

# AUV Communications

(Recommended for 8<sup>th</sup> – 12<sup>th</sup> Grades)

How do scientists talk to Puma and Jaguar AUVs when they are 4000 meters under the ocean?

## Digital Information Packets

Communication in water uses sound waves. Although sound waves are much slower, they travel much farther than either light or radio waves in water. All communication with sound depends on arrangements of frequency (pitch) and amplitude (loudness). When humans talk we use the sound patterns of speech, but a computer circuit responds to wave patterns that it can interpret as a rapid sequence of “on” and “off” states. Each tiny “on” or “off” part of the sound wave is called a “bit,” which is the fundamental unit of digital computing.

A bit by itself does not carry much information because it can only be on or off (represented as “1” or “0”), so the computer on the AUV uses a string of eight bits—called a byte—as its basic unit of information. In human language, a byte is like a letter, a number, or other symbol. There are 256 combinations of eight bits (binary counting) so the computer has 256 “letters” for communication.

With all the things an AUV has to do, it has very little time to “talk” to the scientists on the ship above, so it sends limited information packets composed of 32 bytes about every two minutes. Between information packets, it checks its position relative to the ship and the LBL net (long baseline navigation), receives a 32-byte information packet from the ship, and it checks its position again.

It is as if the AUV talks in sentences that only have 32 letters. At first that does not seem like much information, but we will find that it is plenty.

If you tried to talk in sentences containing 32 letters, it would come out like this:

WITH A BYTE PER LETTER YOU CAN SAY THIS.

(We are counting letters and punctuation, but not the spaces.)

DO YOU HAVE MY PEN? I NEED TO HAVE IT NOW.

Or you might say...

I GOT A IN MATH. CAN I USE THE CAR TONITE?

(Of course ‘tonite’ is spelled incorrectly!) If you always spoke in 32-byte sentences your language would sound simple, but engineers organize information packets so they can communicate as much information as possible using only 32 bytes. Your home address an example of organized information. In most cases a few well-placed words and numbers identify one house on one block in one city in the entire world.

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A mailing address avoids extra words by using a set order for information. We all assume that your name appears first, then the street, and so on. Another method used to shorten words is to use abbreviations. (Think “LOL” when you text or IM your friends!)

**SHORT ACTIVITY:**

Write out your home address and count the number of bytes that are used. Can you write your address in a 32 byte information packet? If it is more than 32 bytes, use abbreviations to shorten it. Make up abbreviations if you have to!