Describe the Artifact

In the *Soil Sleuths* engineering design challenge, students acted as environmental engineers tasked with analyzing a simulated soil sample to determine the presence and impact of contaminants. Using a bag of trail mix to represent soil, students identified which components represented organic matter and which represented contaminants. They then separated the mixture, measured the mass of each component, calculated percentages, and analyzed how contamination levels affected overall soil quality. Students applied academic skills in measurement, data analysis, and proportional reasoning while connecting their findings to real-world engineering concerns, such as environmental safety, land use, and ecosystem health. The assignment required students to follow a structured investigative process similar to how engineers evaluate soil samples before construction, agriculture, or environmental remediation projects

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Reflect on the Artifact

This assignment engaged students in higher-level thinking at DOK levels 3 and 4 through applied problem-solving and analysis. Students were required to synthesize scientific concepts (mixtures, contaminants, organic matter), perform calculations, interpret data, and make judgments about when contaminated soil would be a concern for engineers. Student work samples demonstrate conceptual understanding as learners move beyond simple identification to explaining implications of contamination and connecting results to real engineering scenarios. By requiring students to justify conclusions using evidence from their data and reflect on engineering applications, the task demanded analysis, reasoning, and decision-making rather than rote procedures. The completed lab sheets provide clear evidence of cognitive processing and authentic engineering thinking.

Inspiration

Where do people who are injured playing peek-a-boo go? To the ICU!!

Today we will learn about mixtures and solutions. I will know I am successful when I can describe why engineers care about soil components and when I can successfully weigh and separate the organic and contaminant parts of soil.

- Daily Starter
- Instruction
- Lab
- Closing meeting

Daily Starter:

1. Click here for the Daily Starter Activity: 1:1 and click here for the Daily Starter Activity: 2 of 2.

Instruction

1. You will need to be able to define: **contaminant, organic, mixture, solution, homogenous, heterogeneous**

2. Click here for instruction

Soil Sleuths Lab Worksheet

1. Click here for this assignment and click here to experiment with sheets

2. Career Exploration Assignment click here

Closing Meeting:

1. Rate your behavior on your chart now.

2. If your class earns BINGO tokens, we will do the BINGO points now!

1. Free draw using recycled paper

2. Creative writing

3. Read a novel or draw.

Mixtures & Solutions Instruction

A **mixture** is made up of two or more kinds of matter, and sometimes you can still see the different parts, like sand and water. A **solution** is a special type of mixture where you cannot tell the difference between the parts, and it cannot be separated easily.

What are some other differences between a mixture and a solution? Well, mixtures keep their original properties, while solutions do not. In most cases, a solution has different properties than the parts that went into making it. A solution is made up of a **solute** and a **solvent**. For example, in salt water, the salt is the solute and water is the solvent.

Is it possible to separate the different substances in a solution? Yes! In salt water, the two parts may be separated by evaporation. Sometimes, it can be as easy as using a filter or a screen.

Who can think of another example of a mixture or solution? (Have students list answers such as bubble mix, lemonade, milk, etc.) **What is the difference between milk and Italian salad dressing?** (Possible answers include: difference in color, milk is the same throughout the whole bottle while the dressing separates after sitting for a bit.)

Mixtures and solutions that are the same throughout (like milk, Kool-Aid®, etc.) are called **homogenous**. Those that are not consistent throughout (like Italian salad dressing, oil and water, etc.) are called **heterogeneous**. **Heterogeneous** mixtures and solutions are usually much easier to separate. Filtering is an easy way to separate heterogeneous mixtures. Large rocks can easily be separated from small rocks and sand. It is much harder to separate the individual parts of Kool-Aid® (water, sugar, Kool-Aid® powder).

Why would an engineer care about mixtures and solutions? Engineers design ways to help separate mixtures and solutions in industrial, commercial, and environmental processes. Can you think of any engineers that have worked with the mixtures or solutions we listed a minute ago?

Chemical engineers work with the foods we eat every day. They need to know what chemicals are safe to mix with foods when designing fertilizers and preservatives to keep food healthy for us. Another example is **environmental engineers** who work with **contaminants** like acid mine drainage. Acid mine drainage happens when metals from mining sites break down into the surrounding groundwater and surface waters. This water can become acidic and discolored, disrupting nearby ecosystems. These areas can also be a health concern for humans who use the same groundwater resources. Engineers work on cleaning up the mixtures and solutions of metals and bacteria in acid mine drainage areas, as well as streams, drinking water, air, and soils. They use their knowledge of mixtures and solutions to help create environmental policies, design water treatment processes, and develop new medicines to help people.

Messin' With Mixtures Activity – Soil Sleuths Lab

1. Look at the items in the bag. What do you see?

2. If peanuts and raisins are the organic components of soil, how many different types of contaminants are present in your soil sample? _____

3. What is the total mass of your bag with the entire soil sample? Record this amount in the "Mass of Mixture" column of the chart.

4. Separate the parts of the items and find the mass of each group. Use the following formula to calculate the percentage for each part of the mixture. Record your data in the chart.

Mass ÷ Mass of Mixture x 100 = % of Mixture

5. Check your answer by adding up all the numbers in Column 4. The total should be 100 because all the parts of your mixture combine to make up the whole mixture.

1. Item	2. Mass (g)	3. Mass of Mixture (g)	4. % of Mixture
		68g	100%
Peanuts & raisins	12g		17.64%
cashews	8g		11.64%
M &Ms	10g		7.2%
almonds			63.52%
		Total =	

6. What percentage of the soil was contaminated (not the peanuts and raisins)? _____

7. What situations would a contaminated soil sample be of concern to engineers?

Messin' With Mixtures Activity – Soil Sleuths Lab

1. Look at the items in the bag. What do you see?

Peanuts m&ms cashus almonds and raisns

2. If peanuts and raisins are the organic components of soil, how many different types of contaminants are present in your soil sample? _____3_____

3. What is the total mass of your bag with the entire soil sample? Record this amount in the "Mass of Mixture" column of the chart.

4. Separate the parts of the items and find the mass of each group. Use the following formula to calculate the percentage for each part of the mixture. Record your data in the chart.

Mass ÷ Mass of Mixture x 100 = % of Mixture

5. Check your answer by adding up all the numbers in Column 4. The total should be 100 because all the parts of your mixture combine to make up the whole mixture.

1. Item	2. Mass (g)	3. Mass of Mixture (g)	4. % of Mixture
		85	100%
Peanuts rasins	42		49.41%
Cashus	5		5.88%
Almonds	13		15.29%
m&ms	35		41.17%
		Total =111.75	

6. What percentage of the soil was contaminated (not the peanuts and raisins)? 62.34_____

7. What situations would a contaminated soil sample be of concern to engineers?

When there is more contaminated soil than organic.

Messin' With Mixtures Activity – Soil Sleuths Lab

1. Look at the items in the bag. What do you see?

When I look in the bag I see peanuts, almonds, raisins, cashews, and M&M's.

2. If peanuts and raisins are the organic components of soil, how many different types of contaminants are present in your soil sample? _____3_____

3. What is the total mass of your bag with the entire soil sample? Record this amount in the "Mass of Mixture" column of the chart.

4. Separate the parts of the items and find the mass of each group. Use the following formula to calculate the percentage for each part of the mixture. Record your data in the chart.

Mass ÷ Mass of Mixture x 100 = % of Mixture

5. Check your answer by adding up all the numbers in Column 4. The total should be 100 because all the parts of your mixture combine to make up the whole mixture.

1. Item	2. Mass (g)	3. Mass of Mixture (g)	4. % of Mixture
		89g	100%
Peanuts and raisins	42g		47.19%
cashews	13g		14.60
M &m's	25g		28.08
almonds	14g		15.73
		Total =	

6. What percentage of the soil was contaminated (not the peanuts and raisins)? _____58.43_____

7. What situations would a contaminated soil sample be of concern to engineers?

If the engineers find something that might be harmful to the environment they will find that as a concern and will probably do or find something that will help or fix the source.