Binoculars

Construction:
Porro Prism—yield brighter, sharper images than roof prism. More noticeable on night sky than terrestrial objects.
Roof Prism—more compact than porro prism but don't reflect light as effectively, as they require one internal surface to be aluminized, slightly dimming the image.

Glass: The better prisms are made from BAK-4 (barium crown) glass. They yield brighter, sharper images than those with the cheaper Bk-7 (borosilicate) glass. If in doubt as to which you have, hold the binoculars at arms length and angle them to a light source and look at the exit pupils. If they are round they are BAK-4, if they are diamond shaped with gray-edged shadows, they are Bk-7.
Multicoated optics is the best as they cut down on reflection. You will see a green reflection in the glass when held at an angle to the light, if they are multicoated.

Magnification x diameter: The first number refers to the magnification factor, and the second refers to the diameter of each of the two front lenses. Example: 7 x 35 means 7x (power) and 35mm diameter front elements. Most binoculars range from 7 x 35 to 20 x 125. **Types:** *Wide angle* show wider field of view, and can go as wide as 11 or 12 degrees before getting aberrations from coma. *Giant* are greater than 10x and usually require mounting. *Zoom* are variable magnification, but are heavier, more expensive, and darker at the far end of the range.

Field of View: This is the angle of coverage visible through the binoculars. It is usually expressed in degrees, and is listed as the *real angular field of view*. For example the Nikon 8 x 20 Sportstar binoculars list a real field of view as 6.3 degrees. Sometimes the specs express this as separation in feet (or meters) at 1000 yards (or in meters). Example: 325 feet at 1000 yards, meaning a 325-foot ruler would just fit in the view from 1000 yards away. (To calculate the degrees, divide the number of feet by 52.5 --about 6 degrees is this example). You may also see a reference to *angular apparent field of view*, which refers to the binoculars edge-to-edge angular diameter as seen by the observer's eye, usually shown in degrees. The *real apparent field of view* is the apparent field divided by the magnification. For example, the Nikon binoculars mentioned list an apparent filed as 50.4 degrees. Divide this by 8 since they are 8 x 20, and you get a real field of 6.3 degrees.

Exit Pupil: This is the diameter of the beam of light leaving the binoculars eyepieces. It can be calculated by dividing the size of the aperture by the magnification. For example 7 x 35 binoculars would have an exit pupil of 5mm (35 divided by 7). The exit pupil size should match the clear diameter of the observer's pupils. Most people's range is from about 2.5mm under bright light conditions, to 7mm in low light or night viewing. This varies with each person and with age. Under dark, rural skies a 7mm exit pupil is best, so 7 x 50 or 10 x 70 binoculars would be ideal, for example. If you are older, or are viewing from a city or under light polluted conditions, a 4 or 5mm exit pupil might be best (7 x 35 or 10 x 50, etc.).

Other considerations: *Cost* is always a factor. *Weight*-can you handhold it or will it need to be mounted. *Eye Relief*- the distance your eye can be from the eyepieces when the entire filed of view is seen at once, especially a concern to eyeglass wearers. *Interpupilary distance*- refers to the closest and farthest the eyepieces will separate to accommodate the distance between your eyes. This is measured from the center of the glass in the eyepieces. For example 60mm works best for me, and the Nikon binoculars mentioned, list a 56-72mm interpupilary range of adjustment, so they work fine for me. *Mounting*- do they have a tripod mounting screw, or some way to mount them?

(Handout for Astronomy Club of Asheville, by Tim Barnwell. Direct corrections and additions to him.)