Reading Science

Name: _____ Date: _____

Supersonic Ships?

1 Sound waves move differently through different media. In general, they travel faster in liquids and solids than in air. The speed of sound in dry air is 343 m/s at 20ºC. It is faster at sea level than at higher altitude, because the air is denser at sea level. Increased humidity also increases sound velocity slightly, by about 0.1–0.6%. Airplane speeds are often reported in Mach numbers. The Mach number depends on the medium that the object travels through. To calculate a Mach number, divide the speed of an object by the speed of sound in a medium.

2 Sound travels at a much higher speed through water. The speed of sound is 1533 m/s through seawater. However, it is only 1493 m/s through fresh water at the same temperature and depth. The speed of sound increases with elevated temperatures and salinity. Sound also travels faster when water pressure increases, such as at greater depths in the ocean. By comparison, sound velocity in steel is about 5100 m/s. Therefore, you can hear an approaching train from farther away by putting your ear on the railroad track than by simply listening for it.

3 If you live near an Air Force base, you might hear an occasional loud boom as a fast moving fighter jet passes overhead. The boom indicates that the jet has broken the sound barrier. During flight, an airplane pushes the air ahead of it. As the jet approaches the speed of sound, the air does not have time to get out of the way. A sonic boom is created as the airplane breaks through the sound barrier. The sonic boom wave starts at the nose and sweeps along the plane, as shown in the picture above. The sonic boom travels at the speed of sound away from the aircraft. It will reach your ears after the aircraft has passed overhead.

4 On October 14, 1947, Charles “Chuck” Yeager, flying the *Bell X-1*, was the first person to break the sound barrier in level flight. Since then, both military and commercial aircraft have broken the sound barrier. Although unmanned aircraft have traveled faster, the fastest manned plane is the *SR 71 Blackbird*. It has traveled at 936 m/s, or about three times the speed of sound, Mach 3. The *SR 71 Blackbird* holds the record for a manned air-breathing flight

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for both speed and altitude. It was retired in 1999. The only supersonic commercial airliner flown to date was the *Concorde*. It crossed the Atlantic between New York and Paris at twice the speed of sound. The *Concorde* traveled at a cruising speed of Mach 2. Only 20 *Concordes* were ever built, and it was retired in 2003.

5 In contrast, the fastest ship was the *Spirit of Alaska*, traveling at 142 m/s in 1978. If the *Spirit of Alaska* traveled in fresh water, its speed would be about 0.1 Mach. Merchant ships carry cargo. They are more concerned about fuel costs than transit time between ports. They travel about 11 m/s. Cruise ships carry passengers. They try to arrive in port in the morning so passengers have time to explore the city. They may travel at slightly higher speeds. The top published speed of Navy vessels is about 26 m/s. During wartime, ships may have to worry about torpedoes. Even torpedoes, which are much smaller and more streamlined than ships, travel below the speed of sound. The maximum torpedo speed is about 103 m/s. Ships and submarines use sonar technology to detect torpedoes with sound waves. If they can detect the torpedo before it arrives, they can take action to avoid being struck.

6 Several factors combine to make it difficult to build supersonic ships. The first factor involves the motion of an object through water. Water is much more dense than air. Thus water has much more drag than air due to friction and turbulence. At the same time, sound travels through water much faster than it travels through air, so the sound barrier is greater in water than in air. Combined, these facts make it difficult to build a supersonic ship.