

## Seeing the angular way

- There are two ways to talk about the size of an object – its *physical size* - in terms of its *width and height*, and its *angular or apparent size*.

**Physical size:** Take your friend's head as an example. Measure the width of friend's head – face on – using a ruler. How big is it? Have your friend step back 20 feet (about 6 meters). Is their head still the same physical size?

**Angular size:** Have your friend stand 6 feet (about 2 meters) away. What fraction of your central vision does your friend's head take up?  $\frac{3}{4}$ 's,  $\frac{1}{2}$ ,  $\frac{1}{4}$ ? Now have your friend move back 20 feet (about 6 meters). Now fraction of your central vision does your friend's head take up?  $\frac{1}{4}$ ,  $\frac{1}{10}$ ,  $\frac{1}{20}$ <sup>th</sup>? This way of describing the relative size of an object is its *angular or apparent size*.

- We use angular size to describe the size of an object when we are not sure how close or far away it is or how big it physically is.

If you do not already know the physical heights of the people in this picture, how can you be sure how tall they are?

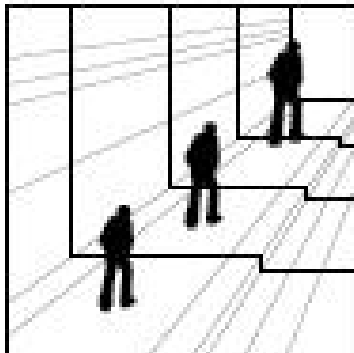


Figure 1 - Where objects' physical sizes are uncertain, you can still describe how big they are in terms of their angular size

- How do you measure angular size?

Angular size is measured in *degrees* ( $^{\circ}$ ). There are  $360^{\circ}$  in a circle. Go to the center of room. Face an exit. No turn around one time completely. That is  $360^{\circ}$ . If you turn  $\frac{1}{4}$  of the circle, that is a  $90^{\circ}$  turn;  $\frac{1}{2}$  a circle is  $180^{\circ}$ .

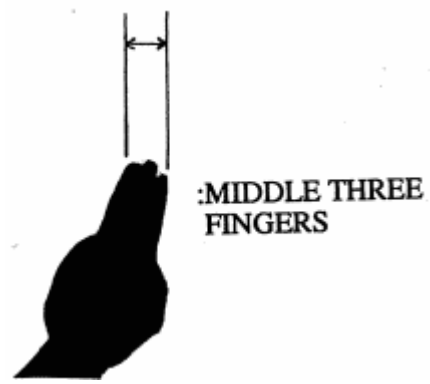
- You can use parts of your body to estimate angular size.

**Hand Position**

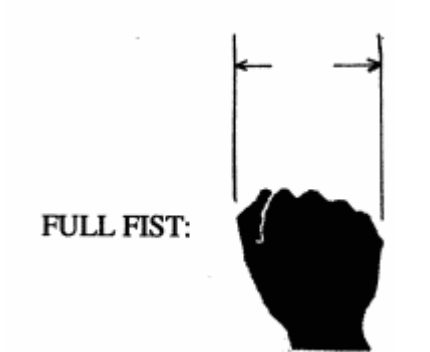
**Usual  
Angular Size**



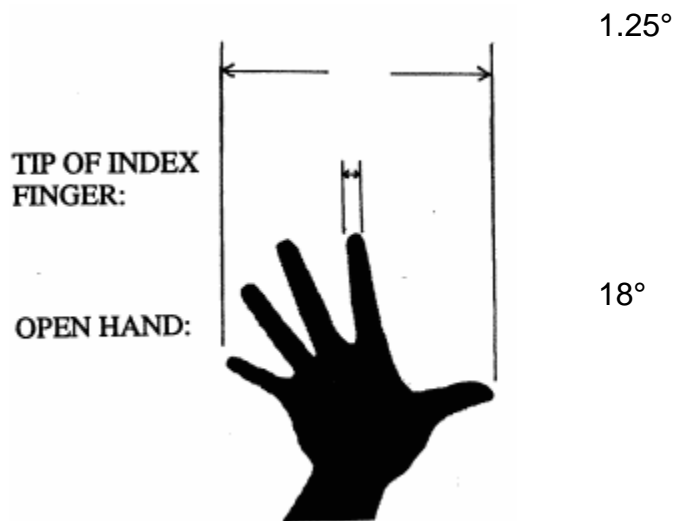
1°



4°



10°



How many angular degrees are:

- Your friend's head when they are three feet (about 1 meter) away.
  - Your friend's head when they are six feet (about 2 meters) away.
  - Your friend's head when they are 20 feet (about 6 meters) away.
  - A tree or building in your yard.
  - A tree or building across the street.
  - A building across town about 1 mile away (about 1.5 kilometers).
  - A distant mountain peak?
  - How many degrees is the Sun or the Moon above your southern horizon?
- **How much sky do you see when you look through binoculars, a telescope at low-power, a telescope at medium power and a telescope at high-power?**

Binoculars usually see a portion of the sky about 5 degrees wide. This is the same view you see when you look at the sky through a toilet paper tube.

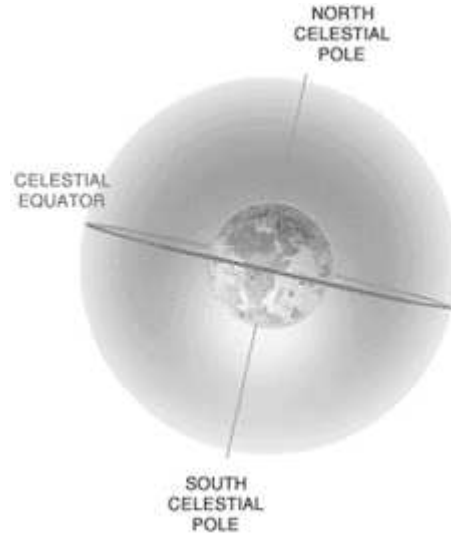
At low power, a telescope sees about 1 circular degree. This is the angular area covered by your outstretched finger tip.

At medium power, a telescope sees about  $\frac{1}{4}$  to  $\frac{1}{2}$  a circular degree. This is about the same size of what you can see when you look at the sky through a soda straw.

At high power, a telescope might see about  $\frac{1}{10}$  of a degree or smaller. This is what you see when you look at the sky through a coffee stirrer.

- **How many angular square degrees are in the night sky?**

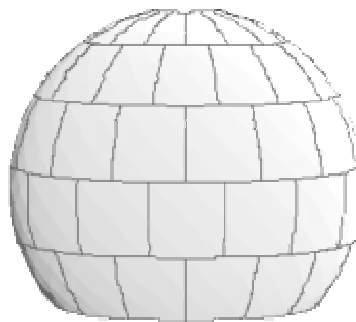
How your outstretched finger tip up to the sky. That covers about 1 square degree. There are about 41,253 square degrees in the visible sky – called the *celestial sphere*.



**Figure 2 – The celestial sphere – an imaginary sphere used to track the position and size of stars and galaxies in the night sky**

The Earth – the ground under your feet - blocks part of your view of the total sky. From 40° North latitude, about 12% of the sky is blocked by the Earth and is never visible to you. You have to go to South America to see that part of the sky.

The part of the sky you can see is called a *truncated sphere*. It looks like this:



**Figure 3 – A truncated sphere**

In the 88% of the sky that you can see throughout a year, there are about 36,426 square degrees. Hold up that finger tip again and start counting!

- **How many degrees are covered in the field-of-view of your central vision?**

You only see clearly in an area of central vision. Hold your open hands outstretched with the backs of your hands towards you. Move your hands about two feet apart. Slowly move your hands closer together – until you can clearly see all the detail on the back of both hands.

For most people, this occurs when the thumbs of both open hands touch. Each outstretched hand covers about 18 degrees of angular size – or an angular *field-of-view*. 2 times 18 degrees is 36 degrees. Most people's clear central vision covers between 36 to 40 degrees.

Telescope eyepieces generally have about a 52° field-of-view, because that is about what a human eye can see clearly at one time.

- **Further reading**

Knap, Robert (Vanderbilt Univ.) 2005. *Measuring Angular Distances*. Webpage for Astronomy 103, Spring, 2006. <<  
[http://brahms.phy.vanderbilt.edu/a103/info/angdist\\_print.shtml](http://brahms.phy.vanderbilt.edu/a103/info/angdist_print.shtml) accessed May 2006 >>

Edmund Scientific. 2001. *Popular Optics*. Edmund Pub. No. 30094-45.  
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