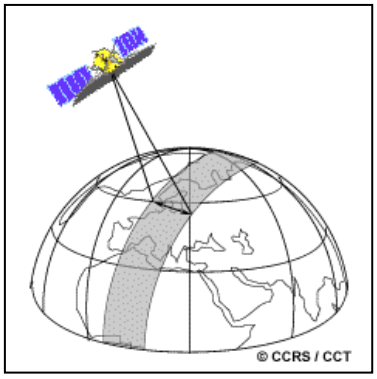

When a satellite looks down on the Earth from space, it only sees a small part of the surface at a time during each orbit. But after many orbits, it eventually sees all of the surface so that a full map can be put together.

This figure shows one 'swath' of images seen by the satellite during part of its orbit.

Problem 1 – A satellite at an altitude of 500 km above the surface orbits Earth from pole to pole once every 90 minutes. How many times does it pass across the Equator?

Problem 2 – If the satellite passes across the Equator going north to south during the first half of its orbit, what direction does it pass across the equator during the second half of the orbit?

Problem 3 – How many times does the satellite pass over the Equator every day if 1 day = 24 hours?

Problem 4 - If the satellite can view a swath of Earth's surface that is 2500 km wide, how many orbits will it take to view all of the Equatorial areas of Earth, if the radius of Earth is 6378 km?

Problem 5 – Draw a scaled diagram of a satellite located 500 km above a flat surface. Draw a vertical line from the satellite perpendicular to the surface. Complete the right triangle by drawing a hypotenuse from the satellite to the surface with a base length of 2500 km/2 = 1250 km. What is the measure of the angle from the satellite between the perpendicular segment and the hypotenuse? (Use a protractor, or use the property of tangents.)

Problem 6 – The distance to the horizon of a planet is given by the formula $D = (2Rh)^{1/2}$ where R is the planet's radius in km, and h is the height of the satellite above the ground in km. For the satellite problem above, what is the maximum swath width that can be viewed by the satellite?

Problem 1 – A satellite at an altitude of 500 km above the surface orbits Earth from pole to pole once every 90 minutes. How many times does it pass across the Equator?

Answer: It will cross the Equator exactly twice per orbit.

Problem 2 – If the satellite passes across the Equator going north to south during the first half of its orbit, what direction does it pass across the equator during the second half of the orbit?

Answer: The satellite will travel south to north across the equator during the second half of the orbit.

Problem 3 – How many times does the satellite pass over the Equator every day if 1 day = 24 hours?

Answer: 90 minutes / 24 hours = 16 orbits. During each orbit it passes across the equator twice, so in one day it passes across the equator 2 x 16 = 32 times.

Problem 4 - If the satellite can view a swath of Earth's surface that is 2500 km wide, how many orbits will it take to view all of the Equatorial areas of Earth, if the radius of Earth is 6378 km?

Answer: The circumference of Earth is given by $C = 2 \pi R$ so C = 2 (3.141 x 6378 km) = 40,066 km. The number of swaths is given by 40066/2500 = 16. But each orbit counts for two equatorial swaths, so we only need 8 orbits to provide 16 swaths at the equator, and this will cover all of the equatorial area when the swath images are placed exactly side by side.

Problem 5 – Draw a scaled diagram of a satellite located 500 km above a flat surface. Draw a vertical line from the satellite perpendicular to the surface. Complete the right triangle by drawing a hypotenuse from the satellite to the surface with a base length of 2500 km/2 = 1250 km. What is the measure of the angle from the satellite between the perpendicular segment and the hypotenuse? (Use a protractor, or use the property of tangents.)

Answer: Tan(theta) = 1250/500 = 2.5, so **Theta = 68^{o}**, and the full swath viewing angle is 2 x 68 = 136^{o}.

Problem 6 – The distance to the horizon of a planet is given by the formula D = (2Rh)1/2 where R is the planet's radius in km, and h is the height of the satellite above the ground in km. For the satellite problem above, what is the maximum swath width that can be viewed by the satellite? D = (2 x 500 x 6378)1/2 = **2525 km**, so the swath is about equal to the maximum area of the Earth that can be viewed from horizon to horizon at the altitude of the satellite.