Amateur radio operators have been hearing this sound for decades, especially at 'dawn'. It is an eerie sound, like a chorus of birds chirping, so it was called Dawn Chorus.

This sound cannot be heard with ordinary ears even though it is in the right frequency range. Because it is a radio wave, you need a radio receiver to hear it.

Space physicists have tried to understand what produces this electromagnetic 'sound wave', but whatever is producing it is occurring somewhere in the Van Allen belts high above Earth.

During its 60-day checkout phase, the twin Van Allen Probes satellites captured chorus waves close to where they are being produced in the Van Allen belts. As the satellites continue to take more data, scientists hope to be able to triangulate the location of these waves to their place of origin. This will provide scientists with a HUGE clue about what is causing them in the first place.

Let's have a look at how they will 'triangulate' the chorus position in space using simple graphing techniques, a compass and the Pythagorean Theorem!

Problem 1 – Suppose the two spacecraft are located at points P1 (+4.0, +2.0) for VAP-A and P2 (+5.0, -1.0) for VAP-B on a coordinate grid where Earth is at the center and each unit on the coordinate axis is an interval of 6,400 kilometers. (Note 1 unit = radius of Earth). Graph this data on a coordinate grid which has an X-domain from [-5.0, +5.0] and a y-range from [-5.0, +5.0].

Problem 2 – If 1 unit on the graph equals the radius of Earth, what is the domain and range of the graph in kilometers?

Problem 3 - What is the separation between the Van Allen Probes spacecraft in kilometers? (Hint: Use either the 2-point distance formula or a ruler!).

Problem 4 – From the location of VAP-A, the distance to the chorus source was found to be 12,800 km. From VAP-B it was 19,200 km. What point inside the orbits of the spacecraft is consistent with these measurements?

Problem 1 – Suppose the two spacecraft are located at points P1 (+4.0, +2.0) for VAP-A and P2 (+5.0, -1.0) for VAP-B on a coordinate grid where Earth is at the center and each unit on the coordinate axis is an interval of 6,400 kilometers. (Note 1 unit = radius of Earth). Graph this data on a coordinate grid which has an X-domain from [-5.0, +5.0] and a y-range from [-5.0, +5.0]. Answer: **See figure below**

Problem 2 – If 1 unit on the graph equals the radius of Earth, what is the domain and range of the graph in kilometers?

Answer: 5 units = 5 x 6400km = 32,000km.
X domain [-32,000 km, + 32,000 km], Y range [-32,000 km, +32,000 km].

Problem 3 - What is the separation between the Van Allen Probes spacecraft in kilometers? (Hint: Use either the 2-point distance formula or a ruler!).

Answer: $d^2 = (5.0-4.0)^2 + (-1.0-(-2.0)^2$, $d^2 = 10.0$ so d= 3.16 units. In kilometers this is 3.16 x 6400 = **20,224 kilometers**.

Problem 4 – From the location of VAP-A, the distance to the chorus source was found to be 12,800 km. From VAP-B it was 19,200 km. What point inside the orbits of the spacecraft is consistent with these measurements?

Answer: 12,800 km/ 6,400km =   2.0 units. 19,200 km/6400 km = 3.0 units. Pt (+2.5, +1.0) or **(+16000 km, +6400 km)**