Introduction

Formative Assessment Exemplar - 8.2.6

Introduction:

The following formative assessment exemplar was created by a team of Utah educators to be used as a resource in the classroom. It was reviewed for appropriateness by a Bias and Sensitivity/Special Education team and by state science leaders. While no assessment is perfect, it is intended to be used as a formative tool that enables teachers to obtain evidence of student learning, identify gaps in that learning, and adjust instruction for all three dimensions (i.e., Science and Engineering Practices, Crosscutting Concepts, Disciplinary Core Ideas) included in a specific Science and Engineering Education (SEEd) Standard.

In order to fully assess students' understanding of all three dimensions of a SEEd standard, the assessment is written in a format called a cluster. Each cluster starts with a phenomenon, provides a task statement, necessary supporting information, and a sequenced list of questions using the gather, reason, and communicate model (Moulding et al., 2021) as a way to scaffold student sensemaking. The phenomenon used in an assessment exemplar is an analogous phenomenon (one that should not have been taught during instruction) to assess how well students can transfer and apply their learning in a novel situation. The cluster provides an example of the expected rigor of student learning for all three dimensions of a specific standard. In order to serve this purpose, this assessment is NOT INTENDED TO BE USED AS A LESSON FOR STUDENTS.

Because this assessment exemplar is a resource, teachers can choose to use it however they want for formative assessment purposes. It can be adjusted and formatted to fit a teacher's instructional needs. For example, teachers can choose to delete questions, add questions, edit questions, or break the tasks into smaller segments to be given to students over multiple days.

Of note: All formative assessment clusters were revised based on feedback from educators after being utilized in the classroom. During the revision process, each cluster was specifically checked to make sure the phenomena was authentic to the DCI, supporting information was provided for the phenomena, the SEPs, CCCs, and DCIs were appropriate for the learning progressions, the cluster supported student sensemaking through the Gather, Reason, and Communicate instructional model, and the final communication prompt aligned with the cluster phenomena. As inconsistencies were found, revisions were made to support student sensemaking. If other inconsistencies exist that need to be addressed, please email the current Utah State Science Education Specialists with feedback.

General Format:

Each formative assessment exemplar contains the following components:

1. Teacher Facing Information: This provides teachers with the full cluster as well as additional information including the question types, alignment to three dimensions, and answer key. Additionally, an example of a proficient student answer and a proficiency scale for all three dimensions are included to support the evaluation of the last item of the assessment.
2. Students Facing Assessment: This is what the student may see. It is in a form that can be printed or uploaded to a learning platform. (Exception: Questions including simulations will need technology to utilize during assessment.)

Accommodation Considerations:

Teachers should consider possible common ways to provide accommodations for students with disabilities, English language learners, students with diverse needs or students from different cultural backgrounds. For example, these accommodations may include: Providing academic language supports, presenting sentence stems, or reading aloud to students. All students should be allowed access to a dictionary.

References:

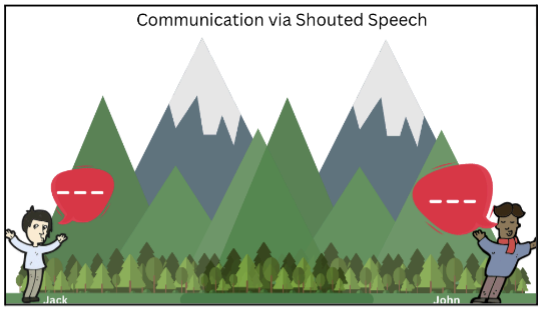
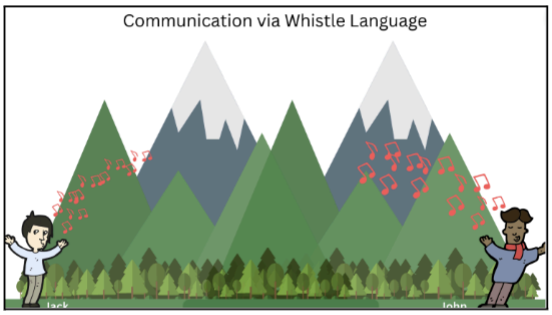
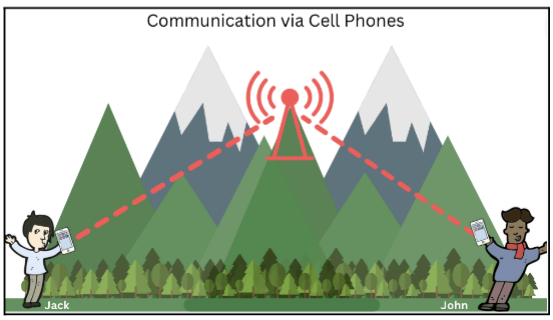
Moulding, B., Huff, K., & Van der Veen, W. (2021). *Engaging Students in Science Investigation Using GRC*. Ogden, UT: ELM Tree Publishing.

Teacher Facing Info

Teacher Facing Information

Standard: Obtain and evaluate information to **communicate** the claim that the structure of digital signals are a more reliable way to store or transmit information than analog signals. Emphasize the basic understanding that waves can be used for communication purposes. Examples could include using vinyl record vs. digital song files, film cameras vs. digital cameras, or alcohol thermometers vs. digital thermometers. (PS4.C)

Assessment Format: Online Only (Requires students to have online access), Printable or Online Format (Does not require students to have online access)

Phenomenon	
Communication across long distances: Jack and John are two friends living in a forest, mountainous area. They try to communicate using different formats: shouted speech, whistle language, smoke signals, and cell phones.   	Proficient Student Explanation of Phenomenon: Since cell phones use digital signals and digital signals transfer the information more accurately over long distances, cell phones are a better way of communication than the shouted speech and whistle language.

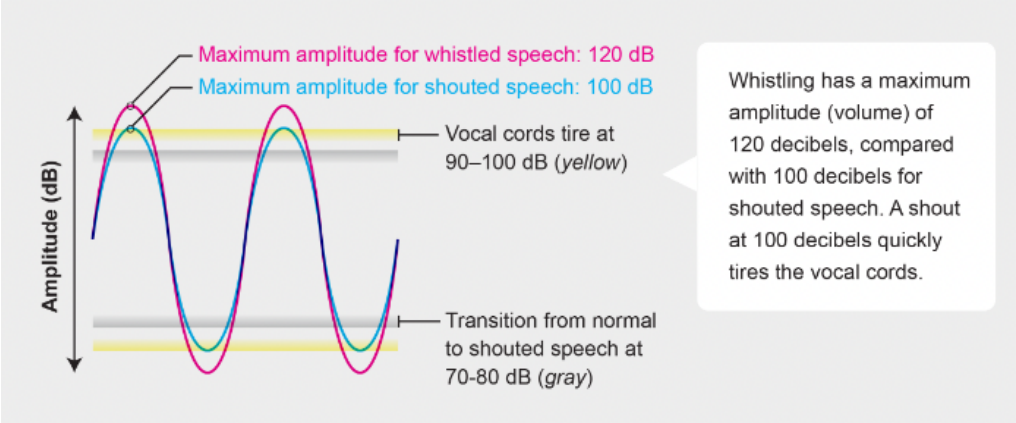
Cluster Task Statement

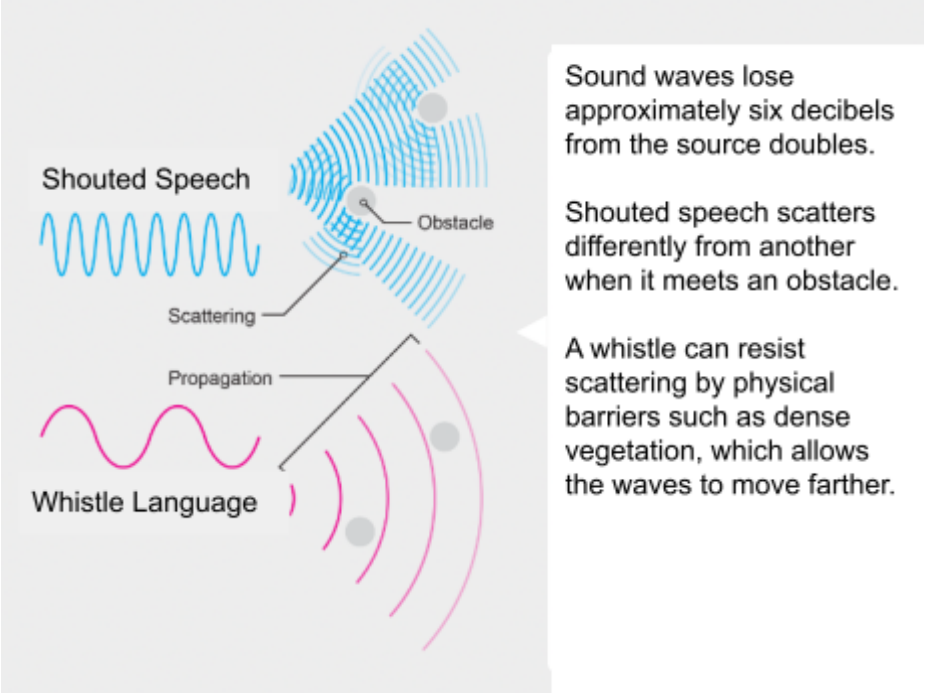
(Represents the ultimate way the phenomenon will be explained or the design problem will be addressed)
In this task you will use a video, text, diagrams, and information to answer questions and write a claim, evidence, and reasoning statement about the best way of communication for Jack and John.

Supporting Information

The Whistle Language
https://vimeo.com/327303614?embedded=true&source=vimeo_logo&owner=83181333

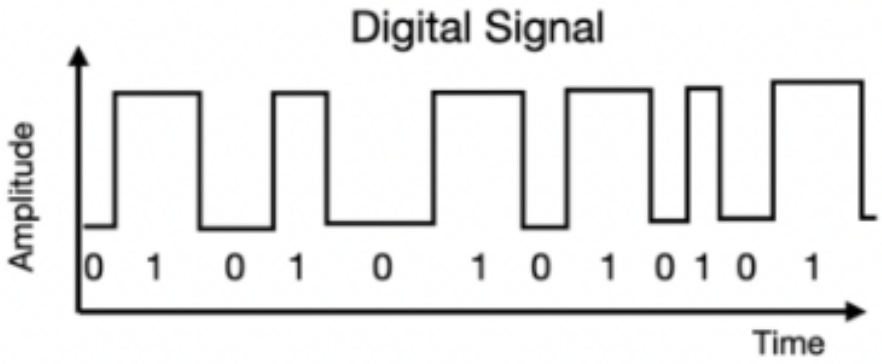
Whistled speech has arisen in at least 80 languages around the world, especially in rugged, mountainous terrain or dense forest, where ordinary speech doesn't carry far enough. Skilled whistlers can reach 120 decibels, louder than a car horn. As a result, whistled speech can be understood up to 10 times as far away as ordinary shouting. That lets people communicate even when they cannot easily approach close enough to shout. Unfortunately, use of whistle language decreased over time with the use of mobile phones.





Resource:
https://www.scientificamerican.com/article/ldquo-whistled-languages-rdquo-reveal-how-the-brain-processes-information/

A cell phone uses technology that breaks a sound into binary code – essentially, a code comprised of 1s and 0s. Once translated into binary code, the signal gets transferred to the other end of the device into another device. This receiving device takes the binary code and reassembles it into the original signal and sends it back to the other end.



Cluster Questions	
Cluster Question #__1___ Question Type: Fill in blank	Question 1:

Addresses:
__x_ DCI
_____ SEP
__x__ CCC
Answer:
Analog signals use sound waves to transfer information. These signals do not use mathematical codes to transfer information.

Digital signals are sent as mathematically coded waves and can be sent over long distances.Once the waves arrive at a receiving station, they are decoded back into
information that you can understand.

Use the following keywords to fill in the blanks.

Key words: digital analog

_____ signals use sound waves to transfer information. These signals do not use mathematical codes to transfer information.

_____ signals are sent as mathematically coded waves and can be sent over long distances.Once the waves arrive at a receiving station, they are decoded back into information that you can understand.

Gather:
Cluster Question #__2___
Question Type: Table Grit
Addresses:
__x__ DCI
_____ SEP
__x__ CCC
Answer:

Communication type	Analog	Digital
Shouting	X	
Whistle	X	
Smoke Signal	X	
Cell Phone		X

Question 2:
Classify the different communication types as the type of signals used:

Communication type	Analog	Digital
Shouting		
Whistle		
Smoke Signal		
Cell Phone		

Reason:
Cluster Question #__3___
Question Type: Table Grit
Addresses:
___ DCI
__x__ SEP
_x__ CCC

Question 3:

Compare and contrast three different waves of communication in terms of distance of travel, accuracy of the information transferred, disturbance by the noise.

Answer:

Key words: short, long, longest

	Shouted Speech	Whistle Language	Cell Phones
Distance of travel	Short distances	Long distances	Longest distances

Key words: low, higher, highest

	Shouted Speech	Whistle Language	Cell Phones
Accuracy of information transferred	Low accuracy	Higher accuracy	highest accuracy

Key words: highest, low, lowest

	Shouted Speech	Whistle Language	Cell Phones
Disturbance by noise	highest disturbance	low disturbance	lowest disturbance

Key words: short, long, longest

	Shouted Speech	Whistle Language	Cell Phones
Distance of travel			

Key words: low, higher, highest

	Shouted Speech	Whistle Language	Cell Phones
Accuracy of information transferred			

Key words: highest, low, lowest

	Shouted Speech	Whistle Language	Cell Phones
Disturbance by noise			

Cluster Question #_4___
Question Type: Table Grit
Addresses:
__x__ DCI
_x___ SEP
__x__ CCC
Answer:
Claim:
Cell Phones (digital signals) are the best way to communicate.

Evidence:
Digital signals can travel across long distances
Digital signals are disturbed by the noise minimally
Digital signals transfer the information more accurately than the analog signals.

Question 4:

Using information given above, write a CER (claim, evidence, reasoning) arguing which type of signals would be best to use if you want to communicate over a long distance.

Claim	Evidence	Reasoning

Reasoning: Since cell phones use digital signals and digital signals transfer the information more accurately over long distances, cell phones are a better way of communication than the shouted speech and whistle language.	

Proficiency Scale

Proficient Student Explanation:
Compared to whistle language and shouted speech, cell phones are the best way of communication because cell phones use digital signals which translate the sound into binary codes. Digital signals do not get disturbed by the obstacles due to binary coding. Whistle language and shouted speech use analog signals which can be scattered by obstacles.

Level 1 - Emerging	Level 2 - Partially Proficient	Level 3 - Proficient	Level 4 - Extending
SEP: Does not meet the minimum standard to receive a 2.	**SEP:** Combine information in written text with that contained in corresponding tables, diagrams, and/or charts to support the engagement in other scientific and/or engineering practices Communicate scientific and/or technical information orally and/or in written formats, including various forms of media and may include tables, diagrams, and charts.	**SEP:** Critically read scientific texts adapted for classroom use to determine the central ideas and/or obtain scientific and/or technical information to describe patterns in and/or evidence about the natural and designed world(s). Integrate qualitative and/or quantitative scientific and/or technical information in written text with that contained in media and visual displays to clarify claims and findings. Gather, read, synthesize information from multiple appropriate sources and assess the	**SEP:** Extends beyond proficient in any way.

		credibility, accuracy, and possible bias of each publication and methods used, and describe how they are supported or not supported by evidence. Evaluate data, hypotheses, and/or conclusions in scientific and technical texts in light of competing information or accounts. Communicate scientific and/or technical information (e.g. about a proposed object, tool, process, system) in writing and/or through oral presentations.	
CCC: Does not meet the minimum standard to receive a 2.	**CCC:** Different materials have different substructures, which can sometimes be observed. Substructures have shapes and parts that serve functions.	**CCC:** Complex and microscopic structures and systems can be visualized, modeled, and used to describe how their function depends on the shapes, composition, and relationships among its parts; therefore, complex natural and designed structures/systems can be analyzed to determine how they function. Structures can be designed to serve particular functions by taking into account properties of different materials, and how materials can be shaped and used.	**CCC:** Extends beyond proficient in any way.
DCI: Does not meet the minimum standard to receive a 2.	**DCI:** Digitized information transmitted over long distances without significant degradation. High-tech devices, such as computers or cell phones, can receive and decode	**DCI:** Digitized signals (sent as wave pulses) are a more reliable way to encode and transmit information.	**DCI:** Extends beyond proficient in any way.

	information—convert it from digitized form to voice—and vice versa.		

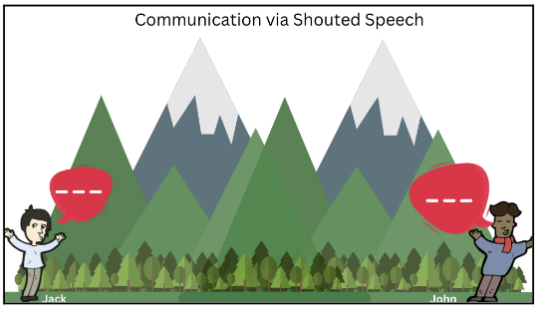
(Student Facing Format on following page)

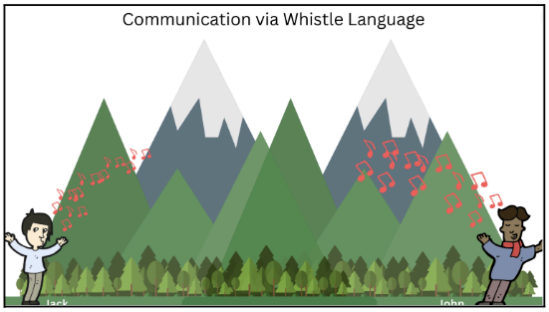
Student Assessment

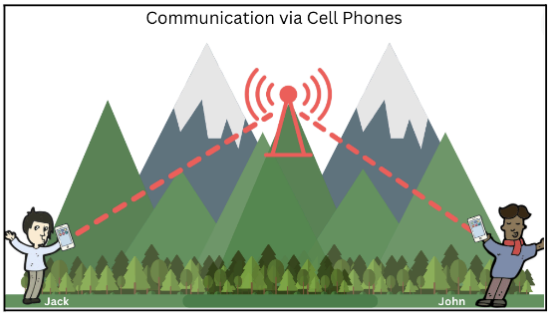
Name: _____ Date: _____

Stimulus

Jack and John are two friends living in a forest, mountainous area. They try to communicate using different formats: shouted speech, whistle language and cell phones.







The Whistle Language
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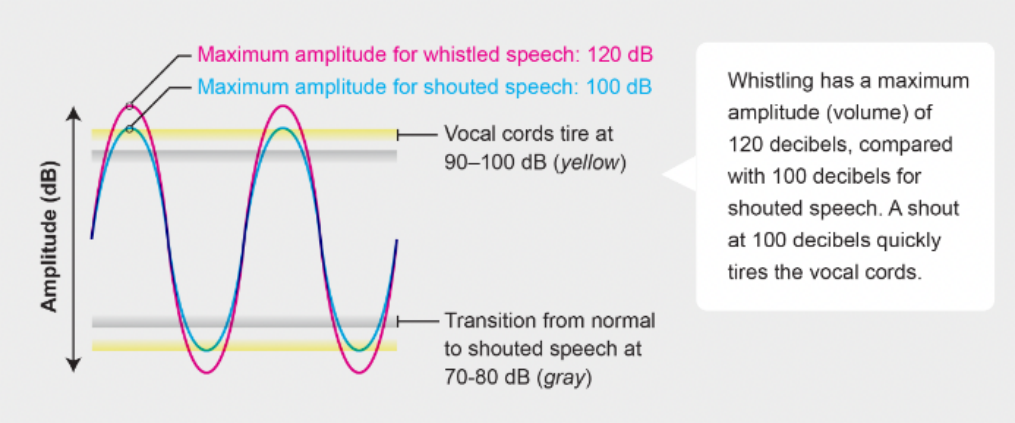

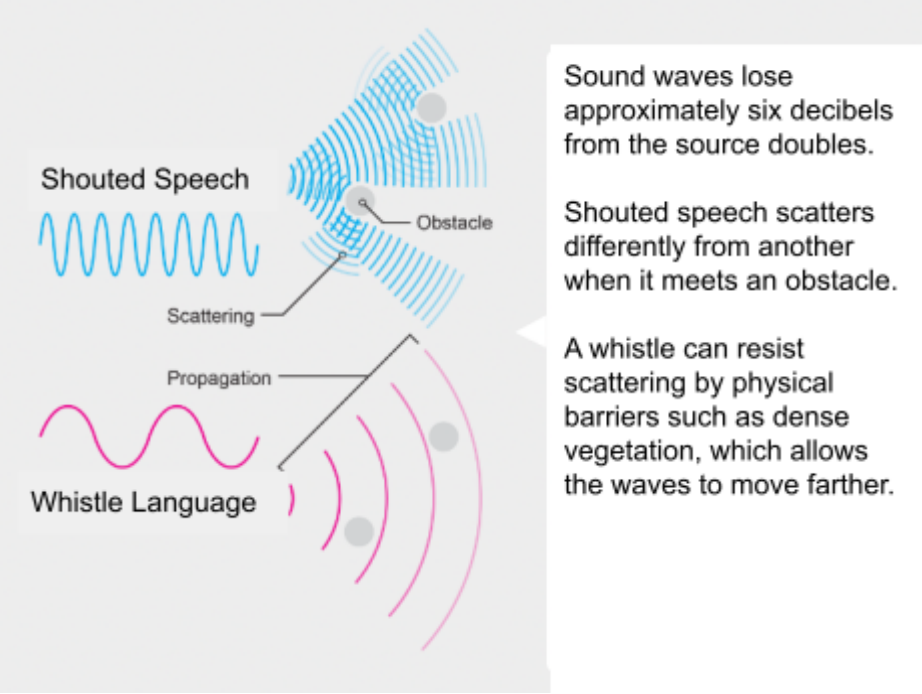

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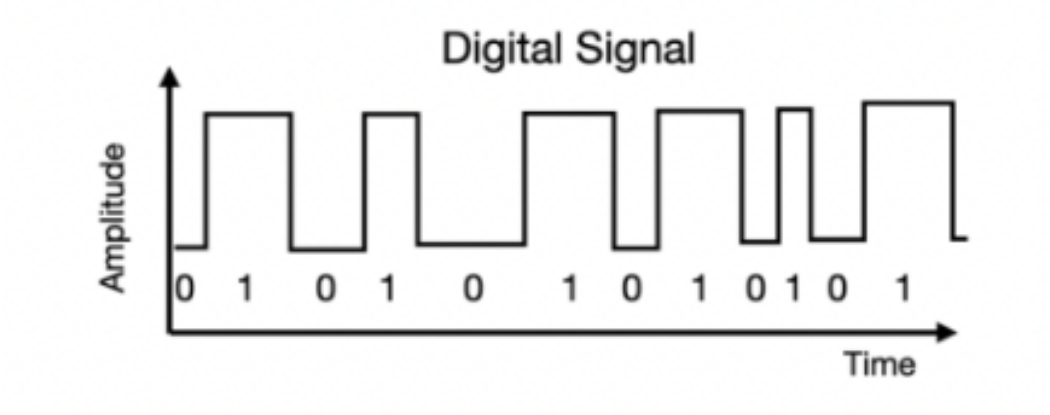

Your Task

In the questions that follow, you will use a video, text, diagrams, and information to answer questions and write a claim, evidence, and reasoning statement about the best way of communication for Jack and John.

Question 1

Use the following keywords to fill in the blanks.

Key words: Digital Analog

_____ signals use sound waves to transfer information. These signals do not use mathematical codes to transfer information.

_____ signals are sent as mathematically coded waves and can be sent over long distances. Once the waves arrive at a receiving station, they are decoded back into information that you can understand.

Question 2

Classify the different communication types as the type of signals used:

Communication type	Analog	Digital
Shouting		
Whistle		
Smoke Signal		
Cell Phone		

Question 3

Compare and contrast three different waves of communication in terms of distance of travel, accuracy of the information transferred, disturbance by the noise.

Key words: longest, long, short

	Shouted Speech	Whistle Language	Cell Phones
Distance of travel			

Keywords: higher, low, highest

	Shouted Speech	Whistle Language	Cell Phones
Accuracy of information transferred			

Key words: low, highest, lowest

	Shouted Speech	Whistle Language	Cell Phones
Disturbance by noise			

Question 4

Using information given above, write a CER (claim, evidence, reasoning) arguing which type of signals would be best to use if you want to communicate over a long distance.

Claim:

Evidence:

Reasoning: