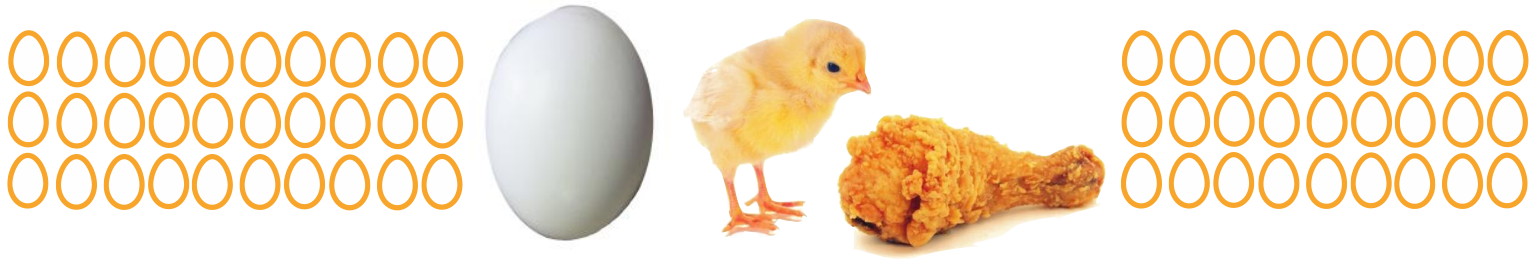


Reproductive Anatomy and Egg Formation

AgScience Poultry Science Curriculum

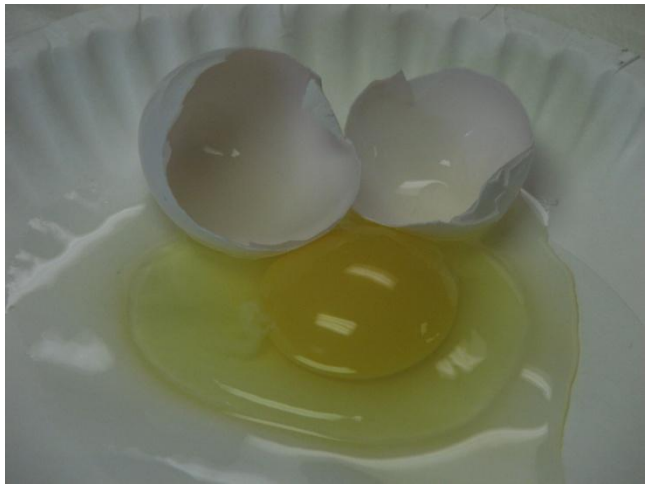
Section 3

Egg Anatomy

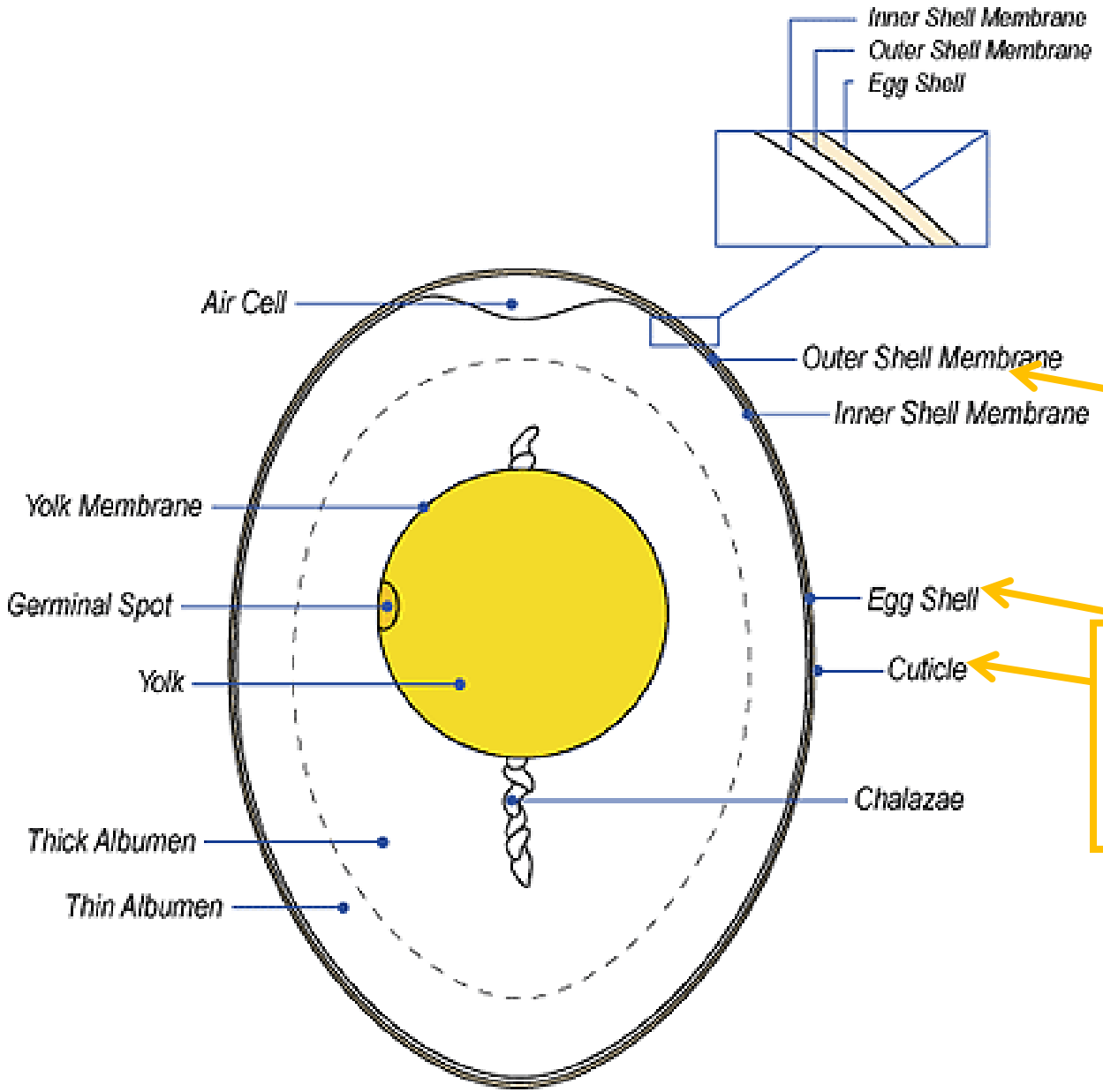
Fertile (hatching eggs) and infertile eggs have many of the same structures

These structures can be classified:

- **Nutritional**
- **Protective (biological and physical)**
- **Facilitative**



Egg Anatomy



Immediately beneath surface of egg shell, regulates gas and moisture exchange, prevents bacteria from entering into egg; Wax coating or cuticle

Complex structure of protective. Air cell develops between inner and outer shell membrane

millions of tiny pores that allow for gas exchange, dehydration, and bacterial passage into egg

primary function is protective

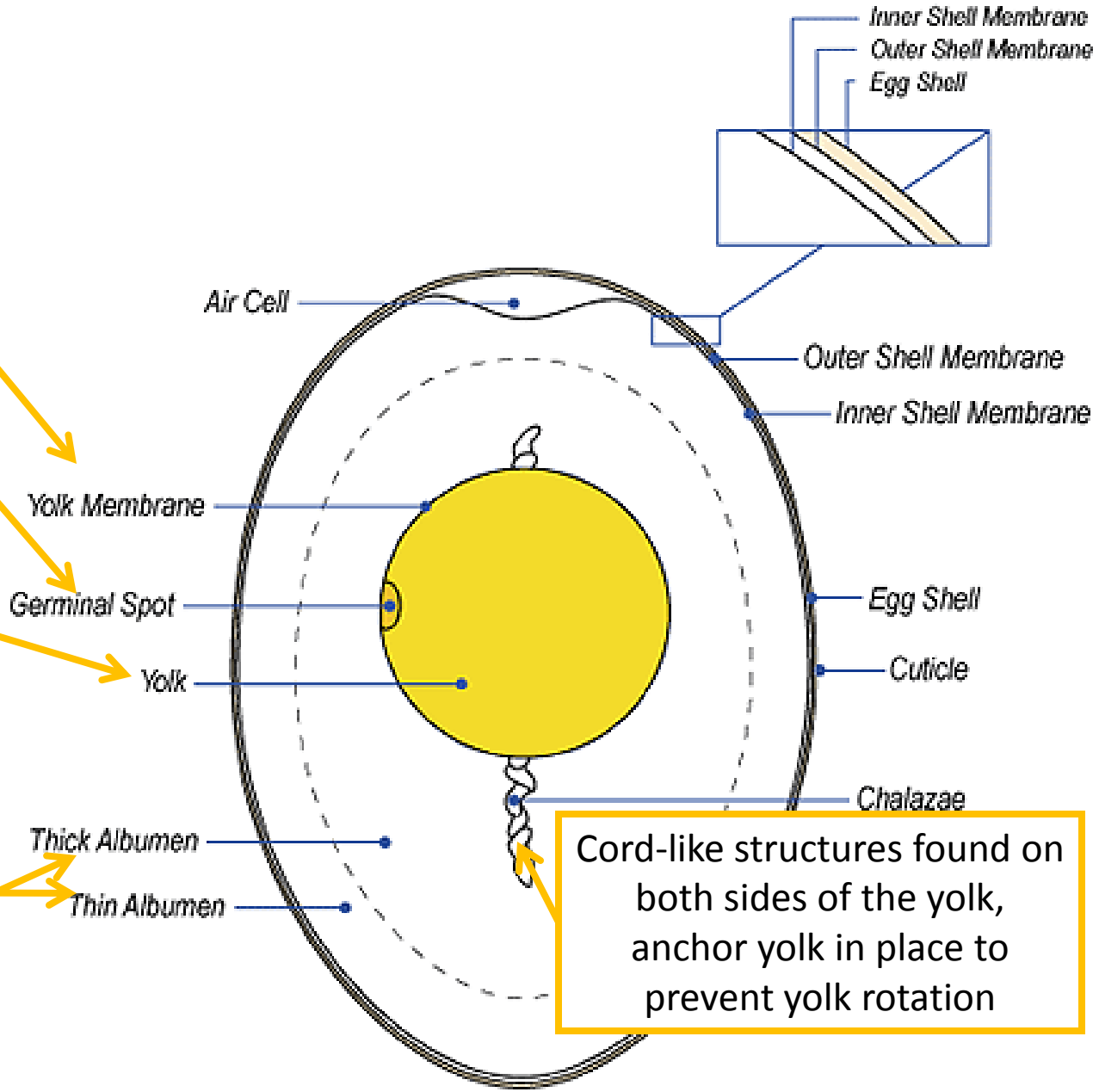
Egg Anatomy

Also called the vitelline membrane, encloses the yolk, secretes enzymes that help breakdown and release yolk nutrients for use by the embryo

Also called the blastoderm, the site where fertilization will occur

Protein Source for the developing embryo, consists of outer layer of thin, watery albumen, middle layer of thick, and inner thin; proportion of thin increases over time as the thick albumen breaks down as it ages

Yolk is the yellow material at the center of the egg, it is the source of lipids for the developing embryo



Cord-like structures found on both sides of the yolk, anchor yolk in place to prevent yolk rotation

Egg Production

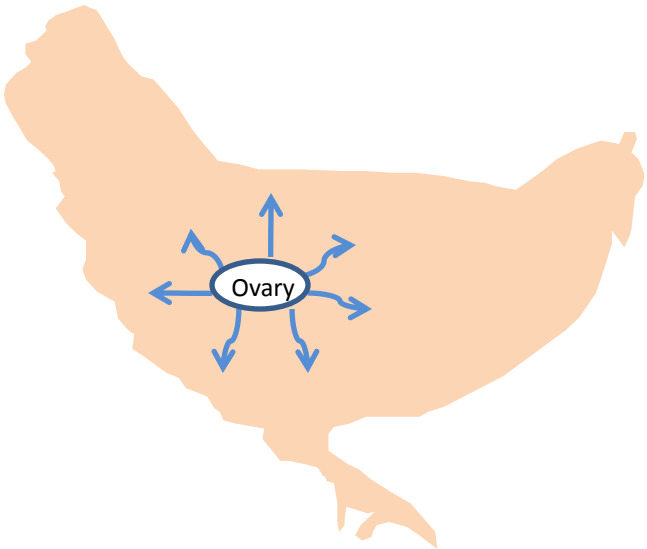
Many physiological changes occur in the hen approaching sexual maturity

- **At 12-14 weeks of age (broiler breeder hen) the developing ovary begins to release estrogen**
- **Estrogen major role is in preparing the hen's body for reproduction**

Egg Production

Estrogen's role in sexual maturity:

- **Enlargement and growth of the reproductive tract (oviduct)**
- **Increased calcium flux in to the medullary bones**
- **Enlargement of the vent area**
- **Spreading of the pubic bones (between which the eggs pass)**
- **Formation of lipids in the liver**



Egg Production

Other factors for initiating egg production:

- **Adequate body size must be obtained**
- **Photosimulation**

Photostimulation:

- **Over 14 hrs of light**
- **Initiates cascade of hormones result in ovulation**

AGE + BODY SIZE/CONFORMATION + INCREASED PHOTOPERIOD =

INITIATION OF EGG PRODUCTION

Egg Production

Events that occur with increasing photoperiod:

- **Hypothalamus responds to increasing photoperiod**
- **Hypothalamus signals anterior pituitary to produce FSH**
  - **FSH = follicle stimulating hormone**
- **FSH travels to ovary in blood**
- **Stimulates development of follicles**

Hypothalamus

Anterior pituitary → FSH → **Ovary** → Follicle maturation

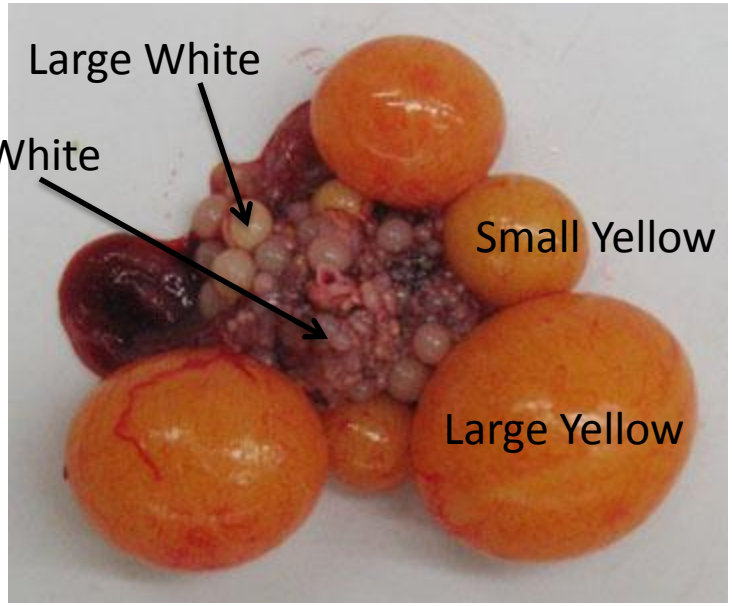
Egg Production

Follicles will be in various stages of development

- **Initially white**
- **More mature follicles appear yellow because of accumulated pigment**

Follicles are categorized as follows:

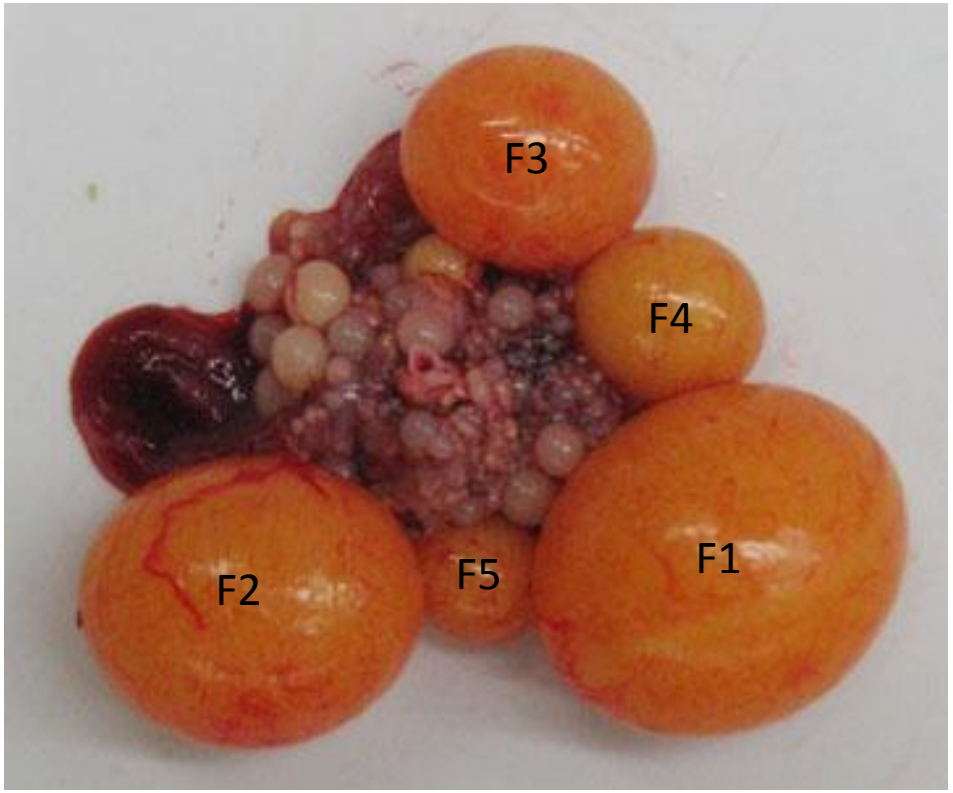
- **Small white follicles**
- **Large white follicles**
- **Small yellow follicles**
- **Large yellow follicles**



Egg Production

At any given time a normal ovary will contain several mature (large yellow) follicles

- **Largest follicle is the next to be released and is called F1**
- **Next largest follicle is the F2, etc**



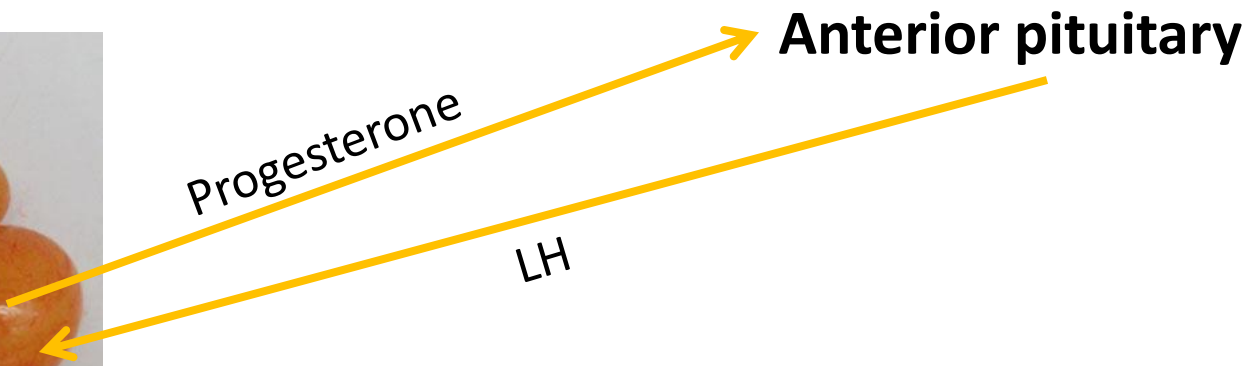
Egg Production

When a follicle is fully mature is releases progesterone

- **Progesterone travels to anterior pituitary**

Anterior pituitary responds by producing LH

- **LH=Luteinizing hormone**
- **LH travels back to mature follicle causing it to rupture**



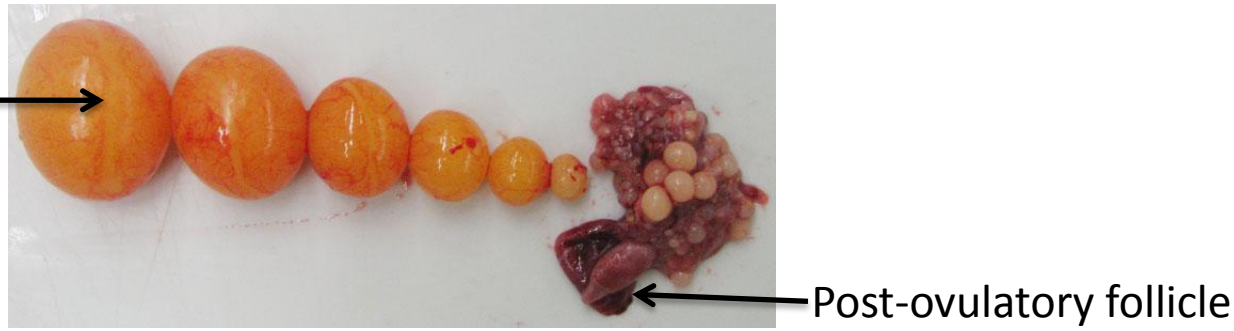
Egg Production

When the follicle ruptures and the yolk is released is referred to as ovulation.

- **Empty follicle after ovulation is referred to as the post-ovulatory follicle (POF)**

Follicles rupture at the stigma

- **Stigma - area on the follicle where there are no blood vessels**
- **If does not rupture at the stigma a blood spot will occur on the yolk**



Egg Production

The reproductive tract of a hen is a very specialized organ capable of producing the different parts of the egg

- **Estrogen released from the developing ovary initiates oviduct growth and maturation**

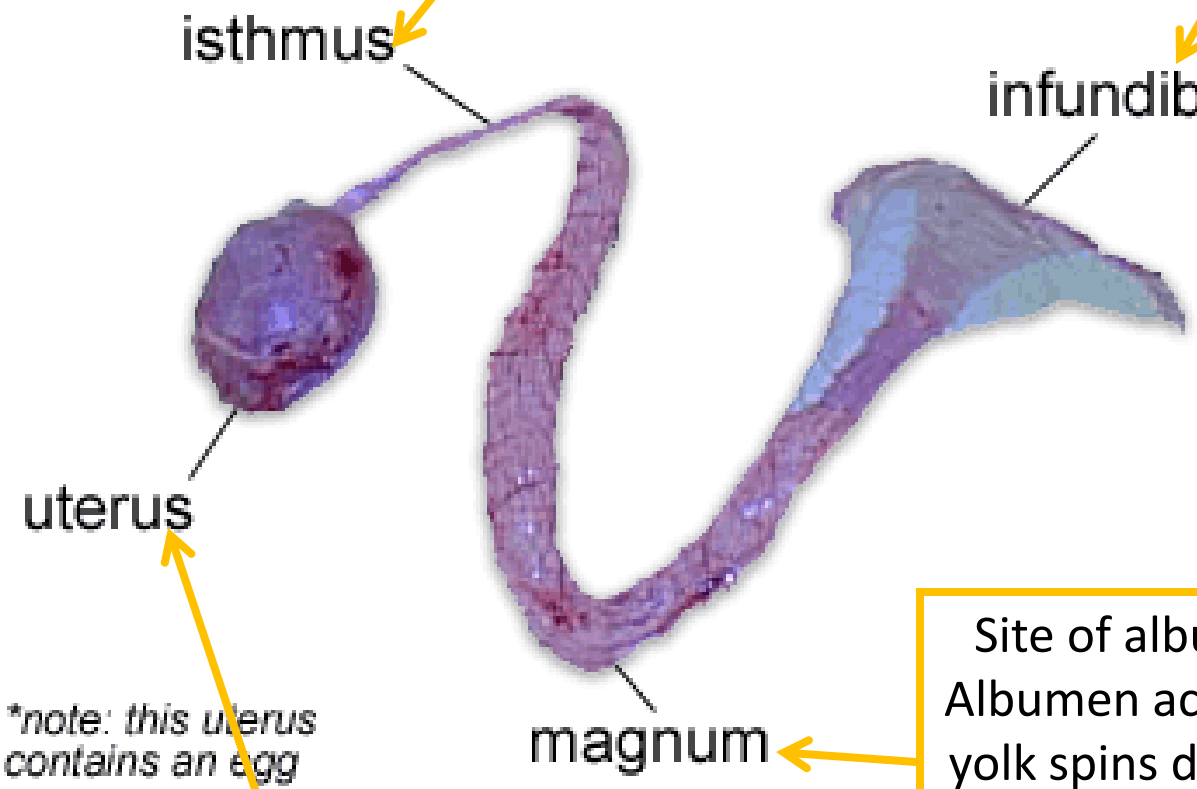
The oviduct contains the following structures:

- **Infundibulum**
- **Magnum**
- **Isthmus**
- **Uterus**

Egg Production

Inner and outer shell membranes are synthesized and placed around albumen

Catches the yolk released from the follicle. Also the site of fertilization



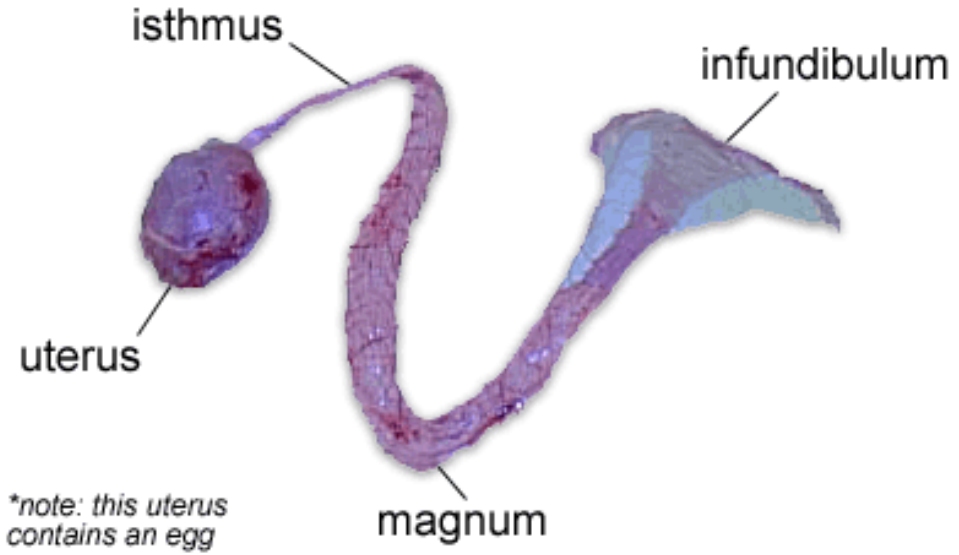
Site of albumen synthesis. Albumen accumulates as the yolk spins down the oviduct. The yolk spinning results in chalazae formation

Also called the shell gland is the site of egg shell formation

Egg Production

It takes approximately 24 hours for an egg to form

- **Time spent in each segment of the oviduct is proportionate to the function of the segment**
- **Infundibulum – 15-30 min**
- **Magnum – 3 hrs**
- **Isthmus – 1.25 hrs**
- **Uterus – 20-21 hrs**



Egg Production

Egg shell is approximately 40% calcium

- **Calcium carbonate crystals ($CaCO_3$)**

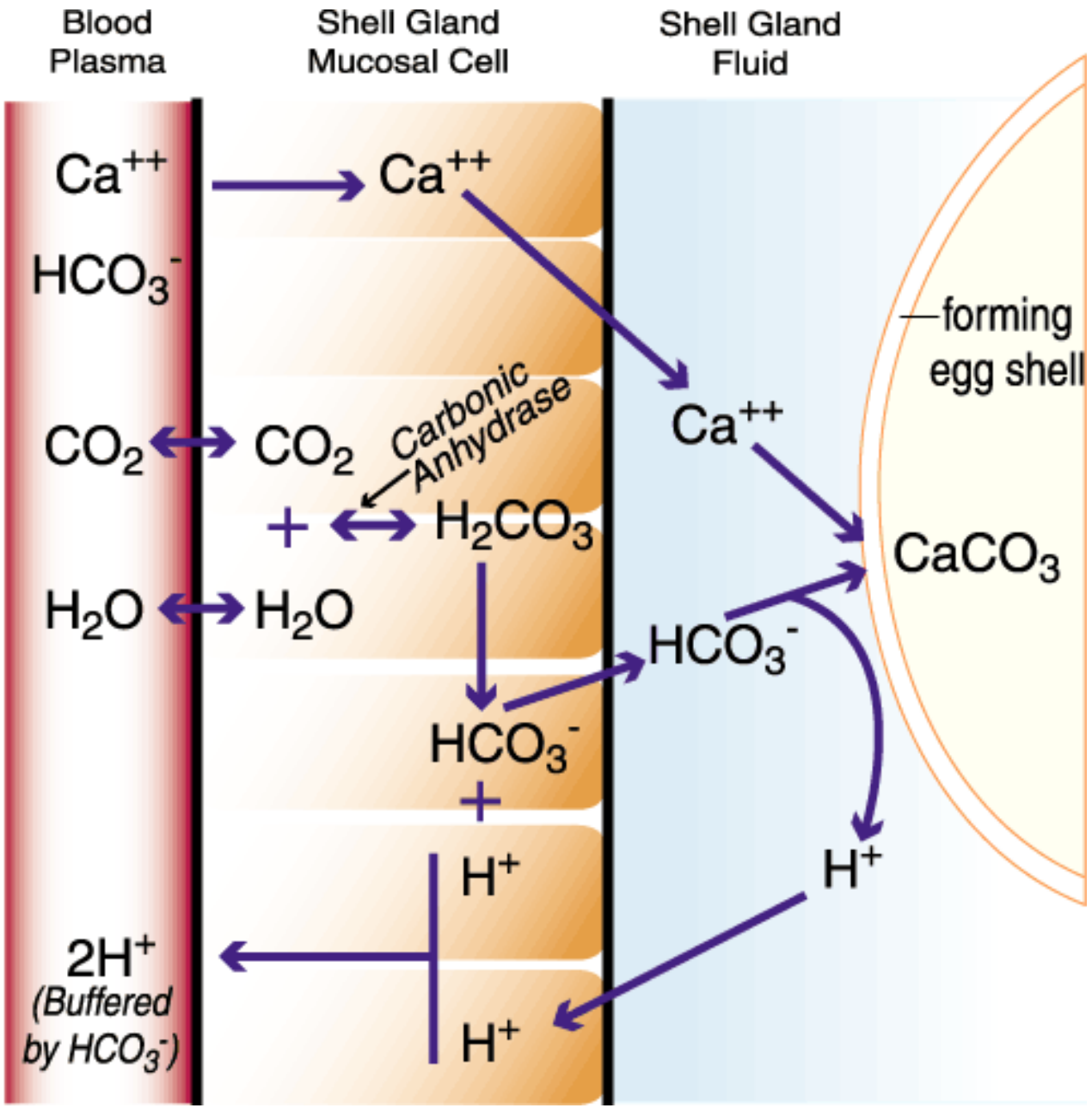
High levels of dietary calcium are required for hens during egg production

- **Dietary calcium is not directly used in egg shell formation**
- **Replaces used calcium from bones**

Most of the calcium used for shell formation is released by the medullary bones

- **Ribs**
- **Femur**
- **Tibia**

Egg Production



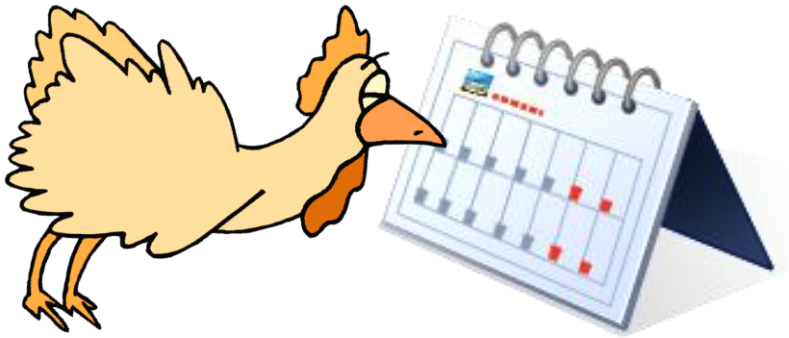
Timeline of Egg Production

Hens usually lay eggs on several consecutive days

- **Number of days in a row is called the clutch length**
- **Leghorn hens which have been bred for egg production have very long clutches**
- **Broiler breeder and turkey hens have shorter clutch lengths**

Hens must have dark hours to initiate egg production

- **LH is released 1 hr after dark**
- **Too little dark will reduce clutch length**



Learning evaluation

Why is it beneficial for the follicle to rupture at the stigma?

The stigma is the area on the follicle where no blood vessels pass, by rupturing at the stigma no blood is released and blood will not be present in the egg.

Learning evaluation

A hen lays eggs for 10 consecutive days and skips a day on the 11th day. What was the clutch length?

The clutch length was 10.

Learning evaluation

Why is it important to expose a hen to dark hours?

LH release only occurs during dark periods, therefore darkness is required for egg production. Too few dark hours will result in the number of consecutive LH releases to be reduced, resulting in short clutch lengths.

Learning evaluation

Critical thinking:

How is the process of shell formation affected by heat stress?

Heat stress leads to panting, causing a drop in carbon dioxide levels. To balance pH in blood HCO_3^- is excreted resulting in a decrease in raw materials for egg shell formation. Decreases feed intake also therefore decrease in calcium consumption. Potential for formation of thin shelled eggs.