explain*	
	What will the purpose of this section be? Do Earth's moon and other planets in our solar system show evidence of tectonics? **What instructions will be provided for teachers here (to be included in a separate part of the resource)?**	**General Notes/Activities:** *Visit the website:* *https://www.space.com/27059-jupiter-moon-europa-plate-tectonics.html* *Answer questions about this video:* • *Where is Europa? How is it related to Jupiter?* • *Does Europa show signs of deformation on its surface?* • *What features of Europa support the activity of plate tectonics on the planet?* • *How does the pull of Jupiter's gravity on Europa contribute to the possibility of*

	Sources of information on the planet Europa.	*plate tectonic activity on the planet?*
Content subsection	*Elaborate*	
	What will the purpose of this section be? Do Earth's moon and other planets in our solar system show evidence of tectonics? **What instructions will be provided for teachers here (to be included in a separate part of the resource)?** *Sources of information on the planet Europa.*	**General Notes/Activities:** *You now have information about whether Europa has active plate tectonics.* *Divide into two debate teams with one team supporting plate tectonic activity on Europa and one team not supporting it.* • *Each team must present convincing arguments why or why not there is tectonism occurring on Europa.* • *Continue to hypothesize whether there might be life on Europa. Why or why not?*
Reflection subsection	**Reflection and summary**	
	The purpose of this subsection is reflection and self-evaluation. **What instructions will be provided for teachers here (to be included in a separate part of the resource)?**	**Activity:** *Record your reflections on what you have learned. Give your reflections to your teacher.* *Questions for the students:* • *Can you offer an answer to the driving question: Do Earth's moon and other planets in our solar system show evidence of tectonics?* • *In light of what you know about the origin of Earth and other celestial bodies, does your answer to the driving question make sense.*

		• *Can you give reasons why Europa might have current tectonic activity but not Mars, Venus, or Earth's Moon?*

2-3 Additional Investigation ideas	**These will be ideas for further investigations – to be added to the 'Practice center' part of the book. They should relate to the Anchoring Phenomenon and provide students with further opportunities to research/explore the ideas.**	
	Leave for now	*Leave for now*
10 Strength questions	**These will be Multiple choice/fill-in-the-blank/short text interactive questions to help test comprehension and knowledge in relation to the Anchoring Phenomenon content.**	
	Leave for now	*Leave for now*