NGSS Lesson Plan – Synthetic Sand Investigation Toolkit

Grade/ Grade Band: 5 - 12th	**Topic:** Analyzing Beach Sand for Microplastics and Natural Components	**Lesson #_2____ in a series of __3__ lessons**

Brief Lesson Description: Investigate beach sand to identify synthetic and natural materials. Measure plastic pollution levels and describe human impacts on coastal ecosystem health. The Synthetic Sand Investigation Kit is free for public school educators in the US, and is available for request at https://algalita.org/wayfinder-society/toolkit/synthetic-sand/. Webpage also includes instructions and downloadable worksheets. All referenced handouts are linked below on last page. They can be edited by the educator if they download their own copy.



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Performance Expectation(s):
MS-PS 1-3 Gather and make sense of information to describe that synthetic materials come from natural resources and impact society.
HS-LS 2-2 Use mathematical representations to support and revise explanations based on evidence about factors affecting biodiversity and populations in ecosystems of different scales.

Specific Learning Outcomes: Students learn about components of sand, including inorganic components, natural components from animals and plants, and synthetic components like plastic pollution and other anthropogenic debris. Students analyze real world evidence of how synthetic materials impact society through environmental pollution. Students use their senses to identify synthetic materials based on their physical properties.

Narrative / Background Information

Prior Student Knowledge: Some knowledge of beaches, pollution, food webs

Science & Engineering Practices:	**Disciplinary Core Ideas:**	**Crosscutting Concepts:**
Planning and Carrying Out Investigations ● Students investigate provided beach sand samples for evidence about the health of the beach using sensory clues, provided information about the sample Analyzing and Interpreting Data ● Students analyze and interpret evidence of natural, biological, and synthetic materials in a beach sand sample to make conclusions about the health of the beach. Using mathematics and computational thinking ● Students quantify natural and synthetic components of sand and calculate percentages, then graph results. Constructing Explanations and designing solutions ● Students use the evidence from their sample and provided Healthy Beach Diagram to explain their reasoning about the health of the beach. Obtaining, Evaluating, and Communicating Information ● Students conduct further research on an element of the beach ecosystem.	Human Impacts on Earth ● This toolkit provides real-world beach samples collected in Southern California that students analyze to gather evidence that human activities and particularly synthetic materials can impact our environment. Students learn to use sensory observations and prior knowledge to interpret evidence in a sample by investigating the properties of a mixture and materials in the mixture. ● Students investigate pollution levels and amounts of natural biological elements in sand, which are a proxy for biodiversity of ecosystems connected to the beach. Students could compare pollution levels and biodiversity levels and ask questions about the connections between them.	Cause and Effect ● Students explore the relationship between human use of synthetic materials (plastics), and the resulting degrading health of beaches. Scale, Proportion, and Quantity ● Students quantify, then compare proportions of synthetic materials and natural materials in beach sand to draw conclusions about the health of a beach. ● Students use the quadrat data to make predictions about the abundance of pollution on the whole beach using proportion and scale mathematics. (Extension Activity) Systems and System Models ● Students analyze a representative sample of beach sand to generate a model of the beach environment and understand it's components and their individual and combined importance.

LESSON PLAN – 5-E Model

ENGAGE: Opening Activity – Access Prior Learning / Stimulate Interest / Generate Questions:

Pass out the sand samples, magnifiers and paper plates. Students pour contents of 1 sample jar onto their plate. If you need to spread one jar between more groups of students, number the jars and plates respectively (e.g. number the first jar as #1 and the multiple plates with a #1 as well).

Ask students to examine and explore their samples before sharing any additional information. Pass out the student worksheet and have students use the ENGAGE prompts to record their observations.

EXPLORE: Lesson Description – Materials Needed / Probing or Clarifying Questions:

Think Pair Share: *What makes a healthy beach habitat?* Record student's prior knowledge and thoughts on the whiteboard.

What do we find in beach sand?

Now, provide students with the sensory ID clue sheet. Explain that you'll use your senses to determine the different components of these beach sand samples to find evidence of the health of the beach.

Have students use the info on the sensory sheet and their magnifying glass to pick out a component in the sample that they think comes from rocks. Ask what their evidence is. Have them write their observations and evidence in their worksheet. Each group shares their item and evidence with the class. Record responses on board. Repeat same process with:

1. A component in the sand that comes from a plant.
2. A component in the sand that comes from an animal.
3. A component in the sand that comes from human activity/society.

Ask students to discuss in their groups: How do each of these components provide evidence about the health of the beach where this sample was taken? (OR assign one component to each group) Summarize thoughts by having each group present their thoughts and record on the white board.

EXPLAIN:
Pass out or project the Healthy Beach Diagram to EXPLAIN how each type of item in beach sand is evidence for the health of the beach. Optional: Have students pick a fact from the diagram that they want to learn more about! Students spend 10 minutes researching that fact and recording their findings in their student workbook. Students use this new information to brainstorm one thing everyone should do to have a positive impact on the health of the beach ecosystem.

Concepts Explained:
Synthetic vs natural materials

Vocabulary Defined:
Synthetic material - natural materials that have been chemically altered
Plastics – a big group of synthetic materials used to make thousands of different things from packaging, to paint, to clothing.
Microplastics – small pieces of plastic less than 5 mm in size
Quadrat – square sampling area used in studies to measure a variable across a large area.
Wrack – the kelp, seagrass and other plant material that washes ashore
Shells – discarded exoskeletons of invertebrates

ELABORATE: Applications and Extensions:

Quantifying synthetic and natural items in our beach sand samples.
Think Pair Share: how could we use these samples to gather evidence of how healthy this beach is? Record student ideas on board.

Next, provide students with the sorting sheet and Sample Info Card (quarter sheet provided in kit). Read the Station Card aloud together. Ask, based on the information in the Station Card, where do you think the items (both natural and synthetic) in the sample might have come from? How did it get from it's source to the beach? Record all ideas on the whiteboard. Connect specific items in the sample to a potential source. E.g. A feather might have come from a seagull living at the beach. A Lego piece might have come from a kid's backyard. A bottle cap may have come from a person walking in the park who littered. A seed might have come from a tree planted in the watershed.

Have students sort all the natural plant and animal items and synthetic items from their sample onto their sorting sheet by placing each item in the correct circle. **Remind them to use their magnifying glass and Sensory Clue Sheet to help with tricky items.

Students record their results in their table and then visualize their results with a graph as prompted in the student workbook. Note: If you split samples between multiple groups, have them total all their results together before analyzing and visualizing their data.

EVALUATE:

Formative Monitoring (Questioning / Discussion): Engage students throughout this lesson with various questions, group discussions, Think Pair Share prompts, and by recording student responses on the whiteboard.

Summative Assessment (Quiz / Project / Report):
N/A

Elaborate Further / Reflect:
See Extension Activity: Connecting Math and Science - Estimating Total Pollution Levels on a Beach
Students use additional workbook (provided on the resource webpage (https://algalita.org/wayfinder-society/toolkit/synthetic-sand/) to use their classes analyzed samples to estimate total levels of pollution at Seal Beach.

Materials Required for This Lesson/Activity

Quantity	Description	Potential Supplier (item #)	Estimated Price
1	Algalita's Synthetic Sand Toolkit (includes link to webpage instructions, Student Worksheets, 4 sand samples, 4 magnifying glasses, 4 sample info cards, 1 printed copy of student worksheet)	Algalita (https://algalita.org/wayfinder-society/toolkit/synthetic-sand/)	$30 value (free for public school educators while supplies last)
20	Paper plates (1 per group of 2-4 students)	Repurpose what you have, or any grocery store	$5

Printable / Editable Handouts:
– Synthetic Sand – **Background and Instructions** – PDF

– Synthetic Sand – **Student Workbook** – Google Sheet
– Synthetic Sand – **Microplastic Sorting Sheet** – PDF
– Synthetic Sand – **Sensory Identification Clue Handout –** PDF
– Synthetic Sand – **Healthy Beach Diagram** – PDF
– Synthetic Sand – **Extension Activity** – Google Sheet