SCIENCE QUIZZES

ACT

ESM PREP

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Interpreting Visuals Exercise Introduction

The ACT Science Test tests your ability to correctly interpret graphs, figures, tables, and diagrams. It is important to develop interpretation skills so that you can answer questions about these visuals, even if you are not familiar with the content.

To prepare you for this, ESM science mentors have put together a variety of science interpretation exercises that range in difficulty. The visuals included in these exercises are designed to look unfamiliar to you, but the questions beneath each visual will help guide you toward a thorough understanding of what you see. Upon completing these exercises, you will realize that you can answer any science question correctly by using your interpretation skills!

*All data and graphs included are hypothetical and for interpretation purposes only.

Date Completed: _____
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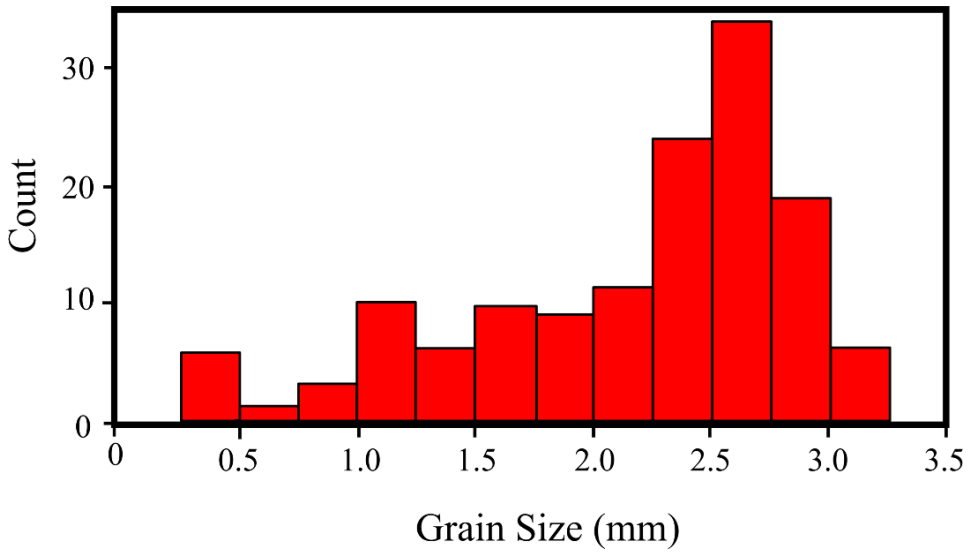
Sediment Grains: Difficulty Level 1

Assume the graph below represents a sampling of individual grains of sediment at a certain beach and that the data is representative of the entire beach.



1. How many axes are present on the graph?

2. Is a value measured along the x-axis? If so, what is it and in what units is it measured?

3. Is a value measured along the y-axis? If so, what is it and in what units is it measured?

4. Is there a key on this graph? If so, what information does it contain?

5. What type of graph is this?

6. In this type of graph, the x-axis is compartmentalized into segments called "bins." How many bins are displayed on the x-axis of this graph? What is the "bin range" displayed on the x-axis? What is the size of each bin? Are there any "empty" bins? If so, which bins are empty?

7. In the sample, about how many grains of sediment are between 2.75 and 3.0 mm in size? How many are between 0.75 and 1.0 mm in size? How many are between 1.75 mm and 2.25 mm?

8. In the sample, about how many grains of sediment are larger than 2.5 mm in size? How many are smaller than 1.5 mm in size?

9. Are there more grains of sediment between 2.0 and 2.25 mm in size or more between 0.5 and 1.25 mm in size?

10. Do you know how many grains of sediment are 1.5 mm in size? If so, how? If not, why not? Can this type of graph tell you the exact size of a grain of sediment?

11. Do you know the minimum and maximum grain size of this sample?

12. In what range does the minimum grain size fall? In what range does the maximum grain size fall?

13. Is the sand grain size data skewed? If so, to which direction is it skewed? What does skew mean?

14. About how many grains of sediment were collected in the entire sample?

15. If a beachgoer were to pick up a single random grain of sediment from the beach, what is the approximate probability that the grain is between 2.25 and 2.5 mm?

16. A randomly selected sediment grain from the sample is most likely to fall into which bin? Into which bins shown will it never fall?

17. A sedimentologist who frequents the beach speculates that sediment grains never reach a size greater 3.5 mm due to wave erosion. Is this hypothesis supported by the data in the graph? Explain.

18. By the same reasoning, the expert hypothesizes that most sediment grains must be relatively small since they are constantly being eroded, skewing any sampling data to the right. Is this hypothesis supported by the data in the graph? Explain.

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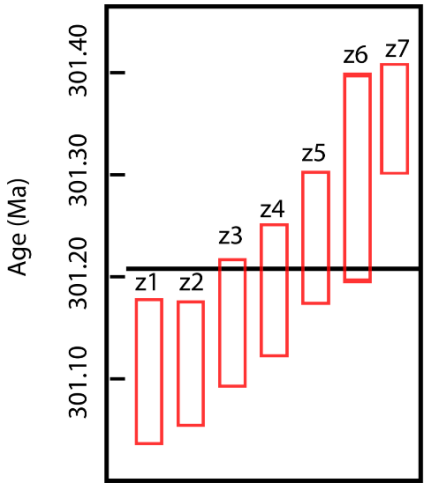
Zircons: Difficulty Level 1

Use the graph below to answer questions 1-16.

Assume the graph below represents a uranium-lead dating of various collections of zircon, giving the range of results for each collection. Assume also that the number of each collection represents the layer of rock from which it was quarried, with 7 being the deepest level and 1 being the shallowest.



1. How many axes are present on the graph?

2. Is a value measured along the x-axis? If so, what is it and in what units is it measured?

3. Is a value measured along the y-axis? If so, what is it and in what units is it measured?

4. Is there a key on this graph? If so, what information does it contain?

5. What type of graph is this?

6. How many zircon collections are displayed on the graph?

7. What is the approximate range of sample ages in collection z2? What about collection z4? Collection z6?

8. What is the approximate age of the oldest sample of zircon? In which collection is this sample?

9. What is the approximate age of the youngest sample of zircon? In which collection is this sample?

10. Based on the data in the graph, how does the age of the zircon collections vary with the depth of their discovery?

11. Assume the bold black line represents the mean sample age of a newly mined zircon collection. What is the mean age of this new collection?

12. If the new collection was mined from the same quarry as one of the other collections, with which collection does it most likely share a quarry?

13. Suppose one zircon sample becomes separated from its collection. If uranium-lead dating dates the sample at 301.35 Ma, from which of collections could the sample have originated?

14. A second separated zircon sample is dated at 301.15 MA. From which of the collections could this sample have originated?

15. Suppose a geologist argues that zircon found deeper in the earth is younger in age because zircon is created in the mantle of the earth and slowly rises through the crust as tectonic plates shift. Is this theory supported by the data in this graph?

16. Using only this graph, is it possible to find the age of any single sample of zircon? What information does the graph supply a reader about a sample of zircon from collection z5?

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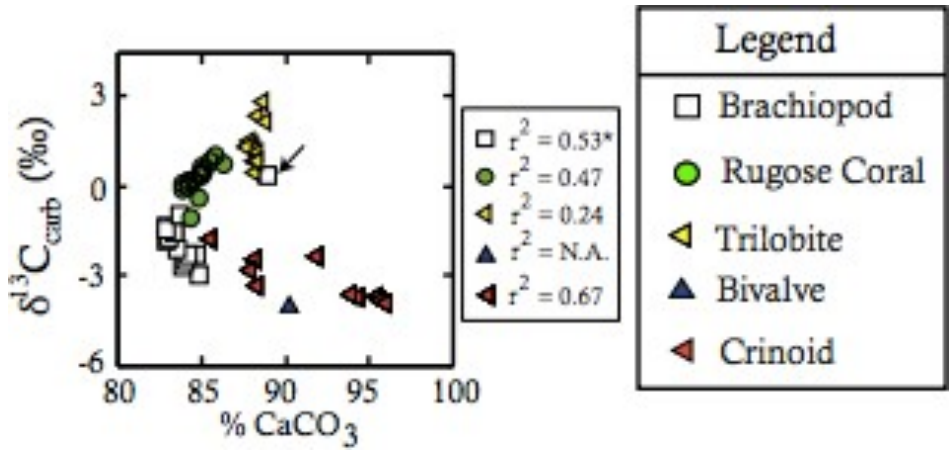
Carbon Isotopes: Difficulty Level 2

The following graph is a cross-plot showing carbon isotope in parts per mill vs. carbonate percentage of a variety of marine invertebrate fossils.



1. How many axes are on the graph?

2. What is being measured on the *x*-axis?

3. What is being measured on the *y*-axis?

4. Is there a Key to decipher the different fossils being shown on the graph?

5. Is there any more information provided about the items in the Key/Legend?

6. The box containing values of r^2 describes the variance of the different types of fossils. In statistics, the r^2 value is called the coefficient of determination. It indicates the proportion of the variance in the dependent variable that can be predicted by the independent variable. Which fossil has the highest coefficient of determination?

7. Which fossil has the lowest coefficient of determination?

8. Approximate the average carbon isotope measure and percentage of carbonate for Trilobite fossils.

9. What is the range of carbonate percentage found in Crinoid fossils?

10. List the fossils in order of carbon isotope content from greatest to least:

11. A scientist claims that for all fossils, as carbon content increases, carbon isotope levels increase. Does the data in this study support his claim?

12. While r^2 represents the coefficient of determination, r represents the correlation coefficient. The correlation coefficient measures the linear dependence between the independent and dependent variable. How could one find the correlation for each fossil type?

13. Graphically, how can one recognize if one fossil has a higher correlation coefficient than another fossil?

14. Which two fossils show a clear positive relationship between carbonate content and carbon isotope content?

15. Which two fossils show a negative relationship between carbonate content and carbon isotope content?

16. Scientists feel that more information needs to be gathered about one of the fossil types. Using the plot and legends, which fossil type should be studied further to determine relationships?

17. If the correlation coefficient measures the strength of a linear relationship between a dependent and independent variable, can the r value be negative? What about the r^2 coefficient of determination variable?

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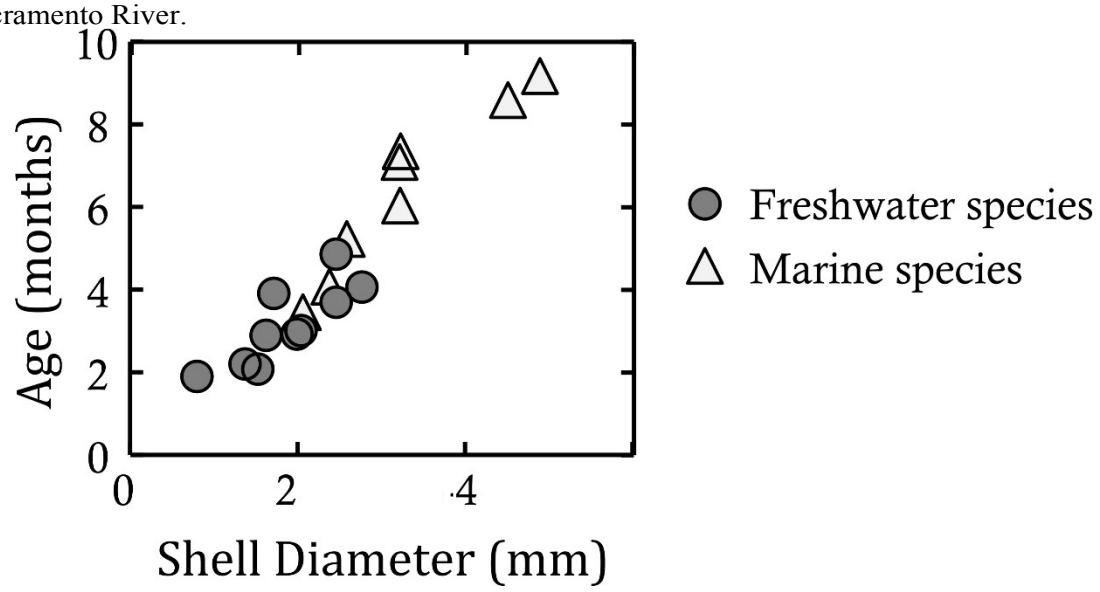
Shells: Difficulty Level 2

Assume the graph below represents the average data for several micromollusk species sampled from Mission Bay and the Sacramento River.



1. How many axes are present on the graph?

2. Is a value measured along the y-axis? If so, what is it and in what units is it measured?

3. Is a value measured along the x-axis? If so, what is it and in what units is it measured?

4. Is there a key on this graph? If so, what information does it contain?

5. What type of graph is this?

6. What does each triangle represent on the graph? What does each circle represent?

7. This graph represents how many freshwater micromollusk species? How many marine species?

8. What is the maximum average age of any micromollusk species? What is the minimum average age of any micromollusk species?

9. What is the maximum average age of a freshwater species? Of a marine species? What is the minimum average age of a freshwater species? Of a marine species?

10. What is the maximum average shell diameter of any micromollusk species? What is the minimum average shell diameter of any micromollusk species?

11. What is the maximum average shell diameter of a freshwater species? Of a marine species? What is the minimum average shell diameter of a freshwater species? Of a marine species?

12. In general, are marine species older or younger than freshwater species? In general, are marine species larger or smaller than freshwater species?

13. A researcher proposes a hypothesis that freshwater micromollusk species are, in general, longer living than marine species due to a lack of natural predators in rivers and lakes. Does the data in the graph support this hypothesis? Explain.

14. A different scientist argues that marine micromollusk species are, in general, longer living than freshwater species. Does the data support this argument? Explain.

15. The second scientist also postulates that marine micromollusk species are smaller on average than freshwater species which helps them to hide from the larger ocean predators. Does the data support this postulate?

16. What are the approximate mean and median average ages of the marine species? Of the freshwater species?

17. What are the approximate mean and median average shell diameters of the marine species? Of the freshwater species?

18. Based on this data, how does the age of micromollusks vary with their size?

19. Suppose one marine biologist claims that marine micromollusk species are genetically larger than freshwater species, while a second marine biologist claims that marine species are not naturally larger than freshwater species; they simply live longer and have more time to grow. Which hypothesis is most supported by the data in this graph? Explain.

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Total Organic Carbon: Difficulty Level 3

Figure A shows four different core locations with rocks containing various levels of total organic carbon (TOC). The shaded area represents rocks from the same interval of time at different core locations.

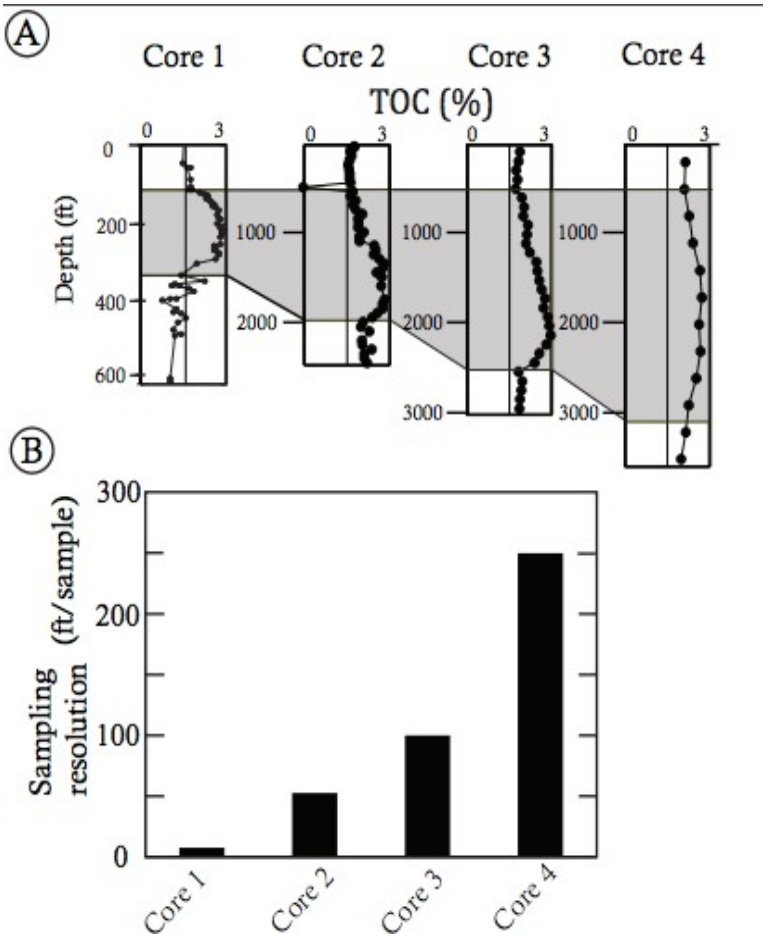

Figure B shows the sampling resolution in feet/sample at each of the 4 Core locations.
Questions:

1. What is measured on the vertical axis of Figure A?

2. What are the intervals of depth in Core 1?

3. What are the intervals of depth in Core 2?

4. What are the intervals of depth in Core 3?

5. What are the intervals of depth in Core 4?

6. What is measured on the horizontal axis of Figure A?

7. The rocks at each location contain between __ and __ percent carbon.

8. What are the units on the vertical axis of Figure B?

9. What are the measurement intervals on the vertical axis of figure B?

10. What is the sampling resolution at Core 3?

11. What is the approximate depth range for Core 4?

12. Which Core location had rocks that contained less than 1.5% TOC for in the shaded time interval?

13. If a 5th Core location was studied with a depth range greater than that of Core 4 in Figure A, what do you expect the sampling resolution to be in Figure B?

14. Core 3 has a sampling distribution that is approximately many times that of Core 2?

15. Which Core location in Figure A has the least variability in percent of total organic carbon for the shaded region?

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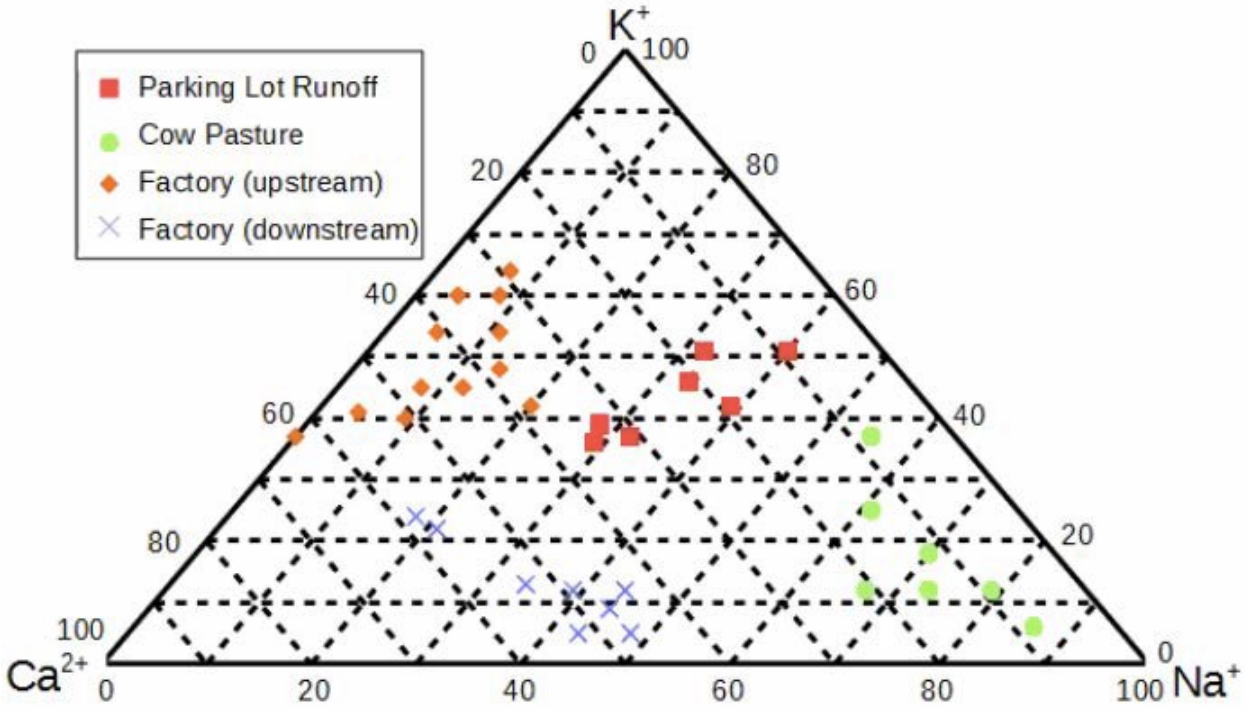
Ternary Diagrams: Difficulty Level 3



1. Which 3 substances are being tested in the runoff samples?

2. What do the numbers on the edges of the triangle represent?

3. Name the 4 locations where runoff samples are being collected.

4. Having never seen a ternary diagram before, how could one logically decide which substance is being measured by each axis?

5. Which substance is measured by the axis along the bottom of the triangle?

6. Which substance is measured by the axis on the right side of the triangle?

7. Which substance is measured by the axis on the left side of the triangle?

8. Does the amount of K^+ measured increase or decrease as you move from the bottom of the triangle to the top of the triangle?

9. Does runoff from factories upstream contain more or less Na^+ than runoff from factories downstream?

10. Does runoff from parking lots contain more or less K^+ than runoff from cow pastures?

11. Runoff from which location contains the highest amount of Na^+?

12. Which two locations contain runoff with the highest amounts of Ca^{2+}?

13. Which 2 location contains runoff with the lowest amount of Ca^{2+}?

14. The two locations with the highest amount of Ca^{2+} contain the lowest amount of what?

15. The location with the highest amount of K^+ has the lowest amount of what?

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□

□
□
+