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| **Lesson Planning Guide** |
| **Develop Lesson Plans for Instruction** |
| Steps in developing [NGSS](https://www.nextgenscience.org/)-/standards-aligned, phenomenon-based lessons that are guided by the [5Es instructional model](https://bscs.org/bscs-5e-instructional-model):   1. Complete the Lesson Plan Overview (Part A) to guide development of lesson plans. 2. Use the Lesson Plan Template (Part B) to create detailed lesson plans. |

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| https://lh4.googleusercontent.com/3nF12fEN5h5hgtv4ZofuvibTcwtHVJ_NWtFhMVgHDmo2KU1R-JQY3ndc2Eo8Bc9pXdnqo8Erfx-JMqcT-KaHxMnFOfqsxBUKLF28abqNdDstymCGzJ6SlLhYSu-KzuetFn1Mts6_yLg | **Lesson Overview Template (Part A)** | | |
| **1.a Select grade level NGSS** [**Performance Expectations**](https://www.nextgenscience.org/search-standards?keys=&type%5B%5D=performance_expectation) **(PEs) or** [**Topics**](https://ngss.nsta.org/AccessStandardsByTopic.aspx)**, or district/state standards that support lesson-based student learning goals.**  For NGSS, PE color coding reflects its 3-dimensional learning components. Search the [Evidence Statements](https://www.nextgenscience.org/evidence-statements) for details on what students should know and do. | | | |
| GEO.ESS2.1 - Analyze surface features of Earth in order to identify geologic processes (including weathering, erosion, deposition, and glaciation) that are likely to have been responsible for their formation. | | | |
| **1.b Identify a lesson-based** [**anchoring phenomenon**](https://static1.squarespace.com/static/56ef1da37da24f301fccaacd/t/5aa86e09652dea04982ceb94/1520987659683/NGSS+StorylineTool%231-AnchoringPhenomenon+-+v2.2.pdf) **that builds towards understanding of the PEs/standards, and is engaging and relevant to students.**  See more about [phenomena](https://www.ngssphenomena.com/) and using [phenomena with NGSS](https://static1.squarespace.com/static/56ef1da37da24f301fccaacd/t/581f4bb3e58c62bd0983dd03/1478446005130/Using+Phenomena+in+NGSS.pdf). | | | |
| Students will watch a 1:30 long YouTube video showing beautiful photos of several landscapes which were created by weathering and erosion including rivers, valleys, caves, frost wedging, etc. Ask, “How were these formations created? What processes were involved?” <https://www.youtube.com/watch?v=yA1Wmc_KtSs> | | | |
| **1.c Ask a Driving Question, which is authentic and student-focused, that relates to investigating the PEs/standards and phenomenon.**  See more about [Driving Questions](http://www.authenticeducation.org/ae_bigideas/article.lasso?artid=53) and using [Driving Questions with NGSS](http://nstacommunities.org/blog/2013/08/01/essential-questions/). | | | |
| How do the processes of weathering, erosion, and deposition lead to unique geologic formations? | | | |
| **1.d Unpack the** [**3-D learning components**](https://www.nextgenscience.org/three-dimensions) **of the Performance Expectations/standards in the table below.**  For NGSS guidance, see the [NGSS Topic Arrangements](https://ngss.nsta.org/AccessStandardsByTopic.aspx) and [NGSS DCI Arrangements](https://ngss.nsta.org/AccessStandardsByDCI.aspx). Use tools to [unpack](https://ngss.nsta.org/ngss-tools.aspx) each PE separately. | | | |
| [**Science and Engineering Practices**](https://www.nextgenscience.org/sites/default/files/resource/files/Appendix%20F%20%20Science%20and%20Engineering%20Practices%20in%20the%20NGSS%20-%20FINAL%20060513.pdf) **(SEP)**  **(skills)** | | [**Disciplinary Core Ideas**](https://www.nextgenscience.org/sites/default/files/resource/files/AppendixE-ProgressionswithinNGSS-061617.pdf) **(DCI)**  **(content)** | [**Crosscutting Concepts**](https://www.nextgenscience.org/sites/default/files/resource/files/Appendix%20G%20-%20Crosscutting%20Concepts%20FINAL%20edited%204.10.13.pdf) **(CCC)**  **(connections)** |
| Analyze surface features of the Earth in order to draw comparisons to various landforms created by weathering and erosion | | Geologic processes including weathering, erosion, deposition, and glaciation help to shape the land as these process break parent rock into sediments and smaller particles, transport them, and then deposit them into a new place. | Processes likely responsible for their formation. Cause and effect relationship between geologic processes responsible for various landform formation |
| 1.e Determine students’ prior knowledge about the lesson concepts. (e.g., pre-test, class discussion, exit ticket, 1-minute report, KWL chart, survey, etc.) | | | |
| Vocabulary Quiz including the words: mechanical weathering, chemical weathering, transportation, erosion, deposition, glaciation, sediment, mineral, landform, strata. | | | |
| **1.f Identify Lesson Topics and Learning Goals:** List main lesson concepts related to grade level PEs/standards that support student learning goals in figuring out the anchoring phenomenon; revise as needed. | | | |
| Students will be able to:   * Describe the process of weathering, erosion, and deposition. * Determine the depositional environment of sediment based on degree of roundness and degree of sorting. * Describe the connection between weathering and erosion with geologic landforms. | | | |
| **1.g Select Lesson Resources:** Identify resources to develop lessons that address the PEs/standards and investigate the anchoring phenomenon through a variety of sequenced activities; revise as needed (include title and URL). | | | |
| Resources:  YouTube anchoring video - <https://www.youtube.com/watch?v=yA1Wmc_KtSs>  The Science of Sand website - <https://www.scienceofsand2.info/> | | | |

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|  | **Lesson Plan Template (Part B)** | | | | | |
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| **Grade and Subject** | 11th/12th grade Geology | | | | **Instructional Time**  (min.) | 4\*90 min classes |
| **Lesson Title (Topic)** | Geologic Landforms Project | | | | | |
| **Anchoring Phenomenon**  (copy from 1.b) | <https://www.youtube.com/watch?v=yA1Wmc_KtSs> | | | | | |
| **Driving Question**  (copy from 1.c) | How do the processes of weathering, erosion, and deposition lead to unique geologic formations? | | | | | |
| **Lesson Overview** | | | | | | |
| **Lesson Summary**  (description) | | | **Lesson Topics and Student Learning Goals**  (copy from 1.f) | | | |
| Day 1: Students will begin by taking a vocabulary quiz over the 10 words which were preassigned. Students will then watch an anchoring video depicting several unique geologic formations. The class will then join in discussion on how they believe those landforms appeared. The teacher will then introduce the geologic landforms project, placing the students in groups of 3 and allowing them to choose their group role. The teacher will randomly select which group receives which geologic location. Students will use the remainder of the class period to begin their research.  Day 2: Students will continue working with their group and assimilating their research into Google Slides. Students will receive feedback on their progress from their teacher. Students will complete their project and prepare for presenting the next day.  Day 3: Students will present their projects  Day 4: Students will jigsaw and complete Venn diagrams on two separate sand samples, comparing and contrasting their sands. Students will then have independent writing time to complete the 4 essay questions. | | | Students will be able to:   * Describe the process of weathering, erosion, and deposition. * Determine the depositional environment of sediment based on degree of roundness and degree of sorting. * Describe the connection between weathering and erosion with geologic landforms. | | | |
| **Lesson Resources Aligned with Standards** | | | | | | |
| **Lesson Resource**  (copy from 1.g, sequenced with titles and links) | | | **Resource Standards Alignment**  (copy from 1.d, standards notated, link optional) | | | |
| YouTube Anchoring Video - <https://www.youtube.com/watch?v=yA1Wmc_KtSs> | | | ESS2.A: Earth Materials and Systems | | | |
| The Science of Sand - <https://www.scienceofsand2.info/> | | | ESS2.B: Plate Tectonics andLarge Scale  System Interactions | | | |
|  | | | ESS2.C: The Role of Water in Earth’s Surface  Processes | | | |
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| **Teacher Preparation** | | | | | | |
| **Student Misconceptions**  (potential student ideas that are problematic when engaging in the lesson) | | | **Scientific Terminology**  (vocabulary named once students “figure out” concepts of lesson) | | | |
| Students often confuse weathering (physical or chemical breakdown of rock) with erosion (transportation of sediments).  Students often don’t view rocks as being worn down through weathering and erosion, but as static, unchanging landforms. | | | Weathering; erosion; sedimentation; deposition; strata; glaciation | | | |
| **Materials Preparation** | | | | | | |
| **Student Needs**  (activity sheets, data packet, etc.) | | **Group Needs**  (lab equipment, group data packets, etc.) | | **Safety & Technology Needs**  (unsafe materials, websites cued, etc.) | | |
| Chromebook, project instruction and rubric handout, vocabulary quiz handout | | Laminated geologic landform and sand sample card. | | Chromebooks and internet needed in order to complete online research. | | |
| **Supporting Information** | | | | | | |
| **References**  (links to cite sources of data, images, websites, etc.) | | | **Background Reading**  (for teachers and/or students) | | | |
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| **Complete the 5E Instructional Model section(s) that are relevant to the lesson:** |

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| **Engage: *Interest in a concept is generated and students’ current understanding is assessed.***  ACTIVATE interest: Introduce anchoring phenomenon and driving question. |
| * Engages students in the concepts through a short activity or relevant discussion * Connects students’ past and present experiences * Creates interest and generates curiosity * Uncovers students’ current knowledge and misconceptions * Initiates students’ investigation into the anchoring phenomenon based on an observation, problem, or question |
| **Phenomenon-based Driving Questions** (questions students are likely to ask about the lesson topic) |
| How did the Grand Canyon get so deep? How does something like the Arch in Arches National Park grow a hole in it? Are some of these landforms man made? Where does all the rock go? |
| **Lesson Activities** (experiment, demonstration, video, visualization, reading, etc., coherently sequenced to help build understanding of PE/standard)  For each activity, provide details of the procedure including timing, teacher guidance, student prompts, strategies for discussions and differentiation, etc. |
| YouTube Video: <https://www.youtube.com/watch?v=yA1Wmc_KtSs>  Students will watch a video showing some unique geologic structures created by weathering and erosion. Students will then engage in class discussion led by questions from the teacher such as, “How did those landform get there?” “Where those landforms always there?” “What is strong enough to wear down a mountain?” |
| **Formative Assessment** (activity sheet, Venn diagram, summary, exit ticket, think-pair-share, etc. to check for understanding of lesson concepts) |
| Think-pair-share when pausing on specific landforms to see what the students summarize as the reason behind its formation. |
| **Consensus Discussion** (claims, evidence, and reasoning on what students figured out in this lesson) |
| Weathering and erosion is what is responsible for forming many unique geologic structures.  Weathering and erosion take broken pieces of rock and transport them to other places.  Landforms are created over time as rock exposed to the elements weather and erode away and sediment is carried and deposited in another location.  Weathering and erosion are an important step in the rock cycle. |
| **New Questions and Next Steps** (student-driven questions, ideas on what to investigate in the next lesson and how to investigate it, etc.) |
| Why do some geologic structures form as canyons, some as arches, some as mountains, etc?  Why do geologic structures form in certain areas and not in others?  Why are there no canyons in Tennessee and no caves in Arizona? |

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| **Explore: *Students participate in activities to explore questions related to a concept****.*  BUILD Knowledge: Learn the science behind concepts. |
| * Students explore the concepts with others to develop a common set of experiences * Provides students with one or more actual experiences * Offers opportunities for creative thinking and skills development * Students make and record observations and ideas, make connections, and ask questions * Students usually work in groups * Teacher acts as coach or facilitator in student-led investigations |
| **Phenomenon-based Driving Questions** (questions students are likely to ask about the lesson topic) |
| Why is my assigned landform shaped as it is? What processes have occurred to form it in this shape? What is my landform made of? Where did the eroded material go? |
| **Lesson Activities** (experiment, demonstration, video, visualization, reading, etc., coherently sequenced to help build understanding of PE/standard)  For each activity, provide details of the procedure including timing, teacher guidance, student prompts, strategies for discussions and differentiation, etc. |
| This portion of the lesson is completely student led research as they use Chromebooks in order to answer the prompted questions about their assigned landform. They will work in groups of three, each with their own portion of the project to research, then assimilate the research together into a presentation to share with the class. The teacher will be available to keep students on track and to help guide students who need a little extra help. Differentiation is embedded by how much the students put into their projects as well as which locations were assigned. Some locations will naturally be easier to understand their formation process than others. Students should have approximately 30 – 45 minutes on the first to be introduced to their project, become familiar with their partners and their role, and begin research. The second day, students will have the full 90 minute class period to work with their groups. |
| **Formative Assessment** (activity sheet, Venn diagram, summary, exit ticket, think-pair-share, etc. to check for understanding of lesson concepts) |
| The teacher will walk around group to group and question students, looking for explanations for important points which should be present in their presentation. The teacher will ask questions such as, “Was mechanical or chemical weathering responsible for the formation of the arch in Arches National Park?” “Do you think water or wind erosion created this formation? Why?” “What does this level of sorting in your sand sample indicate about the level of energy the environment had upon deposition?” |
| **Consensus Discussion** (claims, evidence, and reasoning on what students figured out in this lesson) |
| Students will have learned about the type of weathering which occurred in the environment to create their landform.  Students will have discovered connections between the sand sample and the environment which it was collected.  Students will have discovered how long geologic processes take in order to shape the Earth. |
| **New Questions and Next Steps** (student-driven questions, ideas on what to investigate in the next lesson and how to investigate it, etc.) |
| How does my landform compare to your landform?  Why does your sand sample look so different from mine?  Why is my landform so much younger than the others? |

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| **Explain: *Students construct their understanding of a concept and develop evidence-based explanations.***  DEVELOP Concepts: Research information using real-world data. |
| * Develops students’ explanation for the concepts they have been exploring with teacher providing supporting guidance * Students describe their observations and come up with explanations * Students listen critically to each other’s explanations * Students learn to apply and interpret evidence * Develops students’ academic vocabulary by applying scientific terms once students have figured out the lesson concepts * Teacher guides students’ reasoning, asks appropriate questions, and directs students to additional supporting resources |
| **Phenomenon-based Driving Questions** (questions students are likely to ask about the lesson topic) |
| What type of weathering occurred to form your location? Why does weathering and erosion happen on a faster scale in some locations than others? Why is there a lot of sandstone in this geologic area and limestone in another? Where does all the sediment go when it erodes away? |
| **Lesson Activities** (experiment, demonstration, video, visualization, reading, etc., coherently sequenced to help build understanding of PE/standard)  For each activity, provide details of the procedure including timing, teacher guidance, student prompts, strategies for discussions and differentiation, etc. |
| Students will present their research in the form of a Google Slides presentation. Presentations should be between 7 – 10 minutes long and each group member is expected to speak. Each group member is responsible for knowing the material which was research by all other group members in order to answer questions asked by the students and/or teacher. While one group is presenting, other students are expected to take notes about the types of weathering and erosion which have occurred in each location as well as key features of the sand samples. They will use these notes in the Elaborate portion of the lesson where they will compare their formation and sand sample with a similar and different sample from the other groups. |
| **Formative Assessment** (activity sheet, Venn diagram, summary, exit ticket, think-pair-share, etc. to check for understanding of lesson concepts) |
| The teacher will have a few pre-selected questions to ask each group after presenting depending on their chosen location and landform. |
| **Consensus Discussion** (claims, evidence, and reasoning on what students figured out in this lesson) |
| Students will realize that many different types of weathering occurs to form many different and unique geologic structures.  Students will learn that the Earth is much more dynamic than we see in Tennessee, not only around the world, but right within the U.S.  Students will learn that sand can take on many different appearances depending on parent rock, transportation, climate, etc. |
| **New Questions and Next Steps** (student-driven questions, ideas on what to investigate in the next lesson and how to investigate it, etc.) |
| Why does my landform look so different from yours if they are both made of sandstone?  Why does your sand sample look so different from mine?  Why is your sand sample so uniform while mine is all different shapes, sizes, and colors? |

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| **Elaborate: *Students deepen and expand their understanding by applying their understanding in new contexts.***  APPLY Learning: Utilize information in new ways. |
| * Extends students’ understanding or applies what they have learned in a new setting * Students use the information they have gained to propose solutions and extend their learning to new situations * Teacher supports students in broadening their understanding and extend ideas to other situations so they can draw broader conclusions beyond their experiment or investigation |
| **Phenomenon-based Driving Questions** **Extended/Applied in a New Context** (questions students are likely to ask about the lesson topic) |
| Why does their sand sample look so different from mine? Why don’t we have these types of formations in Tennessee? Why is there a lot of sand in some places and only mud here? Does Tennessee have sand? |
| **Lesson Activities** (experiment, demonstration, video, visualization, reading, etc., coherently sequenced to help build understanding of PE/standard)  For each activity, provide details of the procedure including timing, teacher guidance, student prompts, strategies for discussions and differentiation, etc. |
| Students will compare/contrast their sand with three other sand samples. They will compare with a group whose sand is similar to theirs, a group whose sand is different from theirs, and a locally collected sand sample. These will all be in the form of microphotographs in order to closely see the types of minerals and their composition. Students will complete a Venn diagram for each sample they compare and contrast. The teacher will walk around for guidance and to prompt students with what features or composition of the sand they can focus on for comparisons. After comparisons, the students will begin to answer reflection questions based on their reflections during the compare/contrast session. Differentiation for these activities will be in the form of how many observations the student was able to gather and how much they are able to put these observations into words. |
| **Formative Assessment** (activity sheet, Venn diagram, summary, exit ticket, think-pair-share, etc. to check for understanding of lesson concepts) |
| The students will fill out an exit ticket at the end of class answering the question, “Name one similarity between your sand sample and the local Mt. Juliet sample. What natural process would contribute to this similarity?” |
| **Consensus Discussion** (claims, evidence, and reasoning on what students figured out in this lesson) |
| The students figured out that sand can come in many different shapes, colors, and sizes.  The students figured out what Tennessee sand is and what it’s composed of.  The students figured out that different types of formations can produce different types of sands. |
| **New Questions and Next Steps** (student-driven questions, ideas on what to investigate in the next lesson and how to investigate it, etc.) |
| What would sand look like from Egypt? China? Or other parts of the world?  What other types of geologic formations exist? |

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| **Evaluate: *Students and teachers have opportunities to assess students’ understanding of a concept.***  DEMONSTRATE Ability: Write, illustrate, create, etc. artifacts that accurately describe knowledge gained. |
| * Students have the opportunity to demonstrate understanding of skills and concepts, and evaluate their own progress * Teacher evaluates students’ understanding and progress, as well as their own instructional practice, and may implement alternative assessment strategies * Enables adjustment of misconceptions, reinforces students’ understanding of the PE concepts in greater depth |
| **Phenomenon-based Driving Questions** (questions about the lesson topic) |
| How do the processes of weathering, erosion, and deposition lead to unique geologic formations? |
| **Skills Learning Performance (SEPs) Goals** (assess student skills related to the lesson) |
| Students will have shown mastery of geologic processes including weathering, erosion, deposition, and glaciation help to shape the land as these process break parent rock into sediments and smaller particles, transport them, and then deposit them into a new place as they present their research to the class. |
| **Formative Assessment** (quiz, test, report, presentation, poster, video, model, etc. to demonstrate students’ understanding about the PEs/standards) |
| The teacher will use Plickers at the beginning of class to assess the level of understanding. The questions will be pulled from various student presentations in order to question which weathering and erosion processes led to their formation. |
| **Content Learning Performance (DCIs, CCCs) Goals** (assess student mastery of lesson content) |
| Students will be able to show mastery of analyzing surface features of the Earth in order to draw comparisons to various landforms created by weathering and erosion while presenting their research to the class. They will have explained the cause and effect relationship between geologic processes responsible for various landform formation as they describe the processes of weathering and erosion which have created their researched landform. |
| **Summative Assessment** (quiz, test, report, presentation, poster, video, model, etc. to demonstrate students’ understanding about the PEs/standards) |
| Students were given a rubric to follow which the teacher will use to grade their research project and presentation which will be 50% of their final project grade. Part B of the project includes the 3 Venn diagrams as well as reflection questions which students have answered which will make up the other 50 % of the final project grade. |