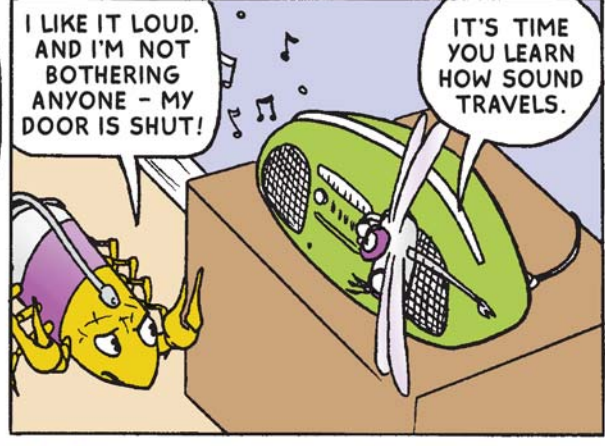
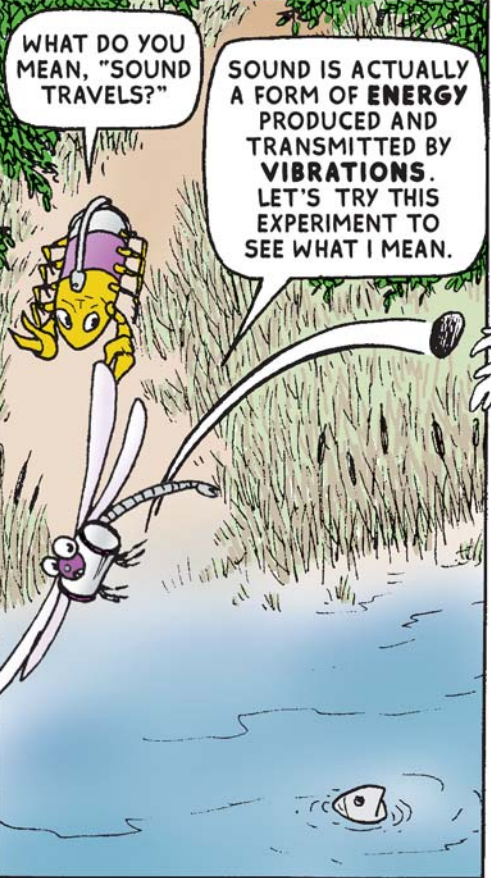


SCORPY! TURN THAT DOWN! YOUR MUSIC IS WAY TOO LOUD! YOU COULD DAMAGE YOUR HEARING AND BUG THE NEIGHBORS!



I LIKE IT LOUD. AND I'M NOT BOTHERING ANYONE - MY DOOR IS SHUT!

IT'S TIME YOU LEARN HOW SOUND TRAVELS.



WHAT DO YOU MEAN, "SOUND TRAVELS?"

SOUND IS ACTUALLY A FORM OF ENERGY PRODUCED AND TRANSMITTED BY VIBRATIONS. LET'S TRY THIS EXPERIMENT TO SEE WHAT I MEAN.



LOOK WHAT HAPPENED TO THE WATER.

AFTER THE ROCK WENT IN, RINGS FORMED CIRCLES AROUND THAT AREA. THE RINGS GET LARGER AS THEY MOVE AWAY FROM THE SPLASHDOWN.

SPLASH

THAT'S HOW SOUND WAVES MOVE. WE CAN'T SEE THE SOUND WAVES, BUT THAT'S HOW SOUND GETS FROM ONE PLACE TO ANOTHER. AND WE'VE GOT A LOT MORE TO EXPLORE ABOUT SOUND ENERGY.

SOUNDS LIKE A GREAT IDEA TO ME!

WHEN WE TOSS THE STONE INTO THE POND, THE RINGS WE MAKE ARE LIKE SOUND WAVES.

I LOVE WAVES - ESPECIALLY THE ONES AT THE BEACH!

OCEAN WAVES ARE A LITTLE DIFFERENT. SOUND WAVES ARE MORE LIKE THIS SPRINGY TOY.


SOUND WAVES ARE CALLED **LONGITUDINAL** - THAT MEANS THEY RIPPLE LIKE THIS TOY.

THE TOP OF EACH WAVE IS CALLED A **CREST**, AND THE BOTTOM OF EACH WAVE IS CALLED A **TROUGH**.

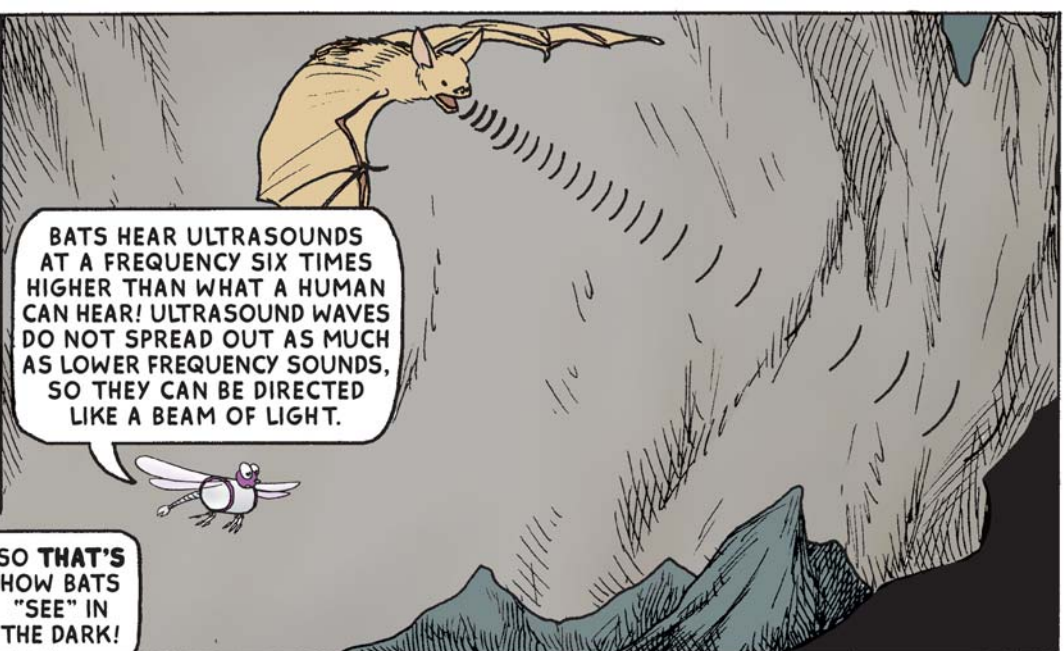
THE **WAVE LENGTH** IS THE DISTANCE FROM THE CREST OF ONE WAVE TO THE CREST OF THE NEXT WAVE. THE **FREQUENCY** IS THE NUMBER OF WAVES THAT PASS A POINT EACH SECOND.

WHO KNEW A SOUND WAVE HAS SO MANY PARTS?!


SOUND WAVES TRAVEL THROUGH SOLIDS, LIQUIDS, AND GASES AT DIFFERENT SPEEDS. THAT MEANS THEY **CAN** GO THROUGH YOUR BEDROOM DOOR IF YOU PLAY YOUR MUSIC LOUD ENOUGH! BUT THEY **DON'T** TRAVEL THROUGH VACUUMS - AREAS EMPTY OF ALL MATTER. SO THERE IS **NO SOUND IN SPACE**.



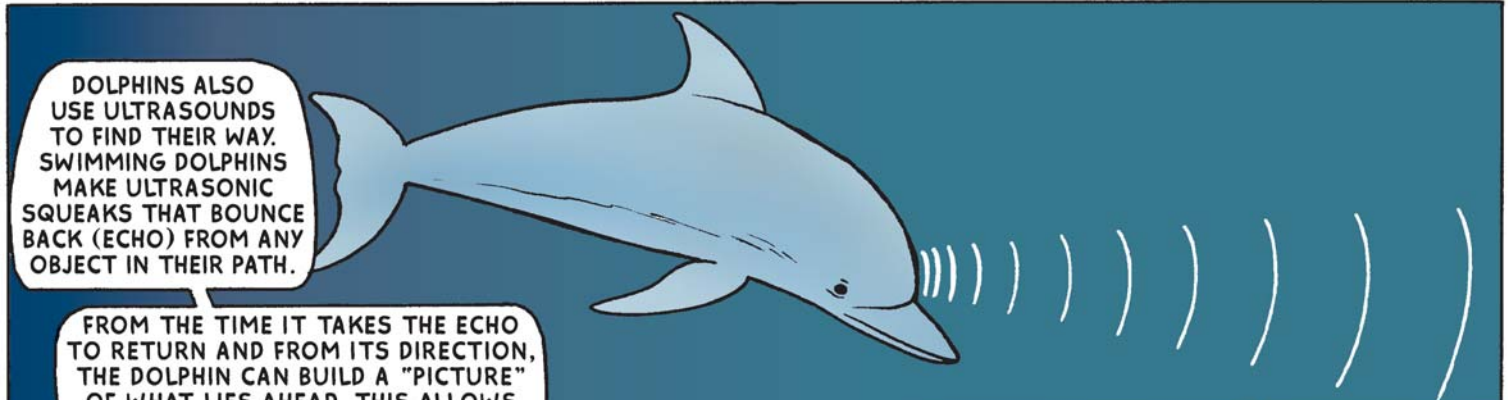
THERE IS A WHOLE WORLD OF SOUND THAT HUMANS CAN'T HEAR. HIGH-PITCHED SOUNDS WE CAN'T HEAR ARE CALLED **ULTRASOUNDS**. LOW-PITCHED SOUNDS WE CAN'T HEAR ARE **INFRASOUNDS**.




BATS HEAR ULTRASOUNDS AT A FREQUENCY SIX TIMES HIGHER THAN WHAT A HUMAN CAN HEAR! ULTRASOUND WAVES DO NOT SPREAD OUT AS MUCH AS LOWER FREQUENCY SOUNDS, SO THEY CAN BE DIRECTED LIKE A BEAM OF LIGHT.



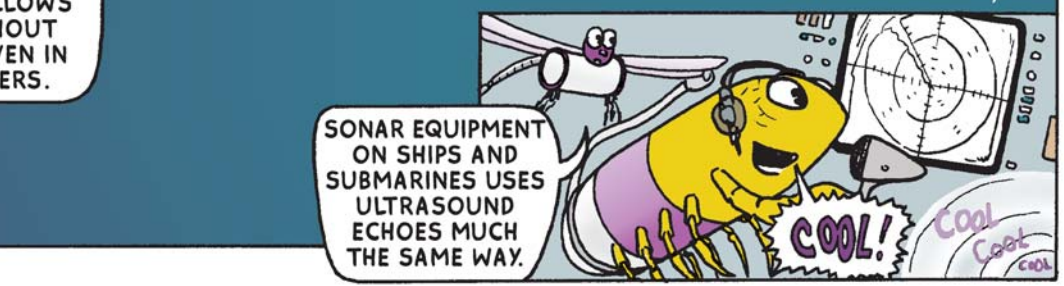
SO THAT'S HOW BATS "SEE" IN THE DARK!



DOLPHINS ALSO USE ULTRASOUNDS TO FIND THEIR WAY. SWIMMING DOLPHINS MAKE ULTRASONIC SQUEAKS THAT BOUNCE BACK (ECHO) FROM ANY OBJECT IN THEIR PATH.



FROM THE TIME IT TAKES THE ECHO TO RETURN AND FROM ITS DIRECTION, THE DOLPHIN CAN BUILD A "PICTURE" OF WHAT LIES AHEAD. THIS ALLOWS THE DOLPHIN TO SWIM WITHOUT BUMPING INTO ANYTHING, EVEN IN THE DEEPEST, DARKEST WATERS.



SONAR EQUIPMENT ON SHIPS AND SUBMARINES USES ULTRASOUND ECHOES MUCH THE SAME WAY.

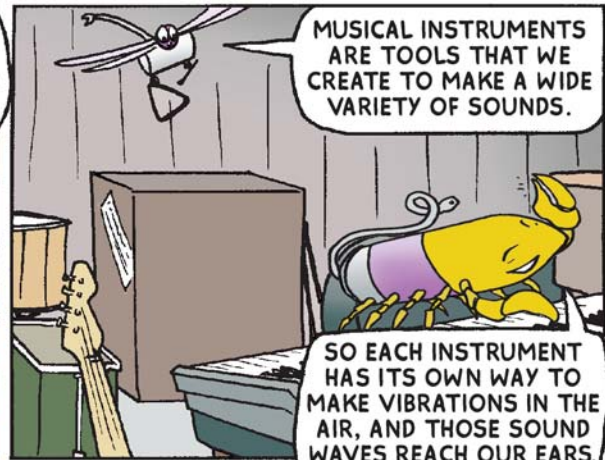
COOL!

Cool
Cool
Cool



OOOH! THAT'S A PRETTY SOUND.

YES, ATTENDING A MUSICAL CONCERT IS A GREAT WAY TO EXPLORE SOUND. LET'S LOOK AT MUSICAL INSTRUMENTS AND HOW THEY WORK.



MUSICAL INSTRUMENTS ARE TOOLS THAT WE CREATE TO MAKE A WIDE VARIETY OF SOUNDS.

SO EACH INSTRUMENT HAS ITS OWN WAY TO MAKE VIBRATIONS IN THE AIR, AND THOSE SOUND WAVES REACH OUR EARS.

YES! WE CLASSIFY INSTRUMENTS BASED ON WHAT VIBRATES. THE FOUR MAIN GROUPS ARE STRINGS, BRASS, WOODWINDS, AND PERCUSSION.

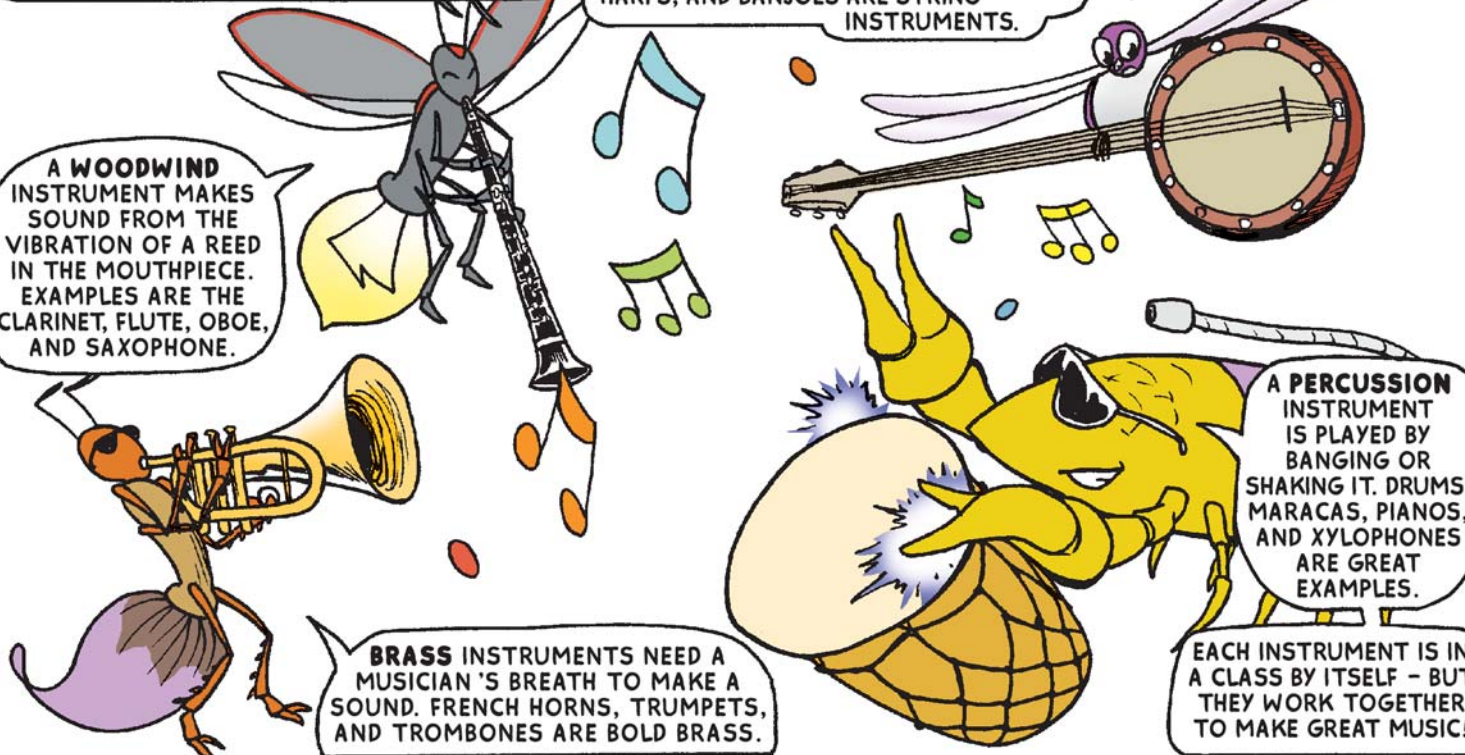
STRING INSTRUMENTS ARE PLAYED BY PLUCKING, STRUMMING, PICKING, OR BOWING THE STRINGS. GUITARS, VIOLINS, HARPS, AND BANJOS ARE STRING INSTRUMENTS.


A **WOODWIND** INSTRUMENT MAKES SOUND FROM THE VIBRATION OF A REED IN THE MOUTHPIECE. EXAMPLES ARE THE CLARINET, FLUTE, OBOE, AND SAXOPHONE.

BRASS INSTRUMENTS NEED A MUSICIAN'S BREATH TO MAKE A SOUND. FRENCH HORNS, TRUMPETS, AND TROMBONES ARE BOLD BRASS.

A **PERCUSSION** INSTRUMENT IS PLAYED BY BANGING OR SHAKING IT. DRUMS, MARACAS, PIANOS, AND XYLOPHONES ARE GREAT EXAMPLES.

EACH INSTRUMENT IS IN A CLASS BY ITSELF - BUT THEY WORK TOGETHER TO MAKE GREAT MUSIC!





WE LIVE IN A WORLD FILLED WITH SOUND, SCORPY. NOISE LEVELS HERE AT THE AIRPORT CAN BE HIGH ENOUGH TO CAUSE PHYSICAL DAMAGE TO OUR EARS.

NO KIDDING! THIS IS EVEN LOUDER THAN MY ROOM!

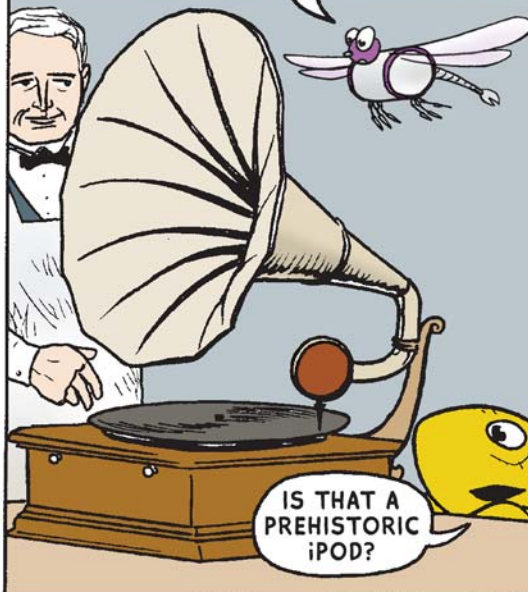


BUT SOUND CAN REACH US IN EVEN THE QUIETEST MOMENTS. HEAR THE WIND RUSTLING THE LEAVES? OR THE SOUND OF OUR OWN BREATHING?



WE'VE KNOWN THAT SOUND IS VIBRATION IN THE AIR EVER SINCE THE GREEK PHILOSOPHER **ARISTOTLE** FIGURED IT OUT 2,500 YEARS AGO.

REMEMBER WHEN WE MET **THOMAS EDISON**? WHILE TRYING TO MAKE A BETTER TELEPHONE, HE NOTICED THAT THE THIN MEMBRANE IN THE MOUTHPIECE OF THE PHONE VIBRATED IN TUNE WITH THE VOICE SPEAKING INTO IT. HE GOT THE IDEA TO RECORD SOUNDS SO WE COULD PRESERVE THEM. IN 1878 EDISON APPLIED FOR A PATENT FOR HIS NEW INVENTION, THE PHONOGRAPH!



IS THAT A PREHISTORIC IPOD?

YOU DON'T HAVE TO PLAY YOUR MUSIC LOUDLY TO ENJOY IT. IN FACT, EXCESSIVE LOUDNESS CAN CAUSE A PERMANENT LOSS OF HEARING OR EVEN DEAFNESS.



I HEAR THE SONG YOU'RE SINGING: LOUDER IS NOT ALWAYS BETTER!