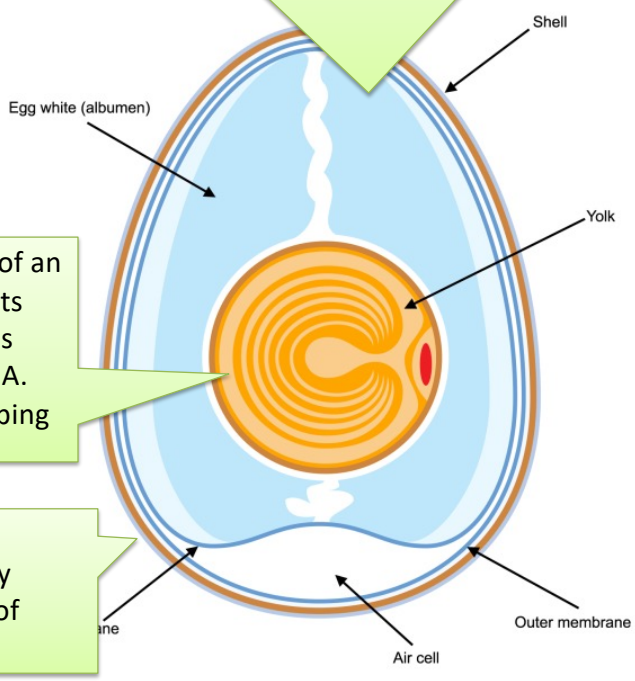
Incredible, edible

EGGS

The White: accounts for ~ ⅔rd of the weight of an intact chicken egg. It is 90% water – the rest being protein. There are only traces of minerals, fatty material, glucose (a sugar) and vitamins. The white provides essential proteins and water, and also provides protection to a developing chick.

The familiar chicken egg has a *yolk* surrounded by egg *white*, contained within a hard shell.



The Yolk: accounts for ~ ⅓rd of the weight of an intact chicken egg. Comprised of mostly fats and proteins – it carries 75% of the calories and most of the iron, thiamin and vitamin A. Its purpose is to provide food for a developing chick.

The shell: Made of calcium carbonate and protein, the shell is riddled with pores (tiny holes) that allow gases to pass in and out of the egg.

Eggs are an excellent source of protein

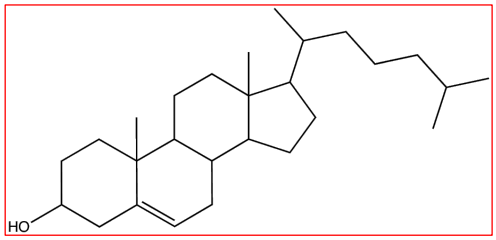
Eggs are also a source of alpha linolenic acid – the essential, polyunsaturated, omega-3 fatty acid

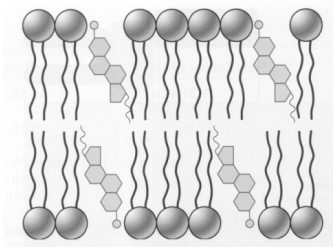
Table : The Composition of a Large Egg*			
	Whole Egg	Egg White	Egg
Weight	5[illegible] grams (g)	38 g	17
Protein	6.6 g	3.9 g	2.7
Carbohydrate	0.6 g	0.3 g	0.3
Fat	6 g	0	6 g
Monounsaturated	2.5 g	0	2.5 g
Polyunsaturated	0.7 g	0	0.7 g
Saturated	2 g	0	2 g
Cholesterol	225 milligrams (mg)	0	225 mg
Sodium	71 mg	62 mg	9 mg
Calories	[illegible]	20	64

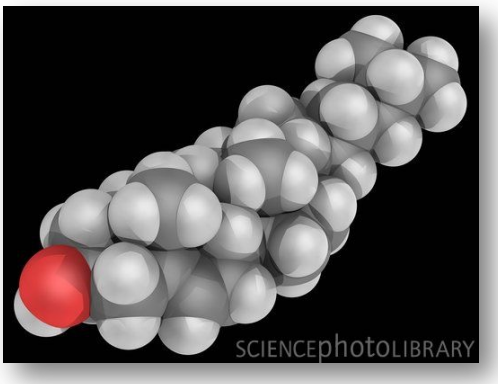
Cholesterol is a lipid
Do we need to worry about cholesterol in eggs?

Another type of lipid: cholesterol

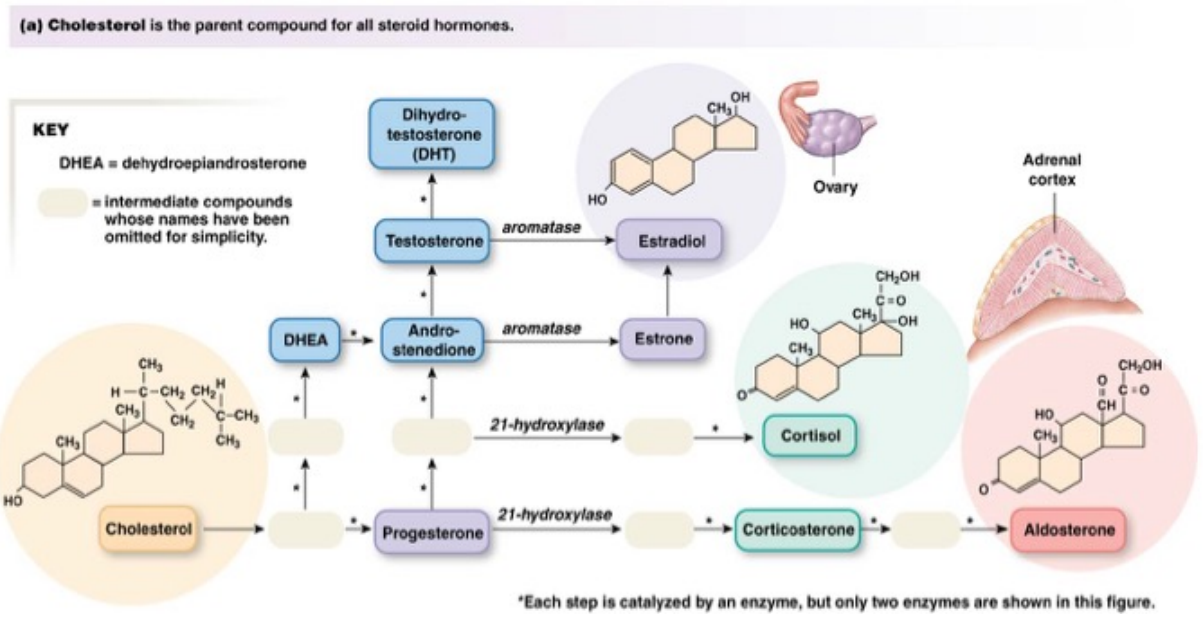
- An important component of animal membranes
- Precursor to steroid hormones
- Obtained both in diet and by synthesis in the liver

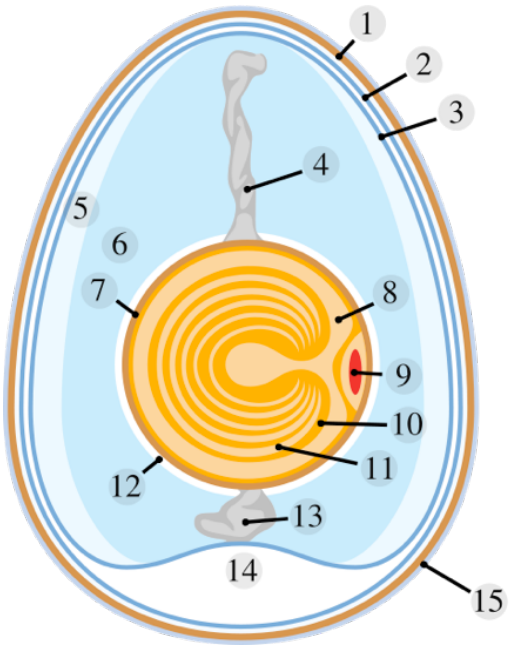






Importance of Cholesterol





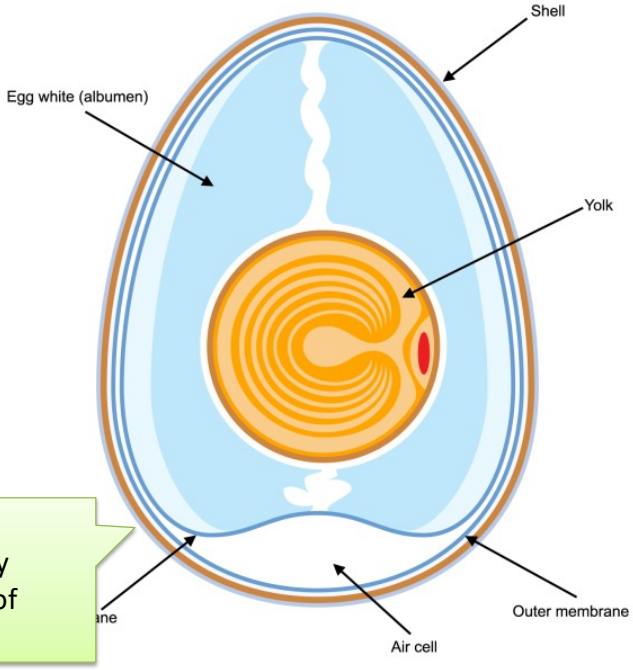
1. **Eggshell** – hard calcium carbonate and protein
2. **Outer membrane** - antimicrobial protein layer
3. **Inner membrane** – antimicrobial protein layer
4. **Chalaza** – protein cord that anchors yolk
5. **Exterior albumen** (outer thin albumen, less protein)
6. **Middle albumen** (inner thick albumen, more protein)
7. **Yolk membrane** – surrounds and protects yolk
8. **Primordial white yolk:** the first yolk to surround the germ cell
9. **Germ cell** (i.e. the egg cell) – not actually red in real life
10. **Yellow yolk** – fats and protein for germ cell
11. **White yolk** – less dense, high in iron
12. **Internal albumen** – the coating from which the chalazae extend
13. **Chalaza** - protein cord that anchors yolk
14. **Air cell** – air for chick to breathe
15. **Cuticle** - protein coating that gives egg color and blocks entry of bacteria

The egg white is made of mostly water and a mixture of proteins called *albumen* (5,6,12). The *albumen* not only nourishes the chick, it is a biochemical shield against infection and predators.

Table. The Proteins in Egg White Albumen		
Protein	% of total	Natural Function
Ovalbumin	54	Nourishment for chick, may block digestive enzymes
Ovotransferrin	12	Binds iron
Ovomucoid	11	Blocks digestive enzymes
Globulins	8	Plug defects in membranes and shell
Lysozyme	3.5	Enzyme that digests bacterial cell walls
Ovomucin	1.5	Thickens albumen, inhibits viruses
Avidin	0.06	Binds the vitamin biotin
Others	10	Bind vitamins; block digestive enzymes….

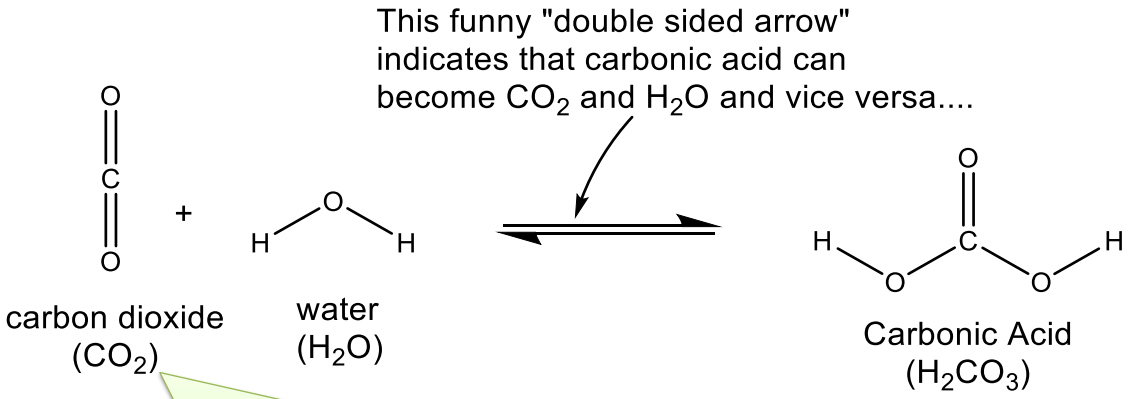
The *chalazae* (4,25) are dense elastic cords made of *albumen* that anchor the yolk to the ends of the shell and allow it to rotate while suspended in the middle of the egg. *Chalazae* are visible in a raw egg when it is cracked open.

The familiar chicken egg has a *yolk* surrounded by egg *white*, contained within a hard shell.



The shell: Made of calcium carbonate and protein, the shell is riddled with pores (tiny holes) that allow gases to pass in and out of the egg.

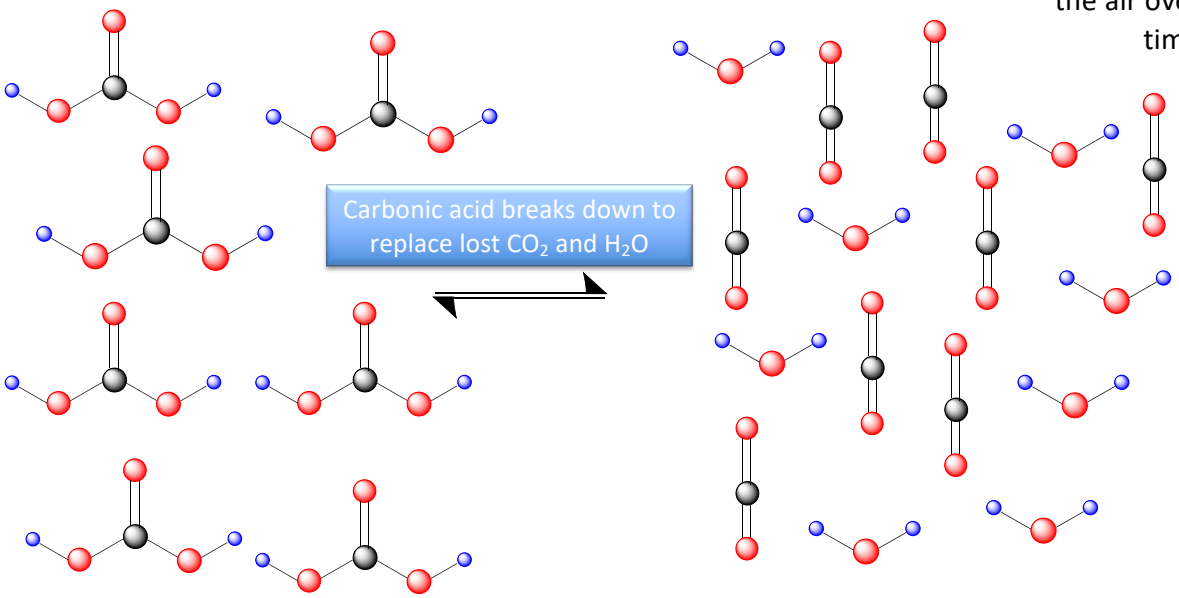
Although an egg can remain edible for weeks if keep intact and cool, egg quality does deteriorate over time. When an egg is freshly laid, it contains carbon dioxide *dissolved* in the white and yolk. When carbon dioxide is *dissolved* in water (and egg white is 90% water) it is in the form *carbonic acid*. When acids are dissolved in water, they make the water *acidic*.



As eggs age, the carbon dioxide dissolved in the white and yolk gradually escapes through the pores in the shell. As carbon dioxide leaves the egg, the white and yolk become more *alkaline*. This change in pH changes interactions between egg white *albumen* proteins (the proteins interact less) and the *egg white albumen* is consequently runnier.

More alkaline egg white = weakens interactions between egg white proteins. This results in looser or runnier egg white as the egg ages

Eggs gradually lose water molecules to the air over time



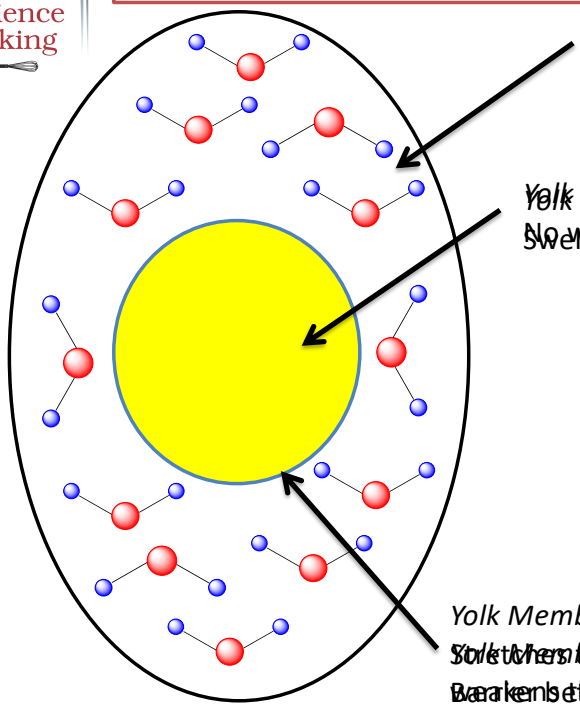
There are now fewer ACID molecules, so the solution is LESS acidic/MORE alkaline

Gaseous carbon dioxide molecules escape from the egg

Eggs

YOLK SIZE, YOLK MEMBRANE AND EGG AGING

Over time, some water molecules from the albumen will push their way across the yolk membrane. Water molecules move from an area of high water concentration (e.g. the white) to an area of low water concentration (e.g. the yolk)



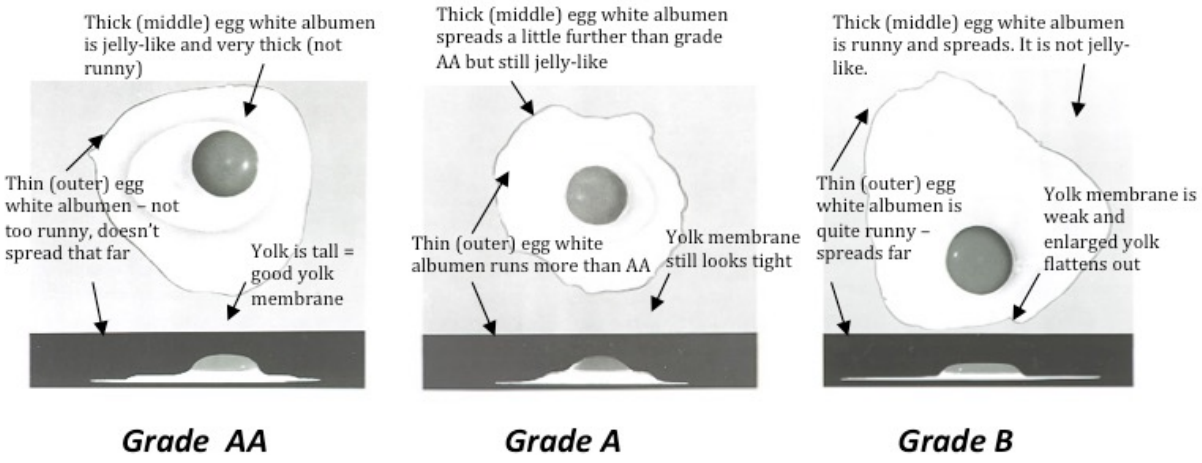
Albumen
Contains many water molecules

Yolk
No water molecules
Swells with additional water molecules

Yolk Membrane
Stretches to accommodate yolk swelling which weakens the membrane, making it break more easily

The Science of Cooking

Egg grade is a function of egg white and yolk membrane.



Grade AA ***Grade A*** ***Grade B***