

## Notes on Hair Analysis

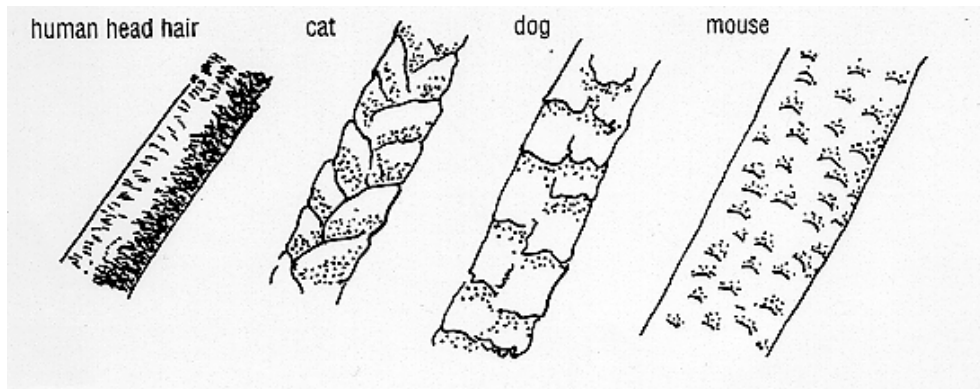
I have found local veterinarians very uncooperative when trying to get samples of dog and cat fur. I have found neighbors, friends and relatives a much better source of fur.

There are some excellent sources of information from the FBI and library books on hair analysis.

Barber shops and styling salons are an excellent source of various sources of hair.

This is an excellent way to introduce students to the parts of a hair and show them how the various hairs differ internally. It is also important that you teach the students how to make wet slides of the hair samples they are given because more and more of the event supervisors are offering the students microscopes to use. That is why we are now including slides in the list of materials they may bring.

The following is a close-up of what the outside (cuticles) of several types of animal hair look like under a microscope or with a powerful hand lens.



### Hair Structure and Life Cycle

#### Structure of Hair

Hair is composed of strong structural protein called keratin. This is the same kind of protein that makes up the nails and the outer layer of skin.

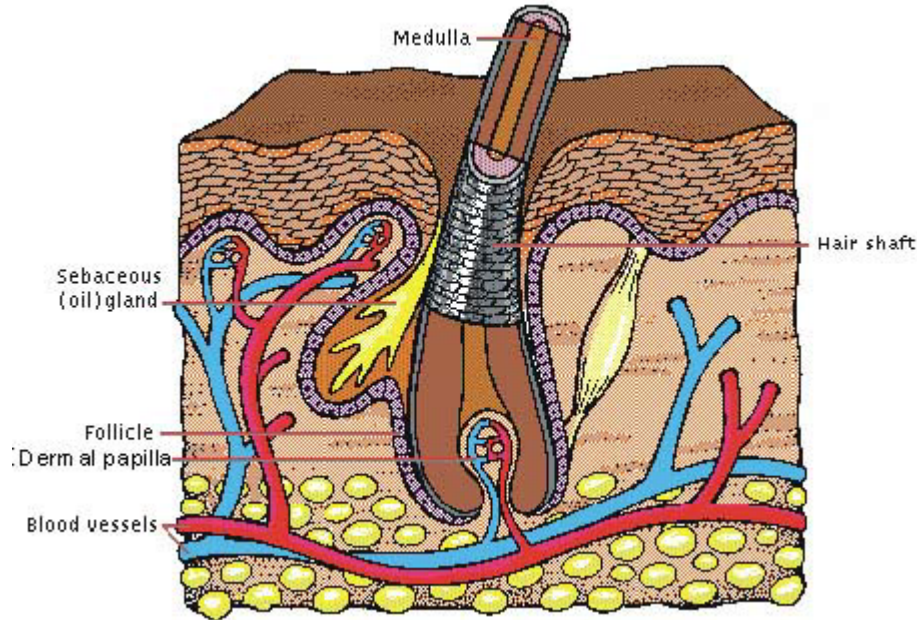
Each strand of hair consists of three layers.

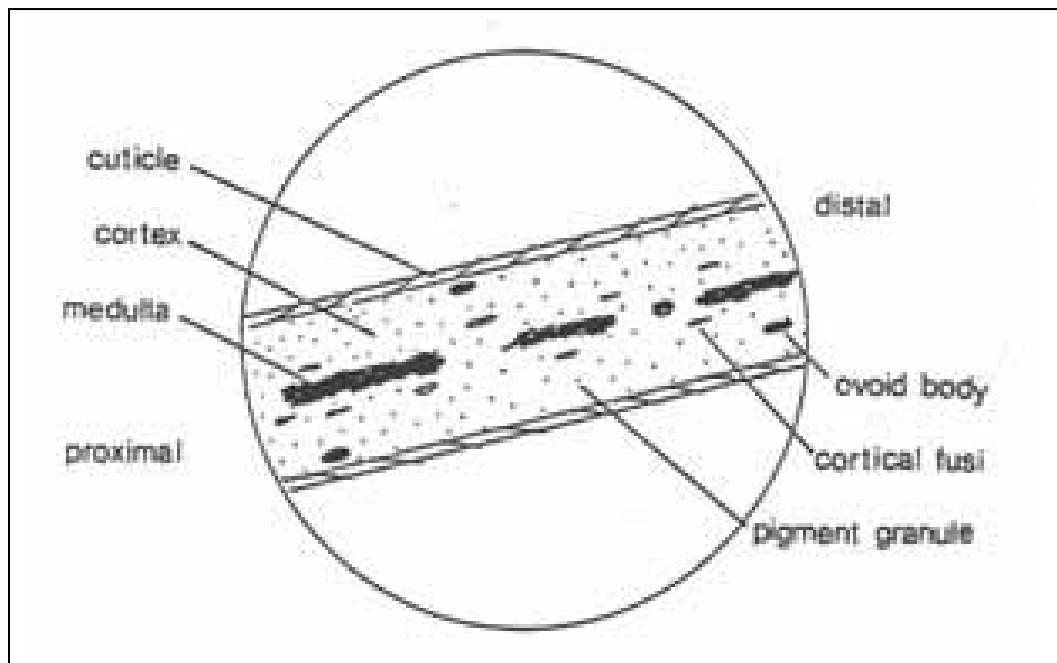
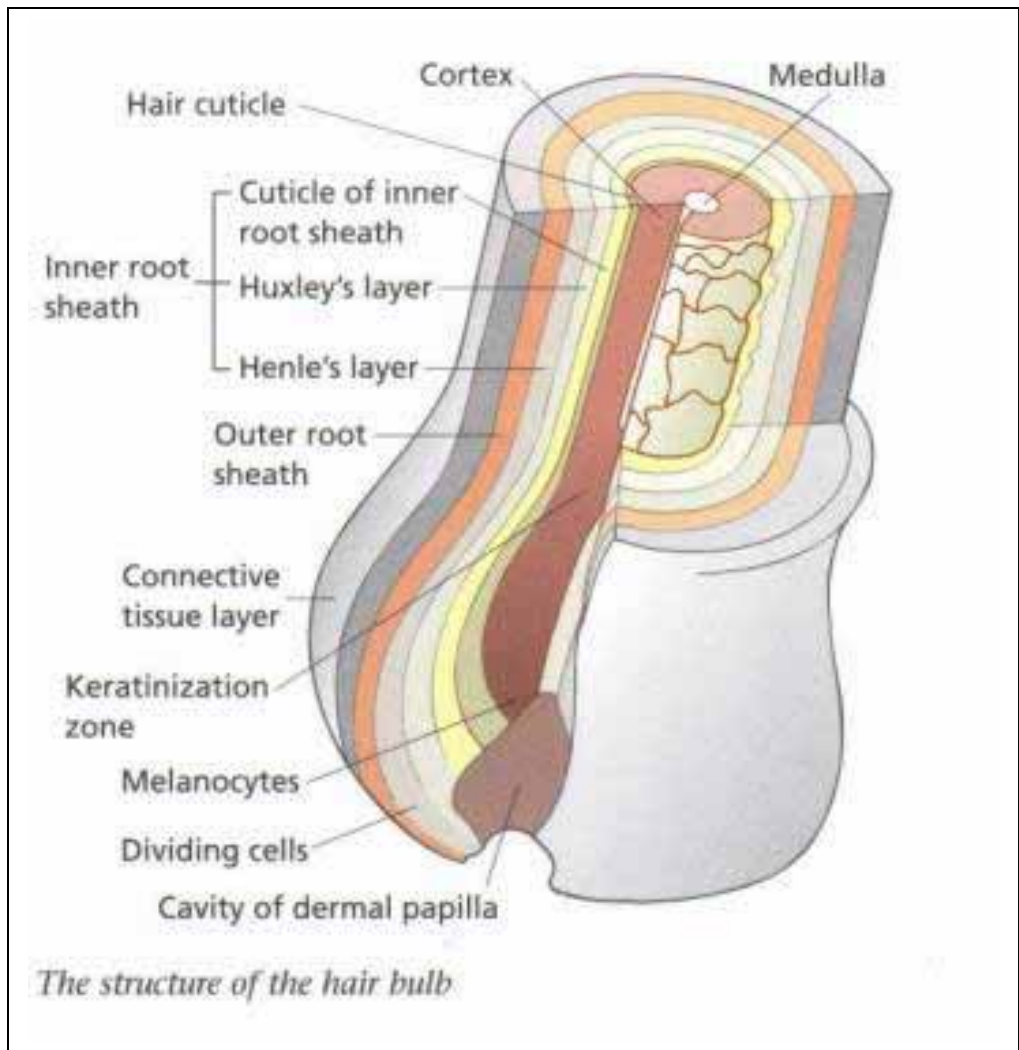
- 1) An innermost layer or medulla which is only present in large thick hairs.
- 2) The middle layer known as the cortex. The cortex provides strength and both the color and the texture of hair.

3) The outermost layer is known as the cuticle. The cuticle is thin and colorless and serves as a protector of the cortex.

### Structure of the hair root

Below the surface of the skin is the hair root, which is enclosed within a hair follicle. At the base of the hair follicle is the dermal papilla. The dermal papilla is fed by the bloodstream, which carries nourishment to produce new hair. The dermal papilla is a structure very important to hair growth because it contains receptors for male hormones and androgens. Androgens regulate hair growth and in scalp hair Androgens may cause the hair follicle to get progressively smaller and the hairs to become finer in individuals who are genetically predisposed to this type of hair loss.





## **The Hair Growth Cycle**

Hair follicles grow in repeated cycles. One cycle can be broken down into three phases.

- 1) Anagen - Growth Phase
- 2) Catagen - Transitional phase
- 3) Telogen - Resting Phase

Each hair passes through the phases independent of the neighboring hairs.

### **Anagen Phase - Growth Phase**

Approximately 85% of all hairs are in the growing phase at any one time. The Anagen phase or growth phase can vary from two to six years. Hair grows approximately 10cm per year and any individual hair is unlikely to grow more than one meter long.

### **Catagen Phase - transitional phase**

At the end of the Anagen phase the hairs enters into a Catagen phase which lasts about one or two weeks, during the Catagen phase the hair follicle shrinks to about 1/6 of the normal length. The lower part is destroyed and the dermal papilla breaks away to rest below.

### **Telogen Phase - resting phase**

The resting phase follows the catagen phase and normally lasts about 5-6 weeks. During this time the hair does not grow but stays attached to the follicle while the dermal papilla stays in a resting phase below. Approximately 10-15 percent of all hairs are in this phase at an one time.

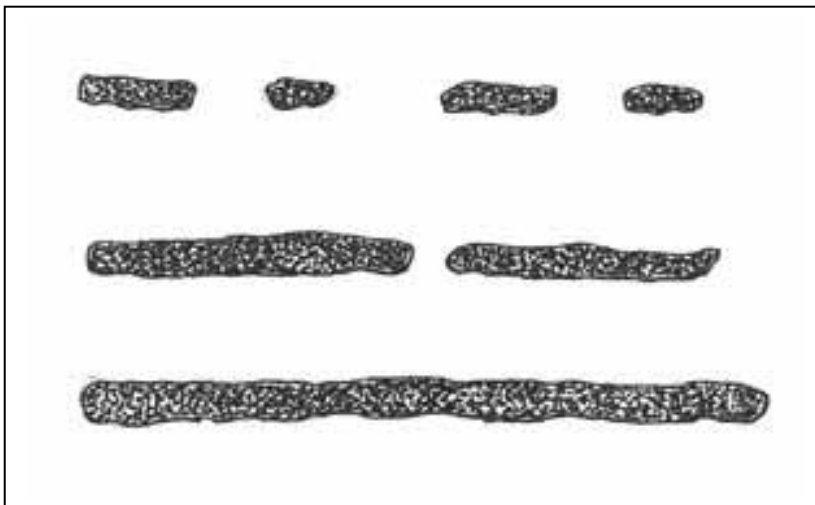
At the end of the Telogen phase the hair follicle re-enters the Anagen phase. The dermal papilla and the base of the follicle join together again and a new hair begins to form. If the old hair has not already been shed the new hair pushes the old one out and the growth cycle starts all over again.

Hair does not have the same cross sectional structure either



Compare these cross-sections of three hairs, all of different racial types:  
(left) Asian, (center) Caucasoid, (right) African

Types of medullas.



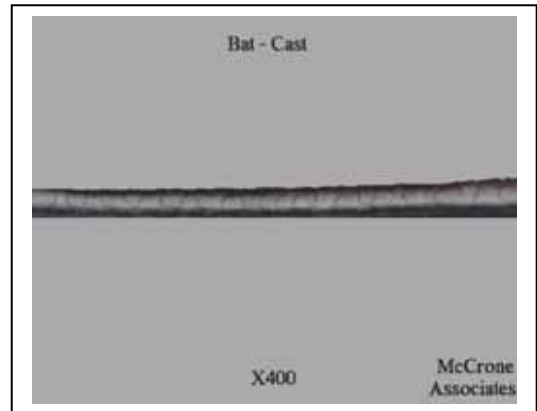
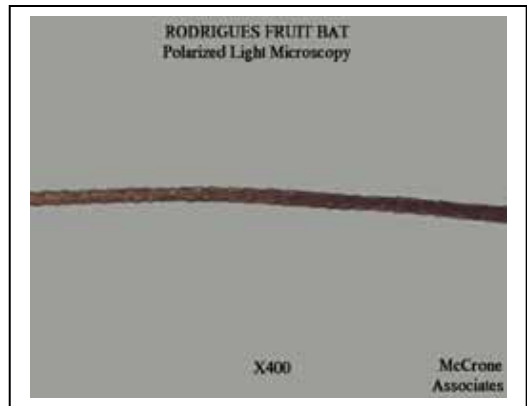
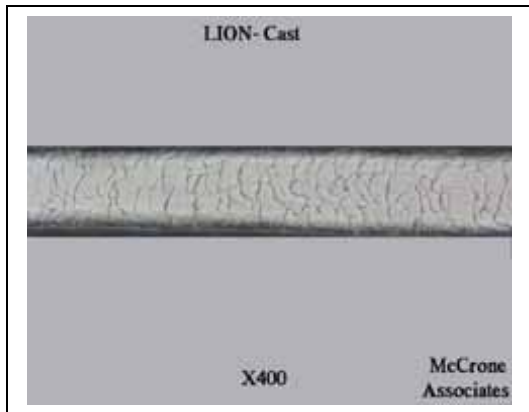
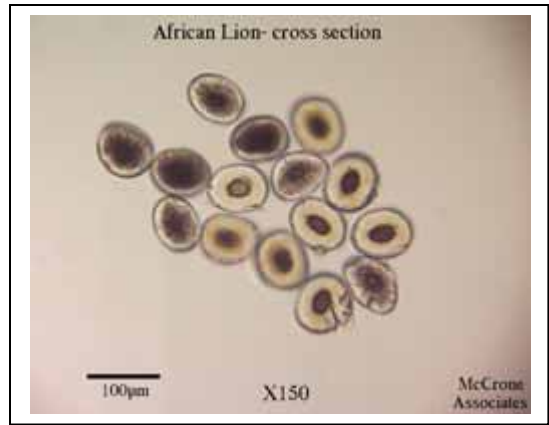
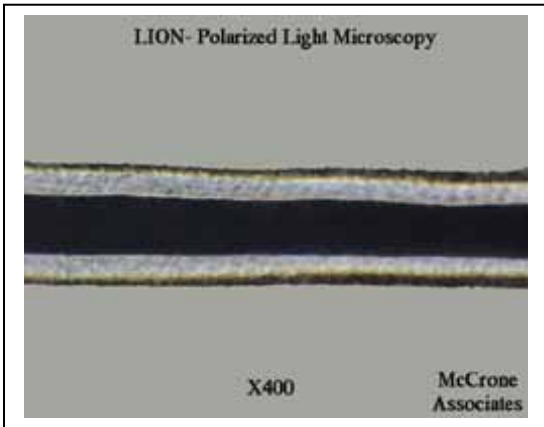
Below are examples of different kinds of animal hair showing their different cuticles, medullas, and ovoid bodies.

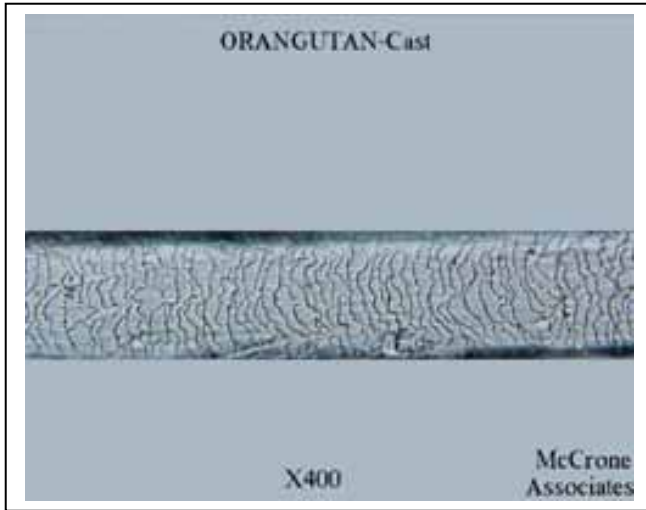
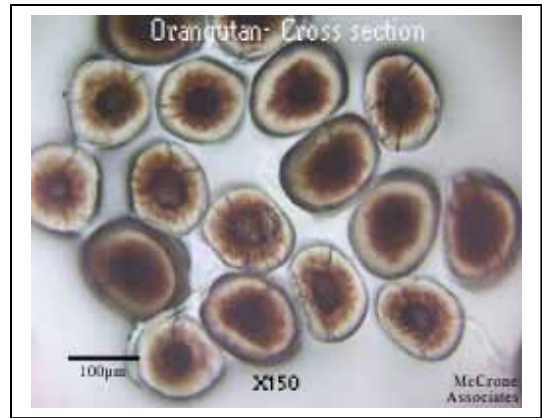
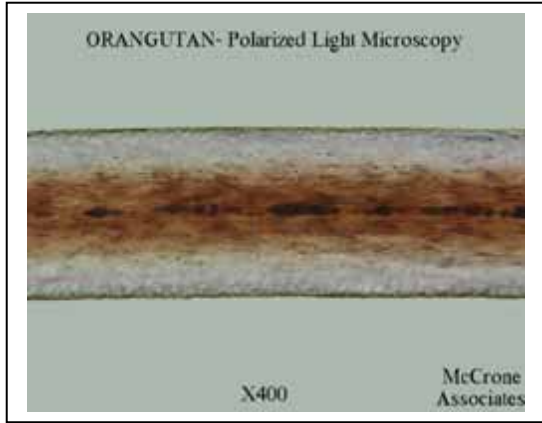
Dog hair



Human Hair







An excellent reference for hair analysis:  
[http://www.fbi.gov/hq/lab/fsc/backissu/july2004/research/2004\\_03\\_research02.htm](http://www.fbi.gov/hq/lab/fsc/backissu/july2004/research/2004_03_research02.htm)