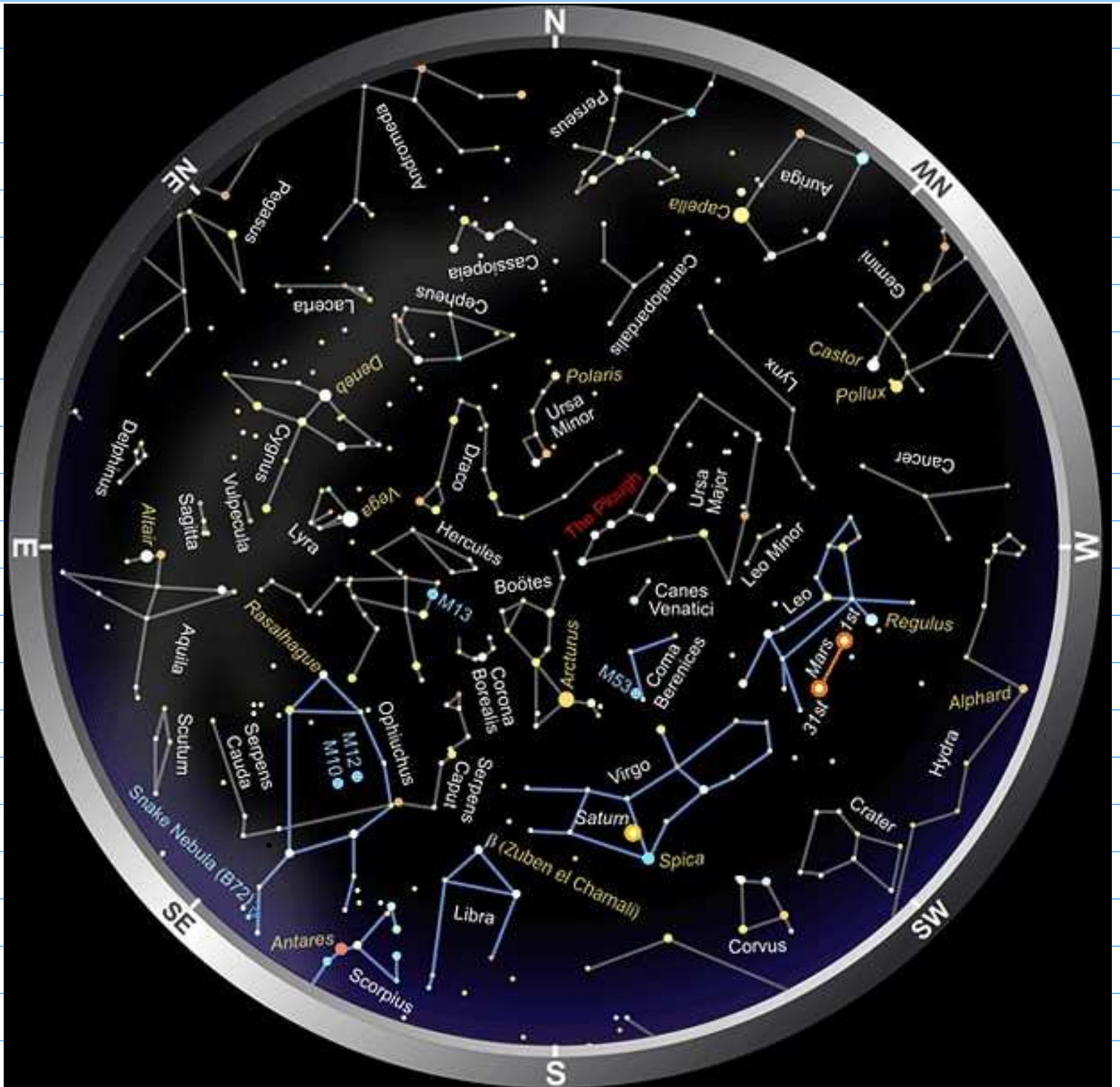


NIGHT Sky



NIGHT SKY IN MAY

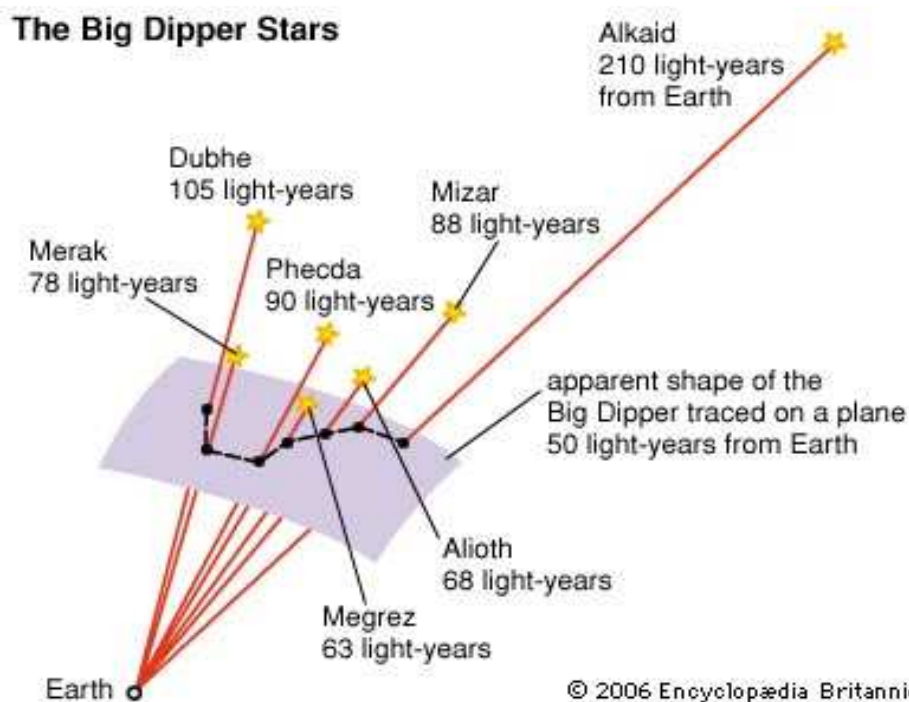
STARS: POLARIS (NORTH STAR), VEGA, DENEUB, ALTAIR, ANTARES, SPICA, ...

CONSTELLATIONS: GROUPS OF STARS WHICH LIE IN APPROXIMATELY THE SAME DIRECTION (THE ONLY THING THEY HAVE IN COMMON - THEY MAY NOT BE CLOSE TO EACH OTHER IN SPACE)

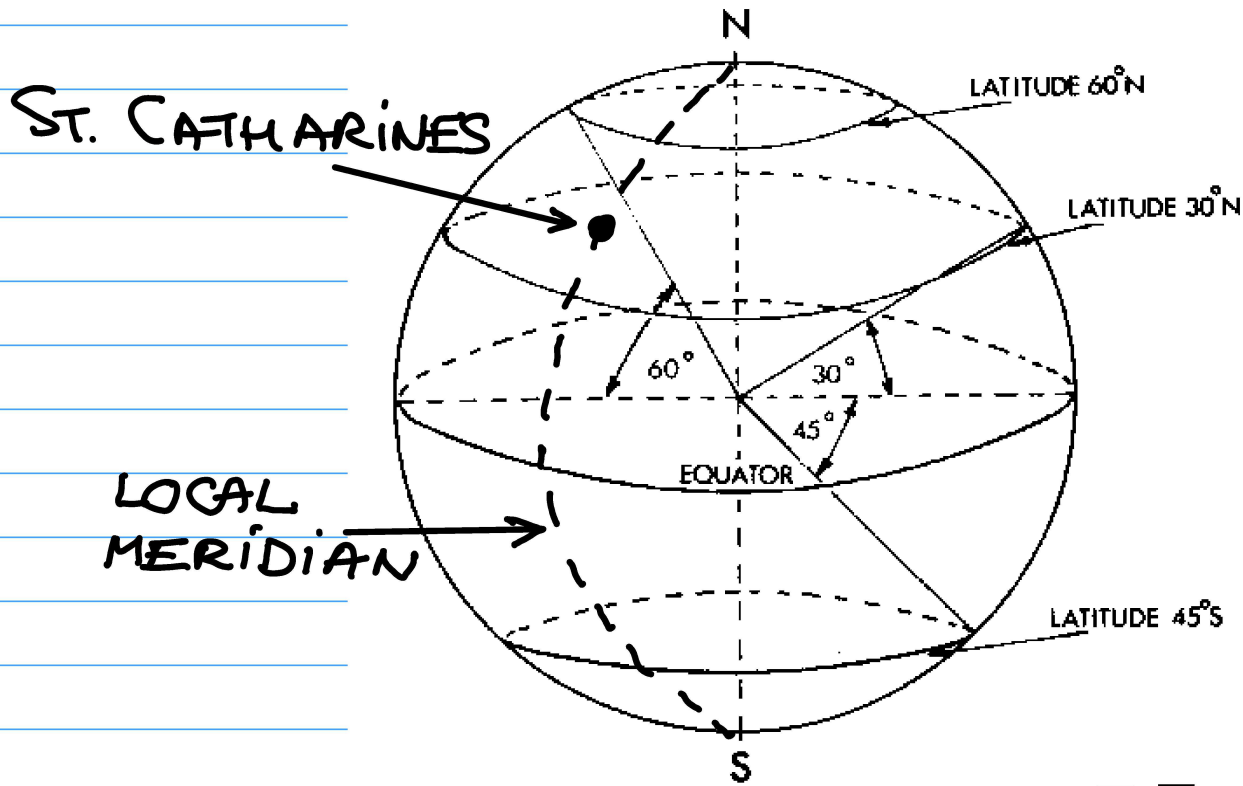
EXAMPLES: VIRGO, LEO, CANCER, LIBRA, ORION, ...

THERE ARE 88 CONSTELLATIONS; 44 WERE KNOWN IN THE ANCIENT TIMES (WE TAKE THEIR NAME FROM GREEK TRANSLATED INTO LATIN)

ASTERISMS: BIG DIPPER, LITTLE DIPPER

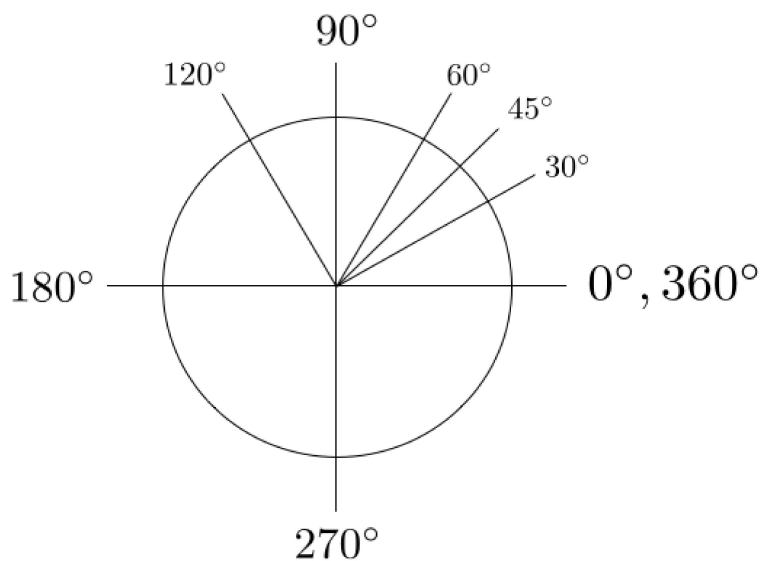


THE NIGHT SKY THAT WE SEE
DEPENDS ON OUR LATITUDE ON EARTH

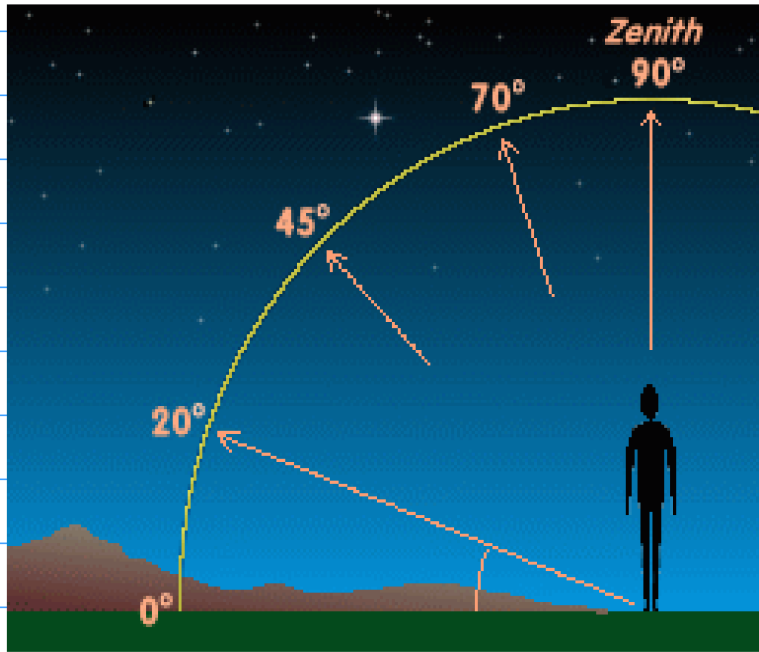


THE LATITUDE OF ST. CATHARINES IS
 43.167° N (ORTH).

RECALL:

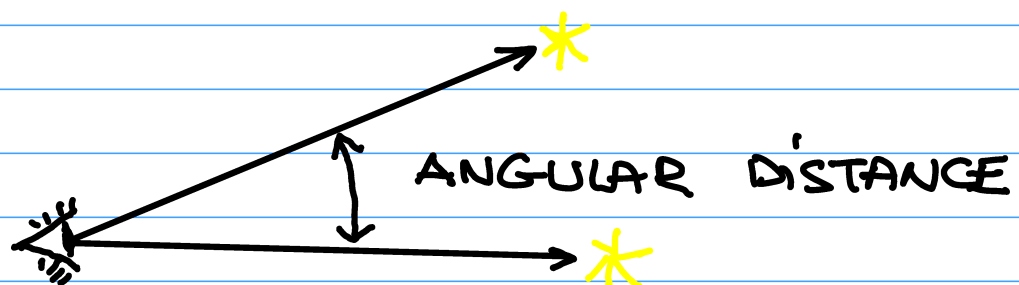


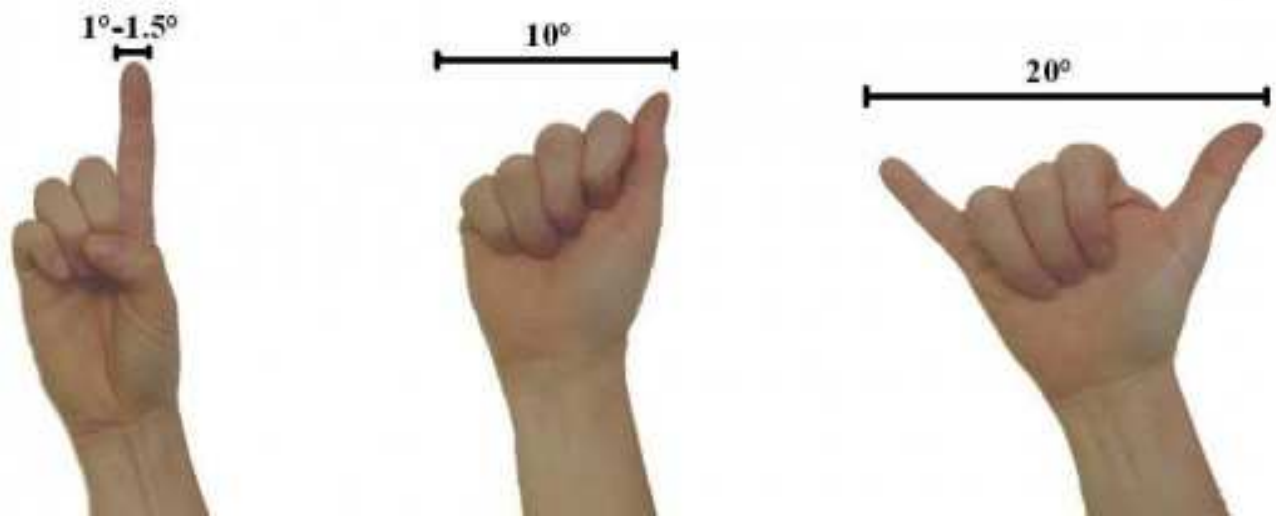
NO MATTER WHERE WE ARE ON EARTH WE ARE ALWAYS UPRIGHT AND THE SKY IS UP :



THE ALTITUDE OF AN OBJECT IN THE SKY IS ITS ANGLE ABOVE THE HORIZON,

THE ANGULAR SIZE/DISTANCE IS THE ANGLE BETWEEN TWO DIRECTIONS FROM THE EYE TO TWO POINTS IN THE SKY:



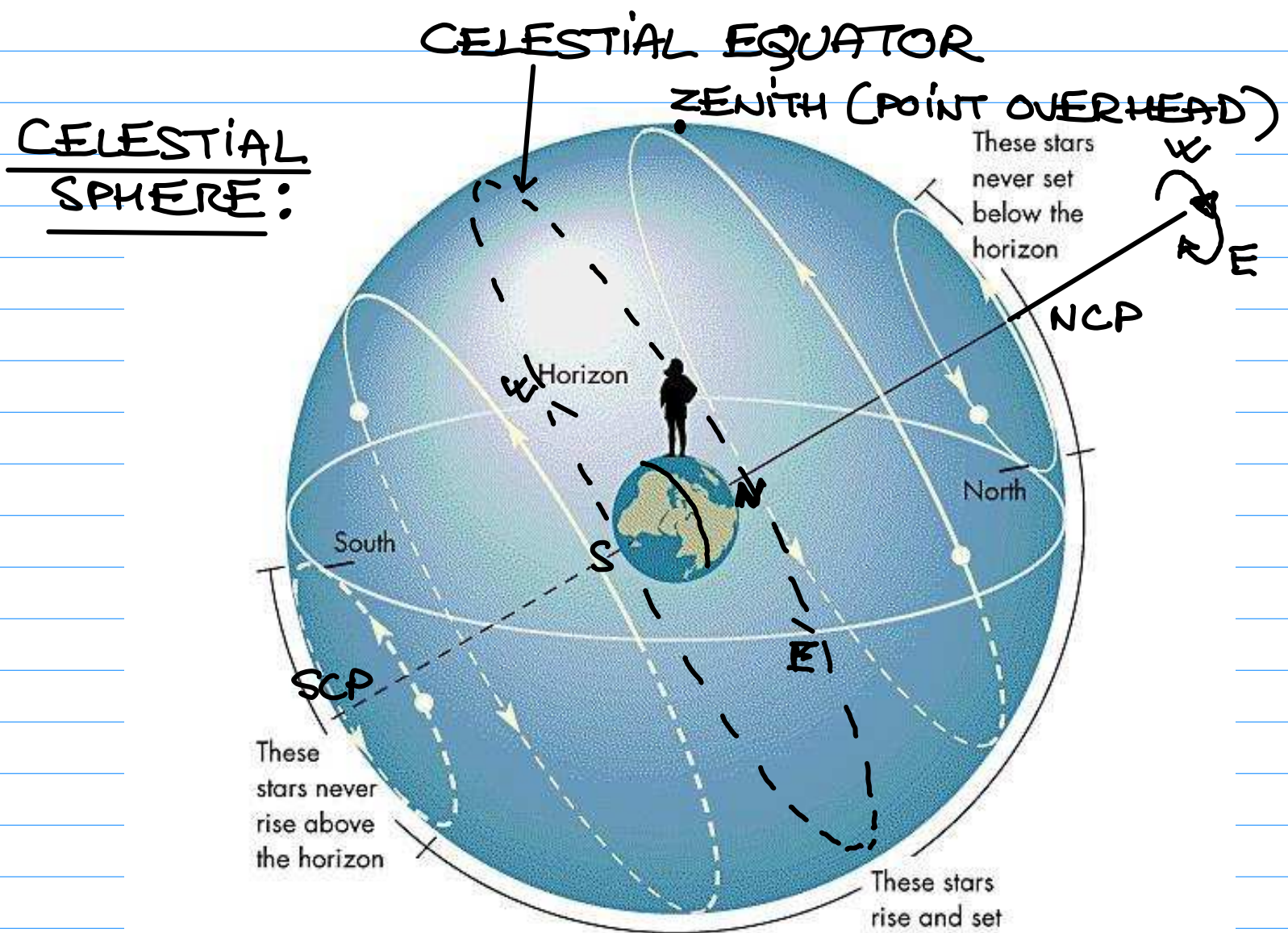


BECAUSE THE EARTH IS 1) ROTATING FROM WEST TO EAST (ONE FULL ROTATION IN 24h) AND IT IS 2) REVOLVING AROUND THE SUN (ONE FULL REVOLUTION IN $365\frac{1}{4}$ DAYS) THERE ARE TWO TYPES OF (APPARENT) STAR AND SUN MOTIONS:

1) DAILY (DIURNAL) MOTIONS RESULTING FROM THE EARTH'S ROTATION ABOUT ITS NORTH - SOUTH AXIS.

2) ANNUAL MOTIONS RESULTING FROM THE EARTH'S REVOLUTION AROUND THE SUN.

TO DESCRIBE THESE MOTIONS WE USE THE CONCEPT OF CELESTIAL SPHERE - IT IS AN IMAGINARY SPHERE WITH A RADIUS WHICH IS MUCH BIGGER THAN THE RADIUS OF THE EARTH AND IS CENTERED ON EARTH:



BECAUSE THE EARTH IS REVOLVING FROM WEST TO EAST WE OBSERVE THE STARS MOVING FROM EAST TO WEST.

THE NORTH CELESTIAL POLE (NCP) IS A POINT ON CELESTIAL SPHERE DIRECTLY ABOVE THE EARTH'S NORTH POLE.

THE SOUTH CELESTIAL POLE (SCP) IS A POINT ON CELESTIAL SPHERE DIRECTLY ABOVE THE EARTH'S SOUTH POLE.

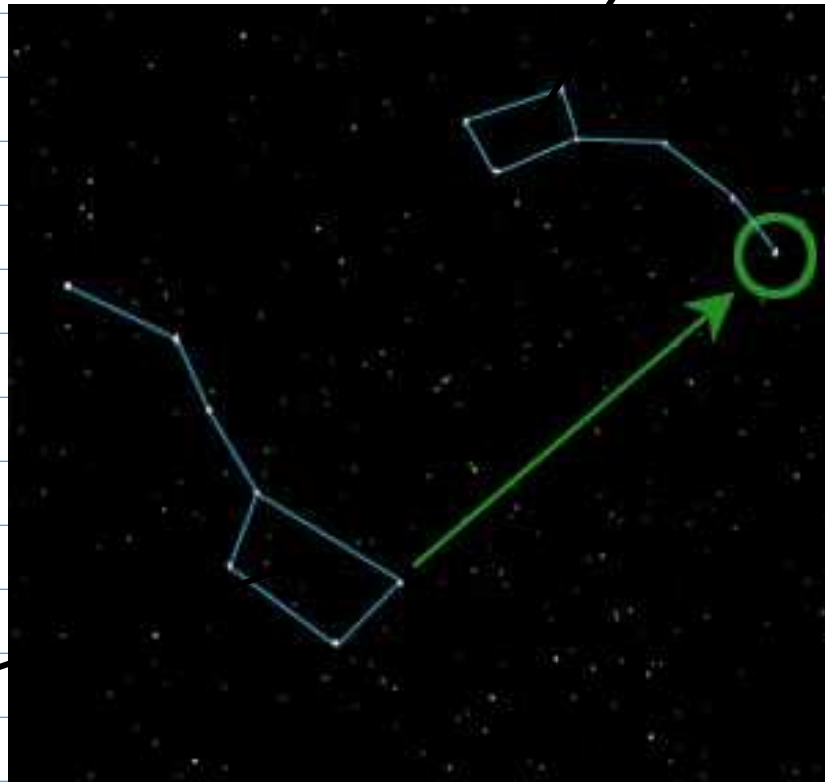
THE CELESTIAL EQUATOR IS A GREAT CIRCLE ON CELESTIAL SPHERE DIRECTLY ABOVE THE EARTH'S EQUATOR.

NOTE: BECAUSE THE EARTH'S ROTATION AXIS IS PERPENDICULAR TO THE EQUATORIAL PLANE WE OBSERVE THAT THE STARS AND THE SUN MOVE ON CELESTIAL SPHERE PARALLEL TO CELESTIAL EQUATOR.

THE CELESTIAL HORIZON (OR SIMPLY HORIZON) IS OBTAINED BY EXTENDING THE HORIZON OF THE OBSERVER ALL THE WAY OUT TO CELESTIAL SPHERE.

STAR POLARIS IS VERY CLOSE TO NCP:

LITTLE DIPPER



POLARIS
(NORTH STAR)

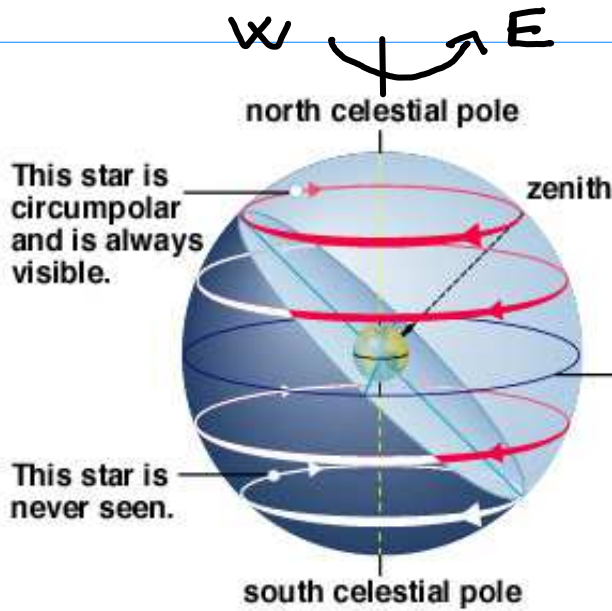
BIG DIPPER

THE STARS/CONSTELLATIONS WHICH ARE SUFFICIENTLY CLOSE TO A CELESTIAL POLE (NORTH OR SOUTH) NEVER RISE OR SET. THEY ARE CALLED CIRCUMPOLAR STARS/CONSTELLATIONS.

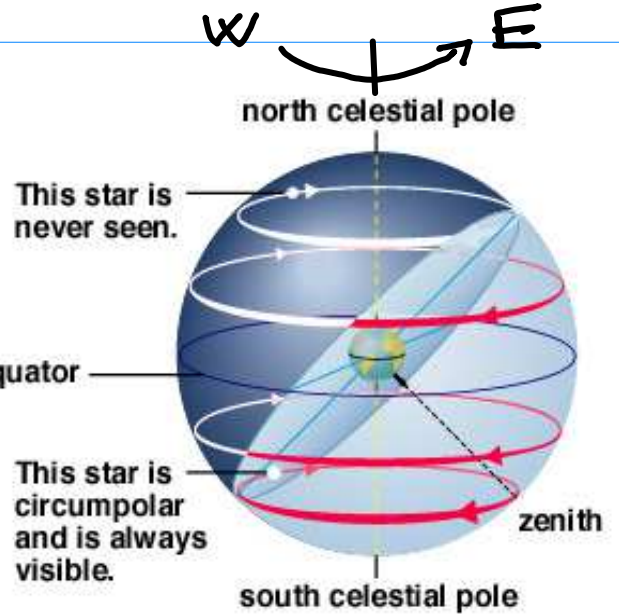


NCP

THE CIRCUMPOLAR STARS MOVE AROUND NCP (SCP) IN COUNTERCLOCKWISE (CLOCKWISE) DIRECTION:



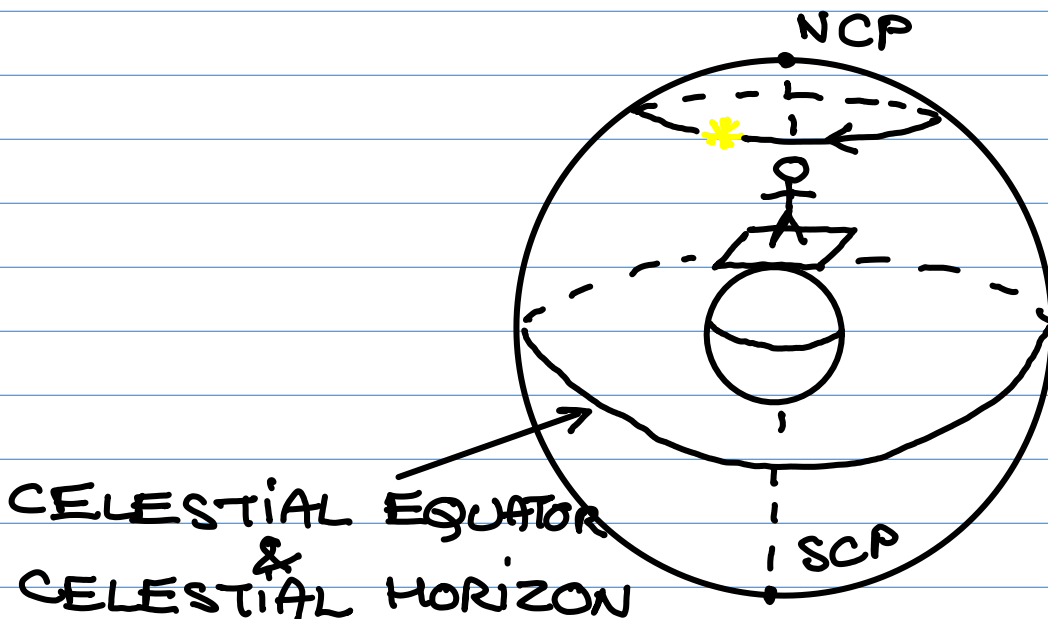
(a) Northern Hemisphere



(b) Southern Hemisphere

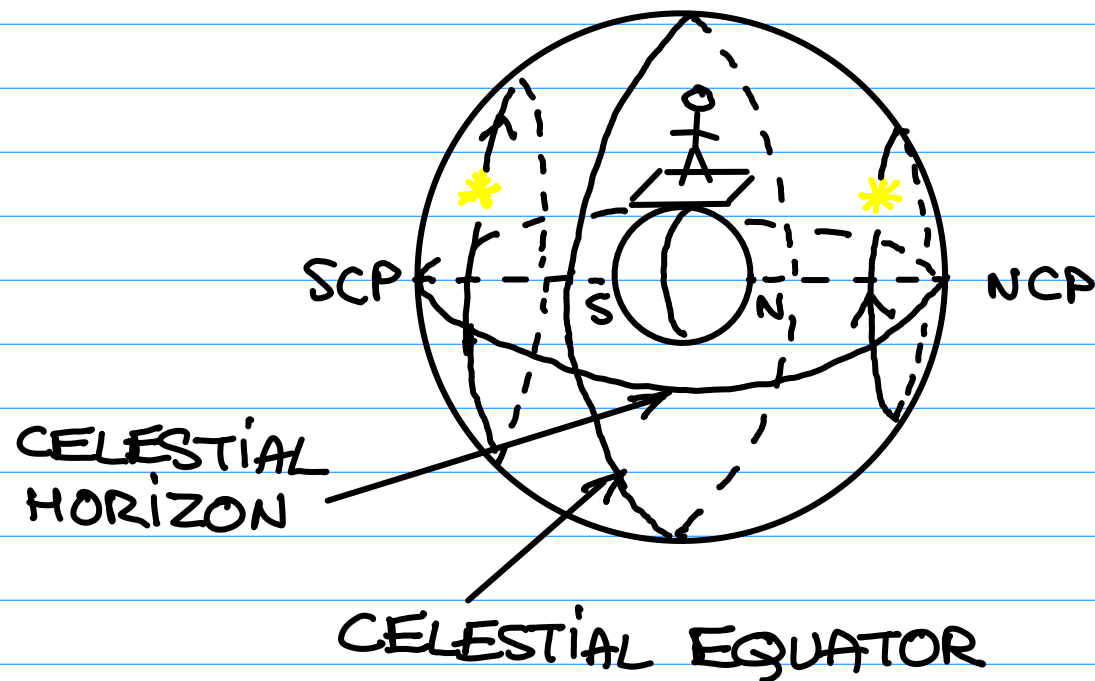
Copyright © Addison Wesley

FOR AN OBSERVER AT THE NORTH POLE THE NCP IS DIRECTLY OVERHEAD AND CELESTIAL EQUATOR IS HORIZON:



FOR THIS OBSERVER ALL STARS ARE CIRCUMPOLAR STARS.

FOR AN OBSERVER ON THE EQUATOR BOTH CELESTIAL POLES ARE ON THE HORIZON AND THE EQUATORIAL PLANE IS PERPENDICULAR TO THE PLANE OF THE HORIZON:



FOR THIS OBSERVER THERE ARE NO CIRCUMPOLAR STARS — ALL STARS RISE AND SET.

NOTE THAT IN THEIR DAILY MOTIONS THE STARS MOVE $360^\circ / 24 \text{ h} = \underline{15^\circ \text{ PER HOUR}}$.
THUS, IN 6 HOURS THEY WOULD MOVE BY 90° .

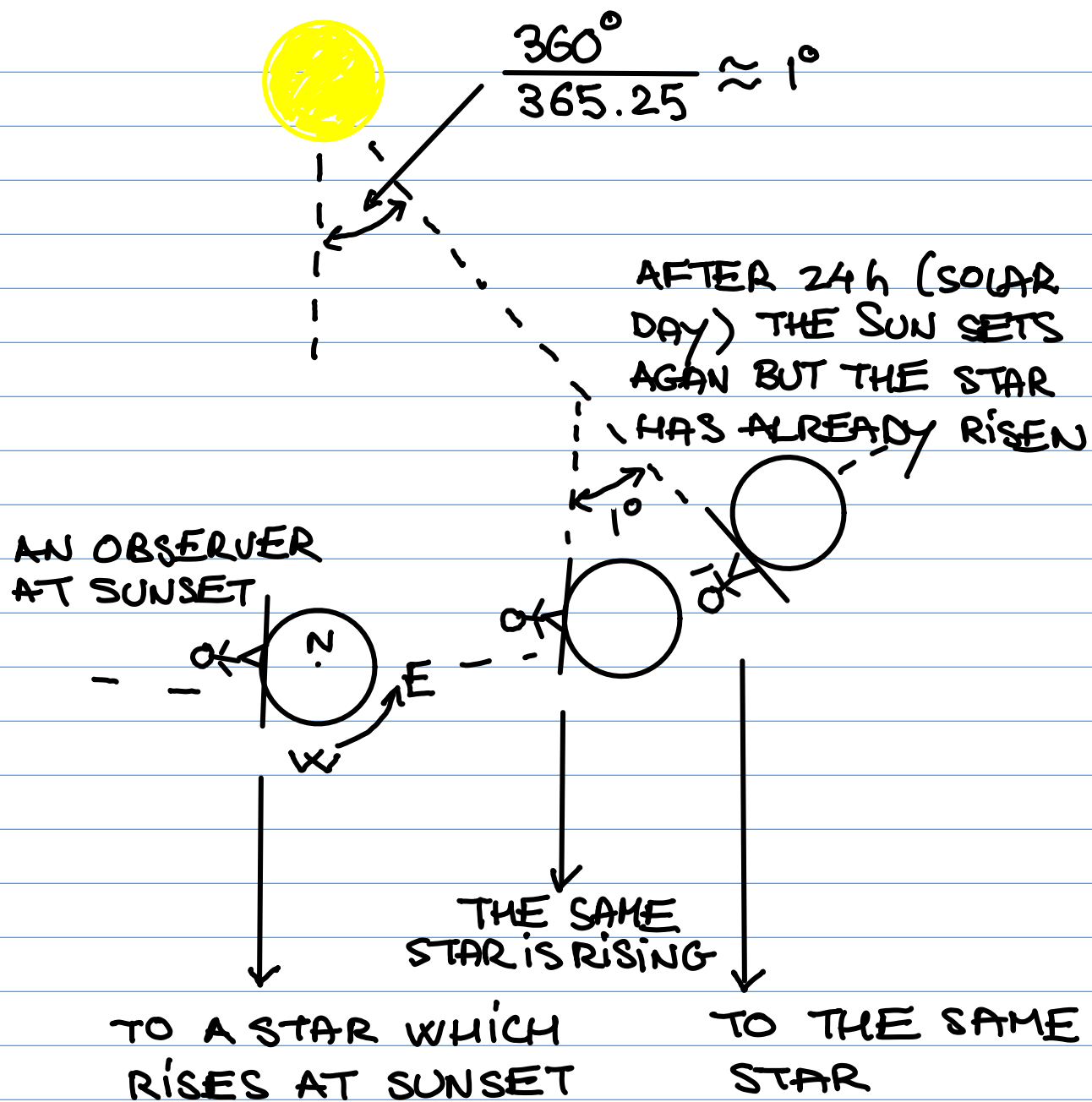
THE ANGULAR DISPLACEMENT OF STARS CAUSED BY THEIR ANNUAL MOTIONS IS MUCH SLOWER :

$$\frac{360^{\circ}}{365.25 \text{ DAYS}} = \underline{1^{\circ} \text{ PER DAY}}$$

THUS, THE ANGULAR SHIFTS OF STARS CAUSED BY THEIR ANNUAL MOTIONS BECOME NOTICABLE OVER A PERIOD OF A COUPLE OF WEEKS OR A MONTH.

CONSEQUENCES:

- 1) EACH RISING STAR RISES (AND SETS) BY ABOUT 4 MINUTES (3 MINUTES AND 56 SECONDS) EARLIER EVERY NIGHT.



HOW LONG DOES IT TAKE EARTH TO ROTATE BY 1° ?

$$\frac{24 \cdot 60 \text{ min}}{360^\circ} = 4 \text{ min PER DEGREE}$$

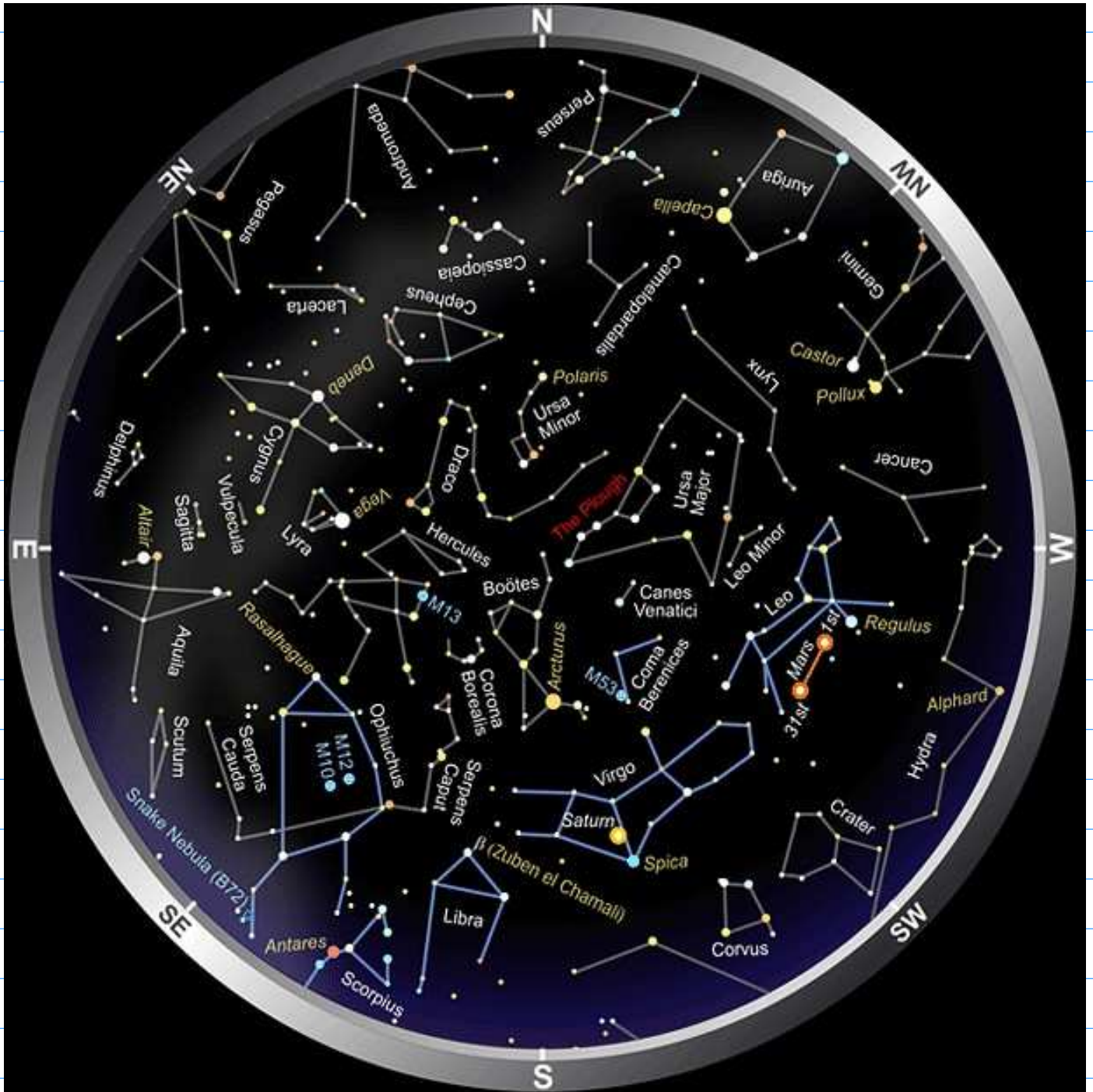
THUS THE STARS RISE (AND SET) BY ABOUT 4min EARLIER EVERY DAY

SOLAR DAY = INTERVAL OF TIME FROM SUNSET TO SUNSET (OR FROM SUNRISE TO SUNRISE OR FROM NOON TO NOON). IT VARIES SLIGHTLY OVER THE YEAR BECAUSE OF THE SMALL ECCENTRICITY (1.7%) OF THE EARTH'S ORBIT. BY DEFINITION, THE AVERAGE SOLAR DAY (COVER A YEAR) IS TAKEN TO HAVE 24 HOURS.

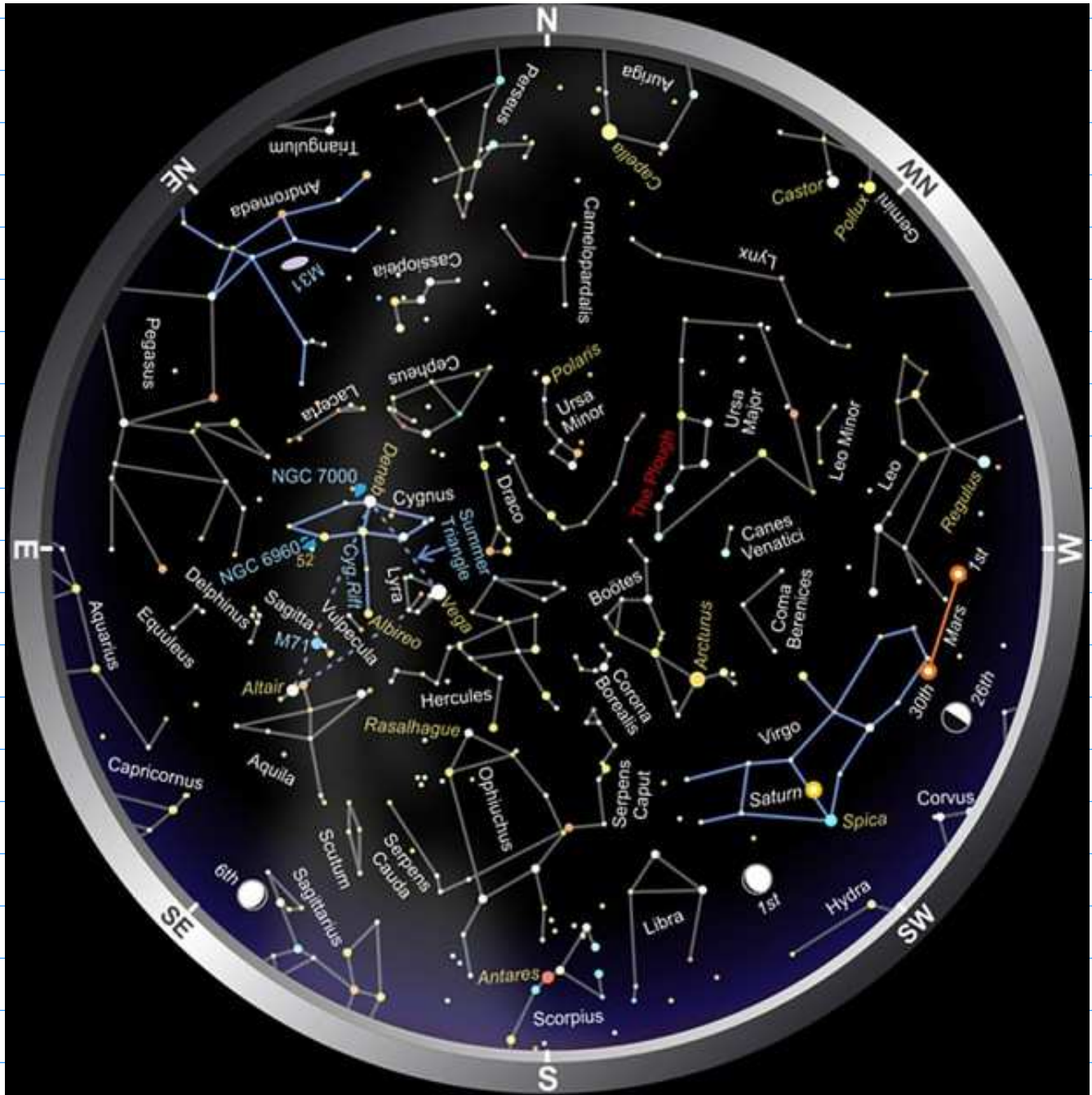
SIDEREAL DAY: INTERVAL OF TIME FROM STARRISE TO STARRISE (OR FROM STARSET TO STARSET) OF ANY GIVEN STAR. IT IS 23h AND 56 min (23h 56 min AND 4 sec) LONG.

2) OVER SEVERAL WEEKS OR A MONTH THE OLD CONSTELLATIONS DISAPPEAR IN THE WEST AND THE NEW ONES APPEAR IN THE EAST:

NIGHT SKY IN MAY:

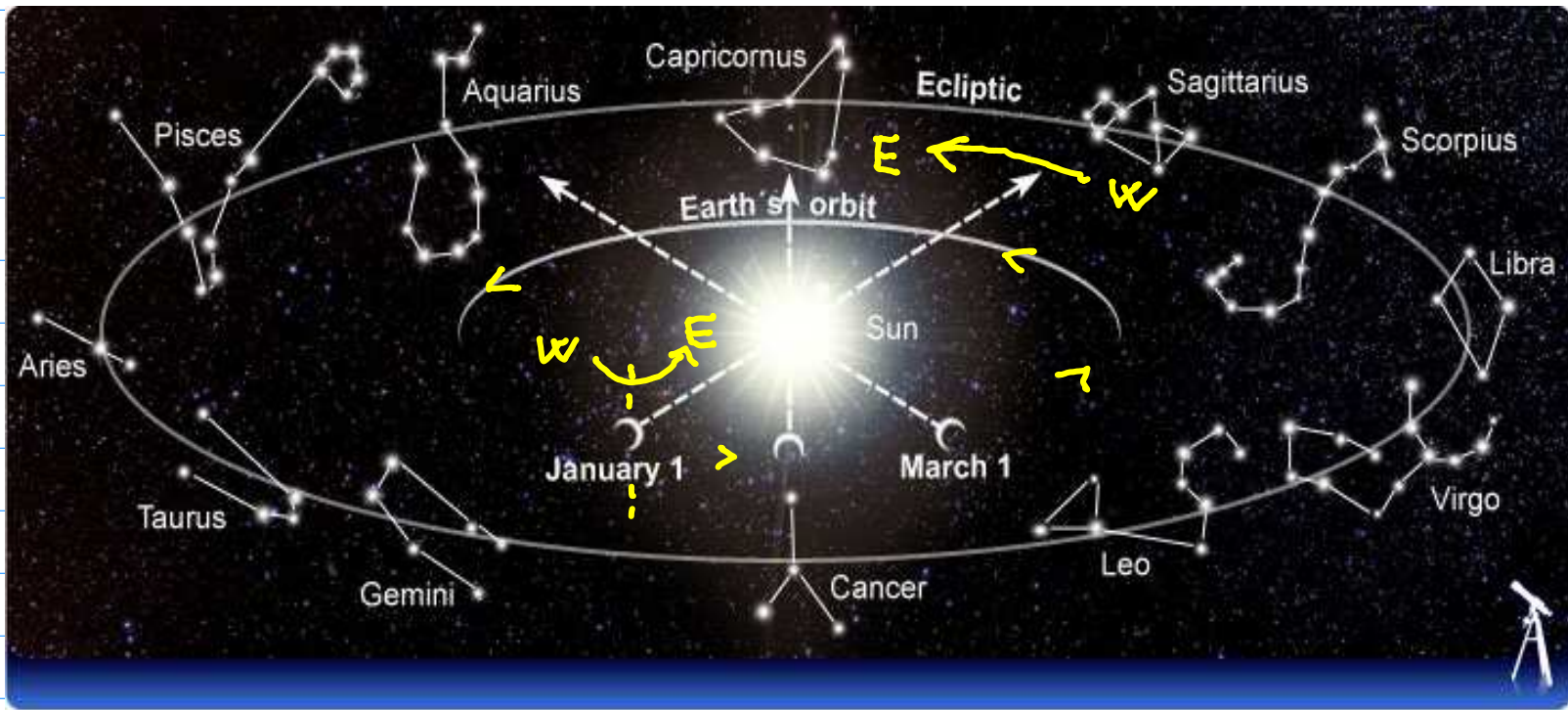


NIGHT SKY IN JUNE:



CANCER HAS DISAPPEARED IN THE WEST
AND AQUARIUS HAS APPEARED IN THE
EAST.

3) RELATIVE TO THE STARS / CONSTELLATIONS
THE SUN IS MOVING EASTWARD (i.e.
FROM WEST TO EAST :



THE PLANE OF THE EARTH'S ORBIT IS CALLED ECLIPTIC. IT INTERSECTS THE CELESTIAL SPHERE ALONG A GREAT CIRCLE WHICH IS ALSO CALLED ECLIPTIC.

THE CONSTELLATIONS ALONG THE ECLIPTIC (THE LINE ON CELESTIAL SPHERE) ARE CALLED THE CONSTELLATIONS OF THE ZODIAC (CIRCLE OF ANIMALS IN GREEK).

AS THE EARTH REVOLVES AROUND THE SUN IN THE COUNTERCLOCKWISE DIRECTION (IT ROTATES IN THE SAME DIRECTION, I.E. FROM WEST TO EAST) WE OBSERVE THE SUN MOVING AMONG THE CONSTELLATIONS OF THE ZODIAC FROM WEST TO EAST. THUS, THE ECLIPTIC IS ALSO THE APPARENT PATH TRACED BY THE SUN ON CELESTIAL SPHERE AS IT MOVES THROUGH THE CONSTELLATIONS (TO GET IT, RECORD THE POSITION OF THE SUN AT NOON, THEN MARK THAT POSITION IN THE MIDNIGHT SKY 6 MONTHS LATER).