Lesson Planning Guide

Develop Lesson Plans for Instruction

Steps in developing NGSS-/standards-aligned, phenomenon-based lessons that are guided by the 5Es 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.

Lesson Overview Template (Part A)

1.a Select grade level NGSS Performance Expectations (PEs) or Topics, 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 for details on what students should know and do.

MS-ESS2-2: Students will be able to understand the formation and building processes that form continental mountain ranges in a North America through the continental-continental plate tectonic collision.

1.b Identify a lesson-based anchoring phenomenon that builds towards understanding of the PEs/standards, and is engaging and relevant to students.
See more about phenomena and using phenomena with NGSS.

Through this lesson students will be able to understand what continental and oceanic tectonic plates are, what causes the plates to move, and what happens when continental plates collide. The students will then engage in a model of the formation of mountains through the use of a simulated continental-continental collision.

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 and using Driving Questions with NGSS.

What are mountains and what caused mountains to form?

1.d Unpack the 3-D learning components of the Performance Expectations/standards in the table below.
For NGSS guidance, see the NGSS Topic Arrangements and NGSS DCI Arrangements. Use tools to unpack each PE separately.

Science and Engineering Practices (SEP) (skills)	Disciplinary Core Ideas (DCI) (content)	Crosscutting Concepts (CCC) (connections)
Developing and using Models: Diagram the progression of the collision Using Mathematics and Computational Thinking: Measurement of the simulated mountain range and diagraming to scale.	ESSA2.A: Earth Materials and Systems Continental and Oceanic plates ESSA2.B: Plate Tectonics and Large Scale System Interactions Continental-Continental collisions Mountain building Cause and effect of continental collisions	ESSA2.B: Demonstration of mountain building process using a model simulating two continents colliding.

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.)

Class discussion on what mountains are, who has seen mountains or hiked on one. If any student has been to a mountain range, what did they see?

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.

Types of tectonic plate: Students will be able to identify the differences between continental and oceanic plates
Tectonic plate movements: Students will be able to identify why tectonic plates move
Mountain Building processes: Students will be able to identify the mountain building processes
Data measurement and diagraming: Students will be able to record the data and diagram the simulation experiment

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).

United States Geological Society: Topographical map of the United States of America to show the mountain ranges.
http://pubs.usgs.gov/dds/dds-81/Intro/TopographicData/DEM/DEM.html
https://www.teacherspayteachers.com/Browse/Search:plate%20tectonics: texts on tectonics and mountain formation
Teachers can use local state geological societies for their specific location.

Lesson Plan Template (Part B)

Grade and Subject	Middle School	**Instructional Time** (min.)	60
Lesson Title (Topic)	Continental plate collisions and Mountain Formation		
Anchoring Phenomenon (copy from 1.b)	Through this lesson students will be able to understand what continental and oceanic tectonic plates are, what causes the plates to move, and what happens when continental plates collide. The students will then engage in a model of the formation of mountains through the use of a simulated continental-continental collision.		
Driving Question (copy from 1.c)	What are mountains and what caused mountains to form?		

Lesson Overview

Lesson Summary (description)	**Lesson Topics and Student Learning Goals** (copy from 1.f)
This lesson will include a lecture on the basics of continental and oceanic plates including the differences separating the two and causes of tectonic plate movement. The lesson will transition to continental-continental collisions resulting in the formation of mountain ranges. The lesson will conclude with the students being split into pairs or small groups where they simulate a continental-continental collision using plastic tubs or another container, moistened sand and pushing these tubs together resulting in the sand piling up in the center. The students then measure the uplifted sand and document the measurements. The students then diagram the "mountain range" on the graph paper to scale using the documented measurements.	Types of tectonic plate: Students will be able to identify the differences between continental and oceanic plates Tectonic plate movements: Students will be able to identify why tectonic plates move Mountain Building processes: Students will be able to identify the mountain building processes Data measurement and diagraming: Students will be able to record the data and diagram the simulation experiment

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)
Lecture on continental and oceanic plate, causes of plate movement and mountain formation.	ESSA2.A: Earth Materials and Systems Continental and Oceanic plates
Topographical map of the United States of America to show the mountain ranges. http://pubs.usgs.gov/dds/dds-81/Intro/TopographicData/DEM/DEM.html	ESSA2.B: Plate Tectonics and Largescale System Interactions Continental-Continental collisions Mountain building Cause and effect of continental collisions
Youtube video of mountain formation https://youtu.be/d9bKXY0OMxc	ESSA2.B: Plate Tectonics and Largescale System Interactions

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 unable to understand the concept of tectonic plates Students unable to understand the concept that the world was not what we see now Students unable to see the simulation as how mountains can be formed	Continental plate Oceanic plate Mountain Orogeny Ocean spreading

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.)
Ruler, graph paper, pencils	Plastic tubs, sand, water	Safety glasses

Supporting Information

References (links to cite sources of data, images, websites, etc.)	Background Reading (for teachers and/or students)
Youtube video: was not able to get a reference or citation for the video. https://youtu.be/d9bKXY0OMxc http://pubs.usgs.gov/dds/dds-81/Intro/TopographicData/DEM/DEM.html	

Complete the 5E Instructional Model section(s) that are relevant to the lesson:

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 long did it take for mountains to form?
How did continents form?
Are mountains still growing?

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.

Simulation of the Mountain Range Formation:

**Plastic containers need to be cut prior to class. They should be cut so that one piece is slightly longer than the other piece.

1) Moisten the sand so it is moist enough to be able to molded and formed.
2) Place the wet sand in each half of the tub. The amount of sand needed depends on the size of the container being used. To avoid a mess, the container should not be completely full.
3) Pack the sand on the open end of the container so it does not loosely fall out prior to simulating the exercise.
4) Once the sand is packed, flush with the end of container, line the two sections of the tub with each other so that the edges are flush.
5) If necessary adjust the edges of the container so that the smaller section of tub can slide into the other section of tub.
6) Once the smaller tub has the sides and bottom set just inside the other section of the tub, gently repack the sand within the tubs and level the surfaces.
7) Slowly push from both ends of the tub so that the overall length of the tub begins to shorten. As the two are pushed together the sand should begin to uplift where the mesh point was. If the sand is pushing up on the ends stop the exercise, repack the ends, and place a heavy book or even let the students use their hands to keep the sand from climbing the side but make sure that they are not manipulating the exercise.
8) As the sand uplifts in the middle have them take note on what is happening reminding them that is one of the ways that mountains form when continents collide.
9) Stop the simulation one the edge of the larger container has reached the back of the smaller container.
10) Have the students measure the height, width of their mountain range.
11) The students then record these measurements.
12) The students then diagram the mountain range using those measurements to show on the paper the height of growth and width of the mountain range.

Formative Assessment (activity sheet, Venn diagram, summary, exit ticket, think-pair-share, etc. to check for understanding of lesson concepts)
Each group of students presents their data and diagram of the mountain range.
Consensus Discussion (claims, evidence, and reasoning on what students figured out in this lesson)
Class Discussion: What did the see? Did this simulation resemble how mountains are formed? Some groups will have done the exercise at a faster rate than others so: Did the speed at which the simulation was done, affect the results?
New Questions and Next Steps (student-driven questions, ideas on what to investigate in the next lesson and how to investigate it, etc.)