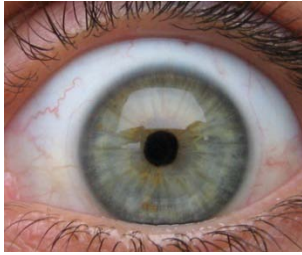




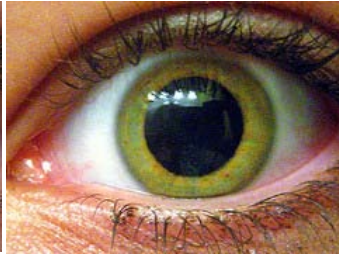
My, What Big Eyes You Have
JWST: The Better to See the Universe With
Larry and Nancy Lebofsky and the NIRCAM Team
and Michelle Higgins and the GSSoAZ STEM Team



We all know that a telescope enables us to see objects that are much fainter than the human eye can see by itself. A telescope can see fainter objects because it gathers more light from a much bigger opening (telescope lens or telescope mirror) than the eye (pupil).



Your pupil in bright light: diameter = 2 mm



Your pupil in dim light: diameter = 8 mm

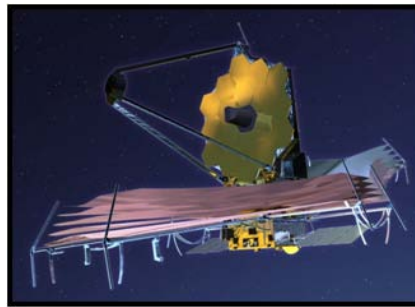


Binoculars: diameter = 50 mm



8-inch telescope: diameter = 200 mm

How much more light does a telescope gather? The pupil of the human eye can go from 2 mm to 8 mm in diameter. If we assume a typical size to be 6.5 mm, we can compare the pupil of an eye to the mirror of an 8-inch (200 mm) telescope (the size of many personal telescopes) and the mirror of the James Web Space Telescope (JWST), which is 6.5 m (6,500 mm or 21.3 ft) in diameter. This means that the JWST is 1,000 times the diameter of the pupil.



James Webb Space Telescope
Diameter = 6,500 mm



Figure (left): About 6.5 disks across the diameter of the CD and 32 disks covering the entire area of the CD.

Figure (right): About 21 disks across the entire area of the pizza pan and 336 disks covering the entire area of the pizza pan.



For the circles above, the diameter of the pizza pan on the right is about 3.2 times the diameter of the CD on the left while the area (the number of disks it takes to cover them) of the pizza pan on the right is about 10 times the area of the CD (3.2 X 3.2). The amount of light collected does not depend simply on the width (diameter) of the lens or mirror but instead on the entire surface (area) of the lens or mirror. So, since the diameter of JWST is about 1,000 times the diameter of the pupil of a human eye, the area is 1,000,000 times the area of the pupil of a human eye (1000 X 1000). If you think of the area of the pupil or the area of the JWST mirror as a bucket that can capture light, the JWST can “capture” 1,000,000 times more light than the human eye!

