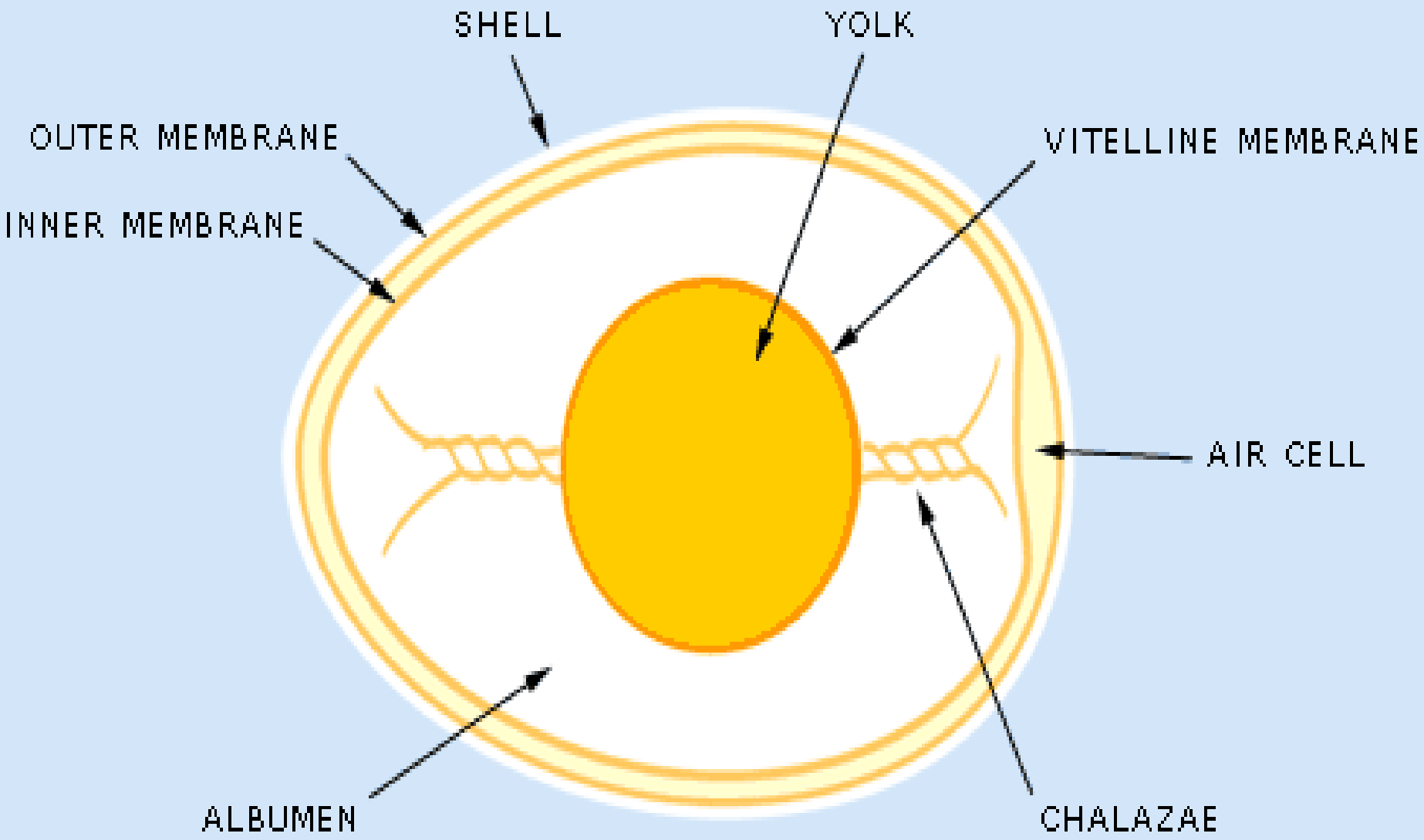
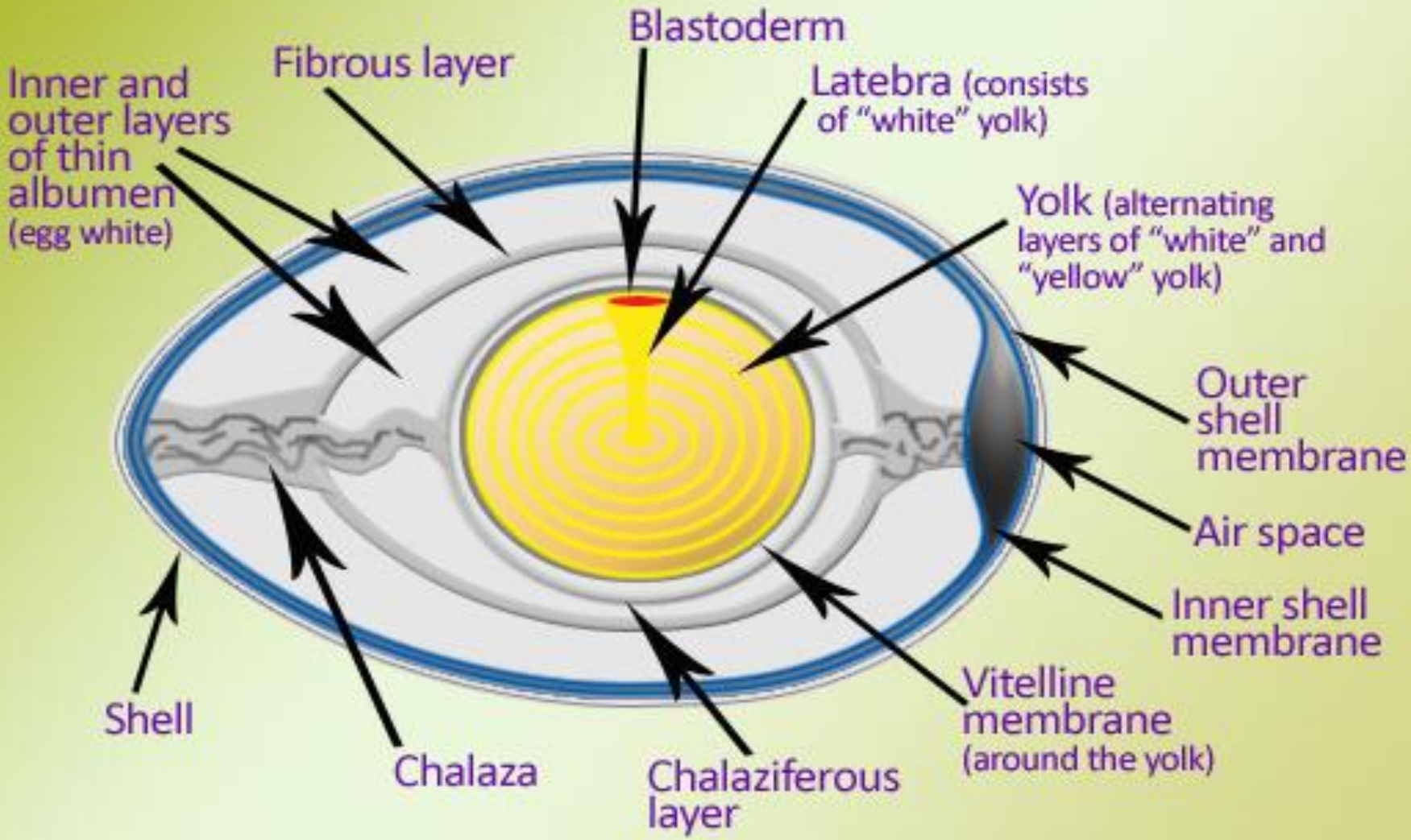
# Anatomy of an Egg



# CHICKEN EGG ANATOMY

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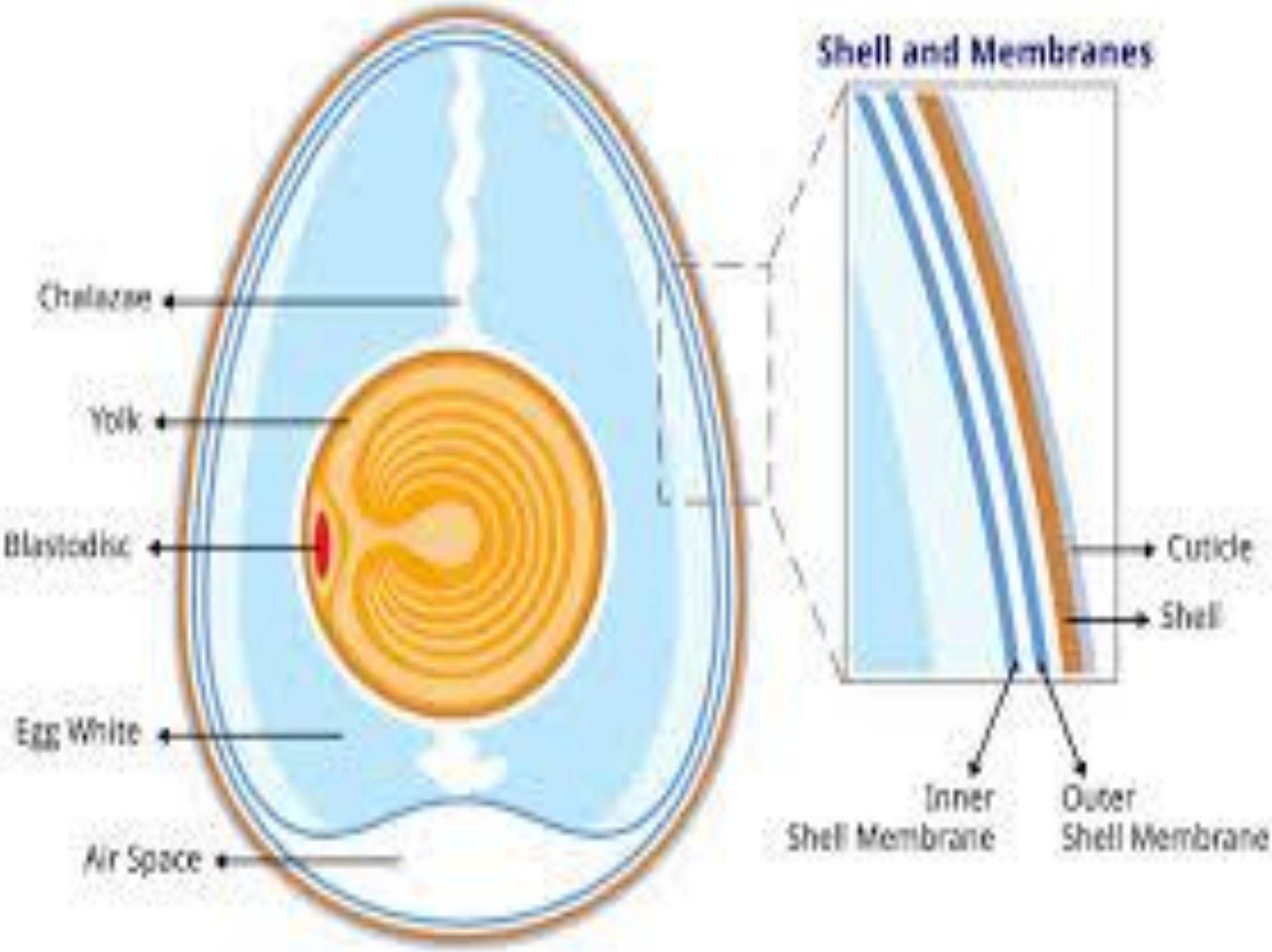

Shell and Membranes
Chalazae
Yolk
Blastodisc
Egg White
Air Space
Cuticle
Shell
Inner
Shell Membrane
Outer
Shell Membrane

# The Entire Chick Came From Just One Egg

# Nutrient Composition of Whole Hen's Egg

| | | |
|---|---|---|
| 1. | Weight | 60 g |
| 2. | Water (percent) | 65 -68.5 |
| 3. | Kilocalories (kilojoules) | 70 (293) |
| 4. | Proteins (g) | 6.3 |
| 5. | Carbohydrate (g) | 0.36 |
| 6. | Total fat (g) | 4.8 |
| 7. | Polyunsaturated fat (g) | 1 |
| 8. | Monounsaturated fat (g) | 1.8 |
| 9. | Saturated fat (g) | 1.6 |
| 10. | Cholesterol (mg) | 185 |
| 11. | Choline (mg) | 126 |
| 12. | Vitamin A (IU) | 270 |
| 13. | Vitamin D (IU) | 41 |
| 14. | Vitamin E (mg) | 0.5 |

# Biological Value (BV)

- This is a measure of the proportion of absorbed protein from a food which becomes incorporated into the proteins of the organism's body
- It captures how readily the digested protein can be used in protein synthesis in the cells of the organism
- Proteins are the major source of nitrogen in food. BV assumes protein is the only source of nitrogen and measures the proportion of this nitrogen absorbed by the body which is then excreted
- The remainder must have been incorporated into the proteins of the organism’s body
- A ratio of nitrogen incorporated into the body over nitrogen absorbed gives a measure of protein 'usability'

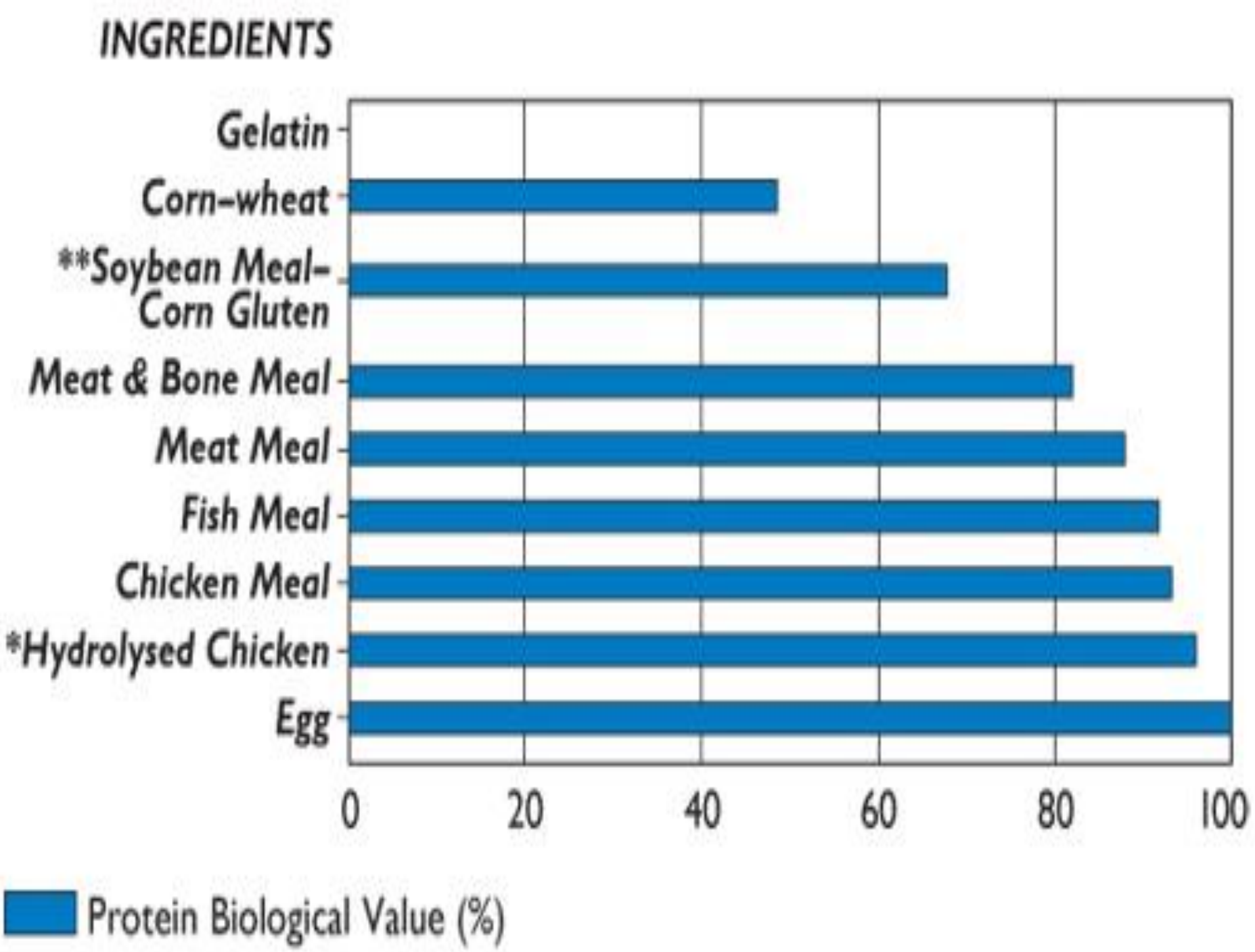
# Biological Value of Some Protein-Rich Foods

| | Ile | Leu | Val | Thr | Met + Cys | Trp | Lys | Phe + Tyr | His | Biological Value |
|---|---|---|---|---|---|---|---|---|---|---|
| Egg, chicken | 1,0 | 1,0 | 1,0 | 1,0 | 1,0 | 1,0 | 1,0 | 1,0 | 1,0 | 0,94 |
| Milk, human | 1,1 | 1,4 | 1,0 | 1,0 | 1,1 | 1,6 | 1,0 | 1,0 | 0,9 | 0,95 |
| Milk, Cow | 1,1 | 1,3 | 1,0 | 0,9 | 0,7 | 1,3 | 1,3 | 0,9 | 1,1 | 0,90 |
| Muscle, beef | 0,8 | 0,9 | 0,7 | 0,9 | 0,9 | 0,9 | 1,4 | 0,7 | 1,6 | 0,76 |
| Soybeans | 1,0 | 0,9 | 0,8 | 0,8 | 0,6 | 1,3 | 1,1 | 1,0 | 1,4 | 0,75 |
| Rice | 0,8 | 0,9 | 0,9 | 0,8 | 0,9 | 1,2 | 0,5 | 1,2 | 0,8 | 0,75 |
| Wheat | 0,6 | 0,8 | 0,6 | 0,7 | 0,8 | 1,1 | 0,4 | 0,8 | 1,0 | 0,67 |
| Potatoes | 0,6 | 1,1 | 0,8 | 1,3 | 0,6 | 1,9 | 1,4 | 0,8 | 1,1 | 0,67 |
| Oats | 0,8 | 0,8 | 0,8 | 0,7 | 0,6 | 1,2 | 0,6 | 1,0 | 1,1 | 0,66 |
| Corn | 1,0 | 1,7 | 0,8 | 0,7 | 1,1 | 0,5 | 0,4 | 1,0 | 1,0 | 0,60 |

McGilvery, Biochemistry, 1970

| Amino acid | Bregendahl et al. (2008)[2] | NRC (1994)[3] | Jais et al. (2008)[4] | CVB (1996)[5] | Coon and Zhang (1999)[5] | Leeson and Summers (2005)[6] | Rostagno (2005)[5] |
|---|---|---|---|---|---|---|---|
| Lysine | 100 | 100 | 100 | 100 | 100 | 100 | 100 |
| Methionine | 47 | 43 | 44 | 50 | 49 | 51 | 50 |
| Methionine + cystine | 94 | 84 | - | 93 | 81 | 88 | 91 |
| Threonine | 77 | 68 | 76 | 66 | 73 | 80 | 66 |
| Tryptophan | 22 | 23 | 16 | 19 | 20 | 21 | 23 |
| Arginine | _[7] | 101 | 82 | - | 130 | 103 | 100 |
| Isoleucine | 79 | 94 | 76 | 79 | 86 | 79 | 83 |
| Valine | 93 | 101 | 64 | 86 | 102 | 89 | 90 |

| Food | Biological Value |
| --- | --- |
| Eggs (whole) | 100 |
| Chicken / Turkey | 79 |
| Beef | 78 |
| Fish | 70 |
| Brown Rice | 57 |
| Peas | 55 |
| Whole Wheat | 49 |
| Soy beans | 47 |
| Corn | 36 |
| Dry Beans | 34 |


INGREDIENTS
Gelatin
Corn-wheat
**Soybean Meal-Corn Gluten
Meat & Bone Meal
Meat Meal
Fish Meal
Chicken Meal
*Hydrolysed Chicken
Egg
0
20
40
60
80
100
Protein Biological Value (%)

# Net Protein Utilization (NPU)

- The net protein utilization, or NPU, is the ratio of amino acid converted to proteins to the ratio of amino acids supplied

- This figure is somewhat affected by the salvage of essential amino acids within the body, but is profoundly affected by the level of limiting amino acids within a foodstuff

# Determination of NPU

- Experimentally, this value can be determined by determining dietary protein intake and then measuring nitrogen excretion. One formula for NPU is:

- NPU = ((0.16 × (24 hour protein intake in grams)) - ((24 hour urinary urea nitrogen) + 2) - (0.1 × (ideal body weight in kilograms))) / (0.16 × (24 hour protein intake in grams))

- NET PROTEIN UTILIZATION(NPU) : It is the product of digestibility coefficient and biological value divided by 100.

$$\text{NPU} = \frac{\text{Nitrogen retained in the body} \times 100}{\text{Nitrogen intake}}$$

- In calculating protein quality, 1 g of protein is assumed to be equivalent to 6.25g of nitrogen.

- Total protein requirements varies with the NPU of dietary proteins.NPU of Indian diet varies between 50 and 80.

# Net Protein Utilization (NPU)

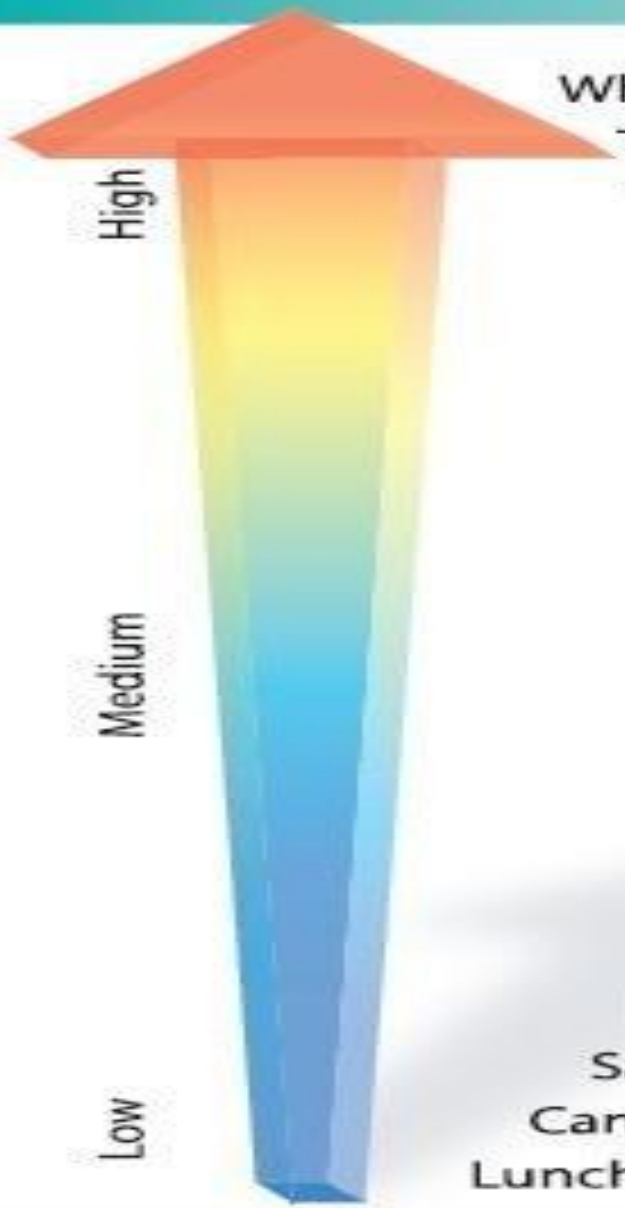
- As a value, NPU can range from 1 to 0, with a value of 1 indicating 100% utilization of dietary nitrogen as protein and a value of 0 an indication that none of the nitrogen supplied was converted to protein

- Certain foodstuffs, such as eggs or milk, rate as 1 on an NPU score

| Protein Type | Protein efficient ratio | Biological value | Net protein utilization |
|---|---|---|---|
| Egg | 3.9 | 100 | 94 |
| Casein | 2.5 | 77 | 76 |
| Whey protein | 3.2 | 104 | 92 |
| Soy protein | 2.2 | 74 | 61 |
| Beans | 0 | | 0 |
| Wheat gluten | 0.8 | 64 | 67 |

THE CORY HOLLY INSTITUTE CSNA Education Program CoryHolly.com

# Protein Quality Chart




Whey Protein Isolate
Tuna Sashimi
Wild Salmon
Halibut
Poached Eggs
Turkey Breast
Venison
Buffalo
Cottage Cheese
Sardines
Ostrich
Chicken Breast
Leg of Lamb
Soy Protein
Pork Ribs
Fried Eggs
Ground Beef
Hot Dogs
Sausage Meats
Canned Tuna
Luncheon Meats

PH 7

Alkaline

Acidic

Non-denatured

Denatured (damaged)

# Nutritive Benefits of Eggs

- A very good source of inexpensive, high quality protein
- More than half the protein of an egg is found in the egg white along with vitamin B2 and lower amounts of fat and cholesterol than the yolk
- The whites are rich sources of selenium, vitamin D, B6, B12 and minerals such as zinc, iron and copper
- Egg yolks contain more calories and fat. They are the source of cholesterol, fat soluble vitamins A, D, E and K and lecithin - the compound that enables emulsification in fatty foods

# Nutritive Benefits of Eggs

- Some brands of egg now contain omega-3 fatty acids, depending on what the chickens have been fed

- Eggs are regarded a 'complete' source of protein as they contain all eight essential amino acids; the ones we cannot synthesize in our bodies and must obtain from our diet

# Fatty Acids Composition of Eggs

## The fatty acid composition of eggs depends on the feed

- Wheat
- Oats
- Supplement
- Flaxseed
- Limestone
- Canola oil
- Groundnut oil (high oleic acid content)
- Soya bean (linoleic acid) or linseed oil (α-linolenic acid)

- Incorporation of groundnut versus linseed into the diet raised the arachidonic acid content of the eggs

- Feeding the linseed diet produced higher contents of eicosapentaenoic and docosahexaenoic acid

# Gene Expression

# Choline and The Brain

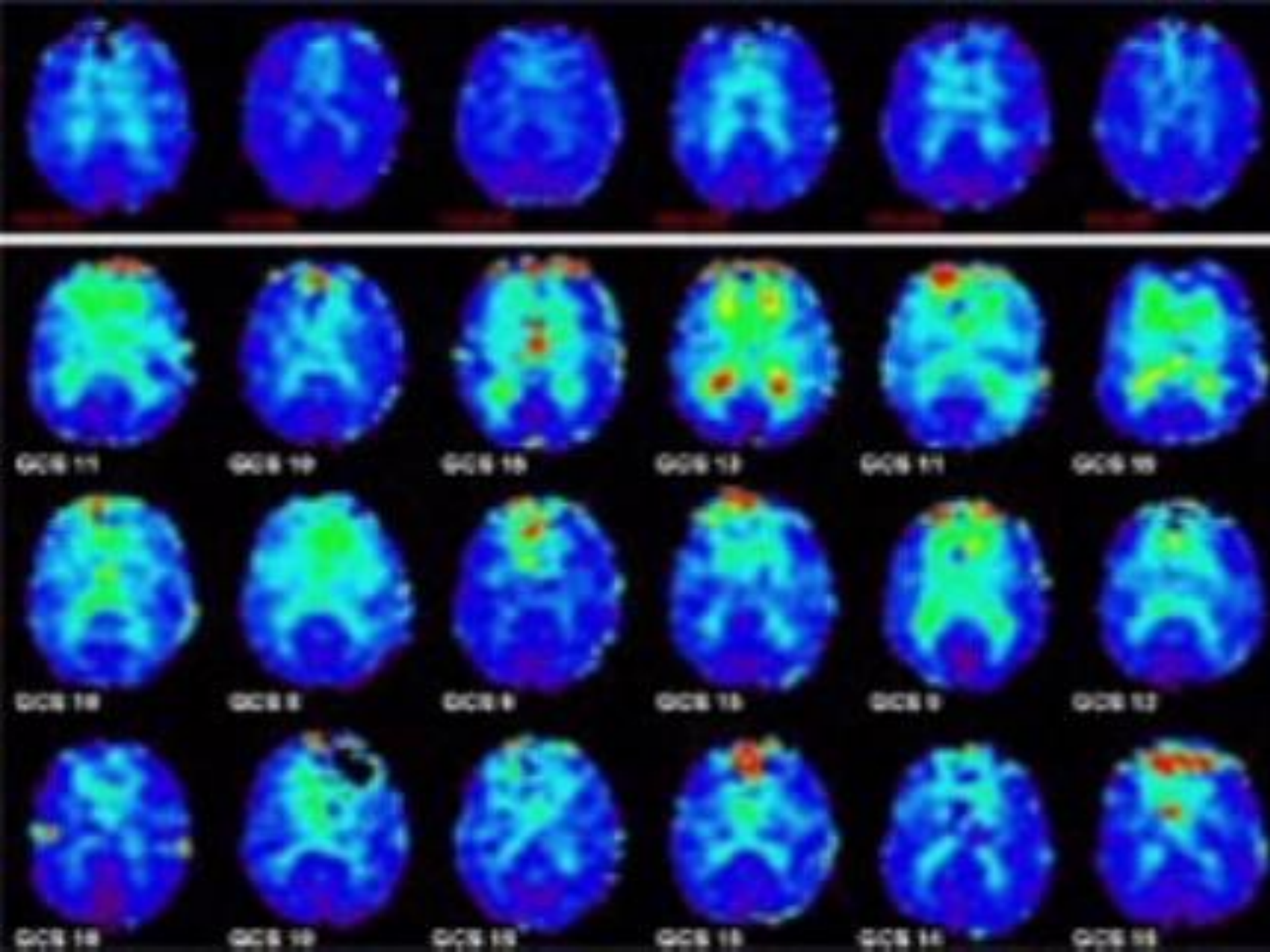
- Choline's vital role in the production of the neuro-chemical acetylcholine provides a host of cognitive benefits
- It is most well known as a memory enhancer, but that is just one of dozens of positive effects it can have on the mental landscape
- A brain's ability to remain plastic is another way of describing intelligence, with the potential to adapt to and thrive in new situations
- All of this begins with healthy amounts of acetylcholine, which in turn requires choline to produce that is abundantly found in eggs

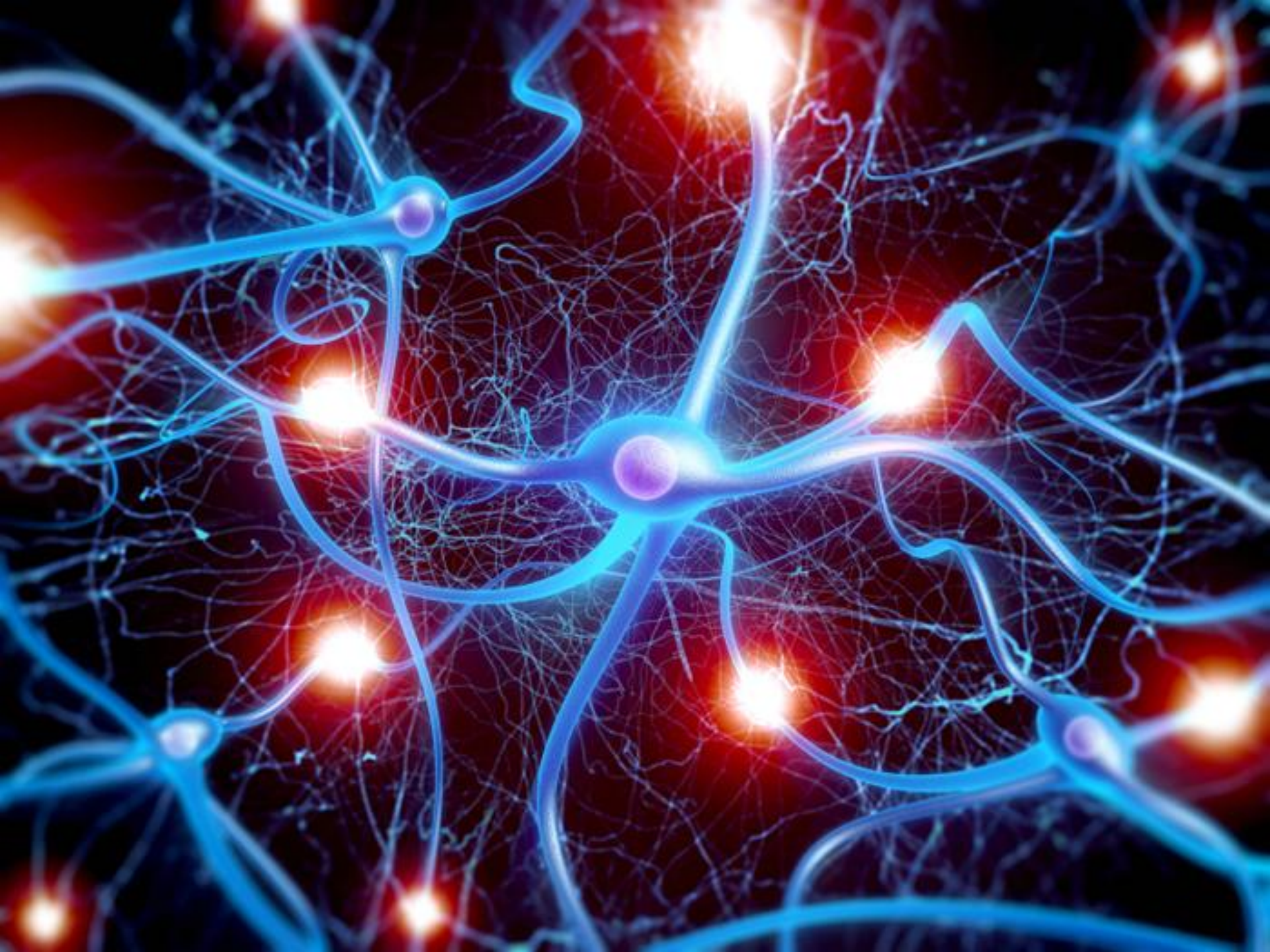
# Choline and The Brain

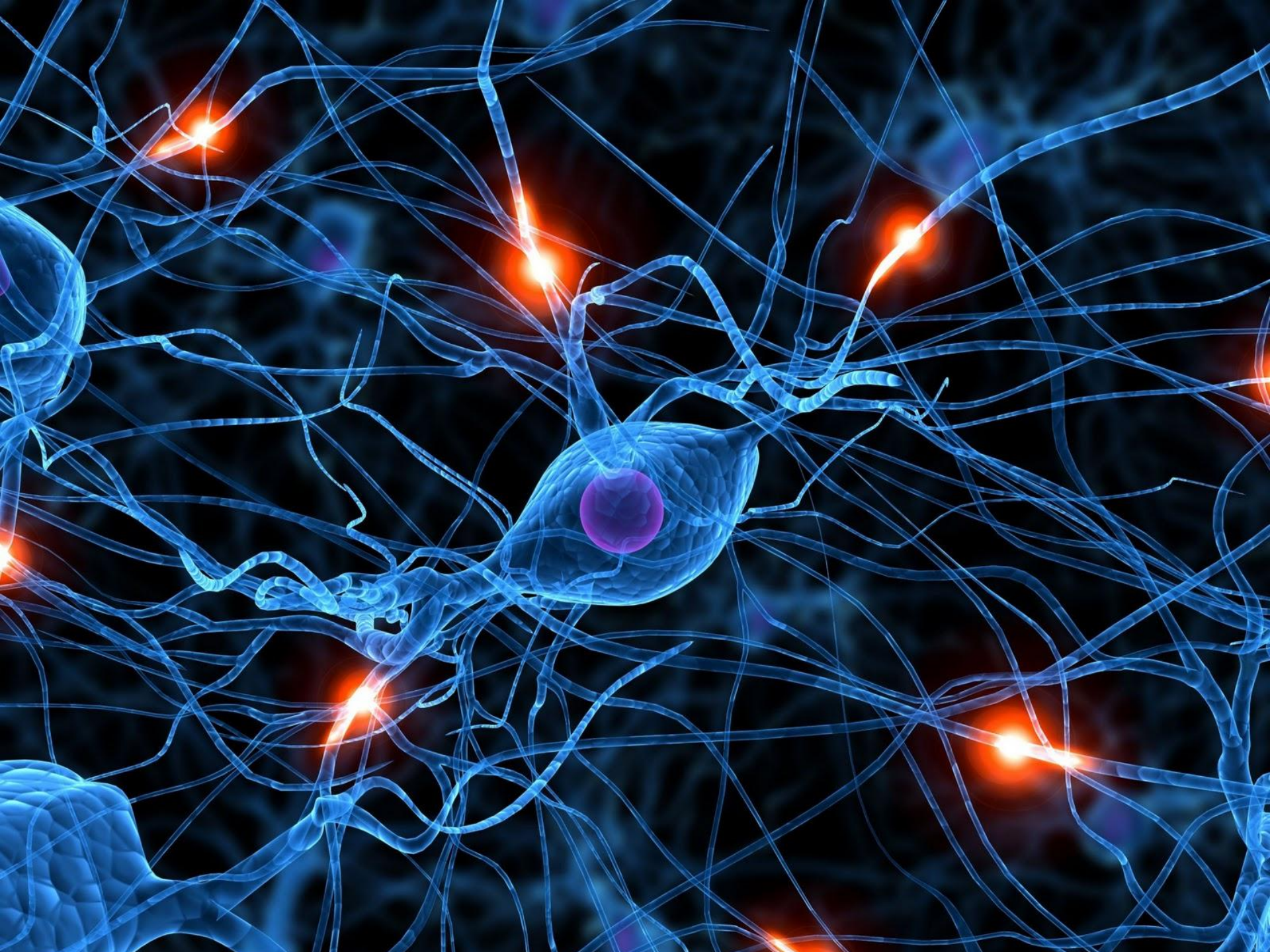
- Perhaps the most important effect is enhanced neuroplasticity in the physical structure of the brain

- This refers to the ability of neurons to form new connections through synapses, which happens when we have new experiences or make new connections of logic or insight about facts, sensory stimulus, and emotion.

MORE ELECTRICAL IMPULSES ARE GENERATED IN ONE DAY BY A SINGLE HUMAN BRAIN THAN BY ALL THE PHONES IN THE WORLD.


GCS 11
GCS 10
GCS 15
GCS 13
GCS 11
GCS 15
GCS 10
GCS 8
GCS 9
GCS 15
GCS 9
GCS 12
GCS 10
GCS 10
GCS 15
GCS 15
GCS 14
GCS 15





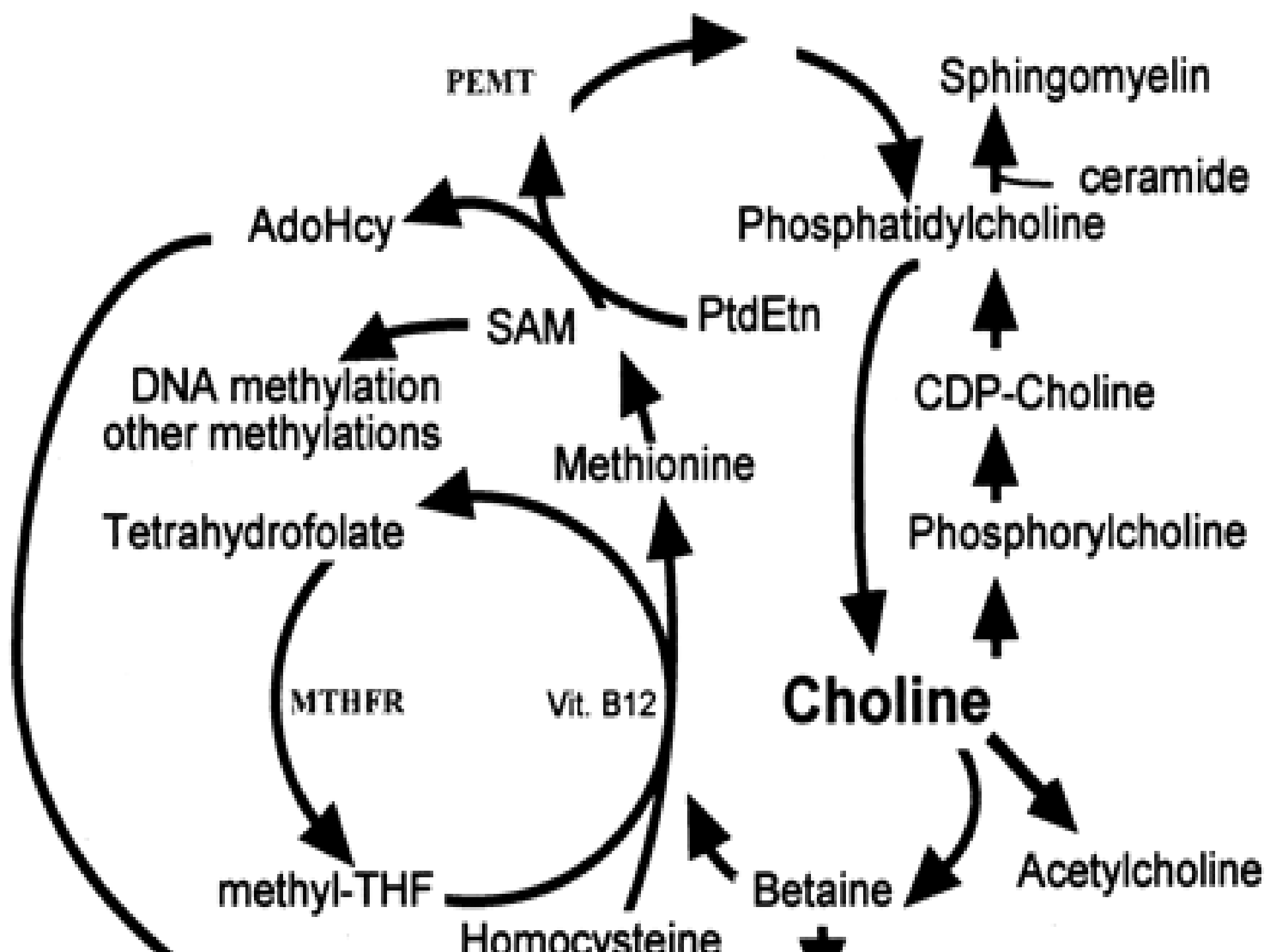
GAMMA:
Active Thought

BETA:
Alert, Working

ALPHA:
Relaxed, Reflective

THETA:
Drowsy, Meditative[

DELTA:
Sleepy, Dreaming


PEMT
Sphingomyelin
ceramide
AdoHcy
Phosphatidylcholine
SAM
PtdEtn
DNA methylation
other methylations
CDP-Choline
Methionine
Tetrahydrofolate
Phosphorylcholine
MTHFR
Vit. B12
Choline
methyl-THF
Betaine
Acetylcholine
Homocysteine

# Egg is a Memory Enhancer

1. Better memory
2. Recall of facts, feelings of mental clarity,
3. Ability to reason and articulate thoughts clearly
4. Coherent verbal skills, and logical thinking

# Egg is a Memory Enhancer

5. Choline leads to enhanced focus and the mind's ability to concentrate
6. Faster reaction times to stimulus
7. Crucial for various learning

# Egg is a Memory Enhancer

- Due to choline sharpening of concentration, the consumption of eggs may be a beneficial adjunct therapy for symptoms of

- Attention Deficit Hyperactivity Disorder (ADHD) or Attention Deficit Disorder (ADD)

# 13 BRAIN Foods - Boost Your Brain and Memory

## *Surge Your Brain Power*

Almonds
increase blood flow to the brain

Walnuts
high in omega 3

Blueberries
improve learning & motor skills

Brussels Sprouts
has tryptophan which converts to serotonin in the brain

Broccoli
assists in proper brain functioning

Cauliflower
Assists in cleansing white matter in brain & spine

Ginger
anti-inflammatory may help protect from brain disease

Apples
power food for mind, body & emotions

Watermelon
targets Brain Function

Cabbage
High intake of cruciferous may lower risk of brain, lung & prostate cancer

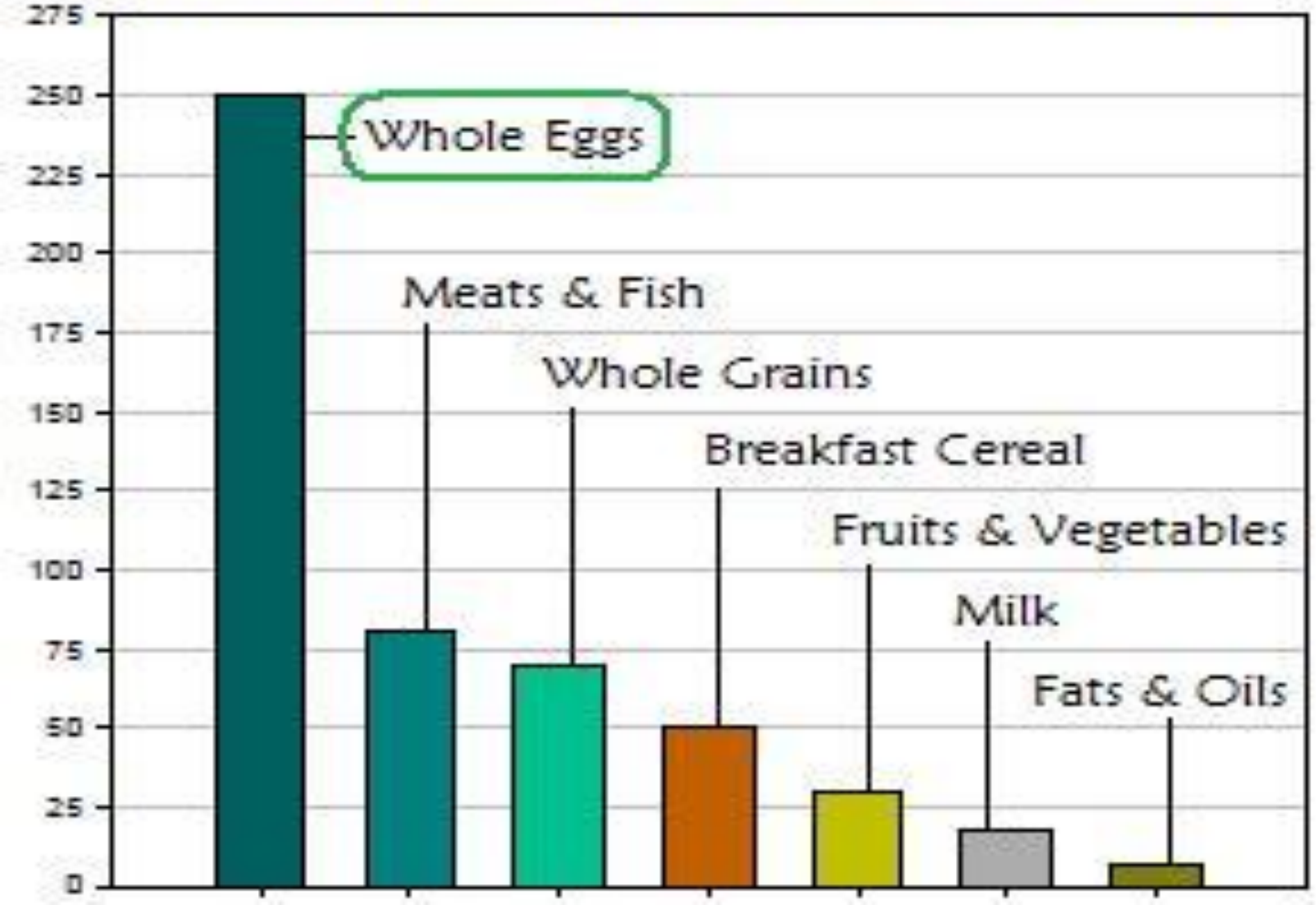
Lettuce helps increase blood flow to the brain & cleanse blood plaque

Cantaloupe/Rockmelon
supports the brain

Pine Nuts
helps stimulate brain activity

# A Rich Source of Choline

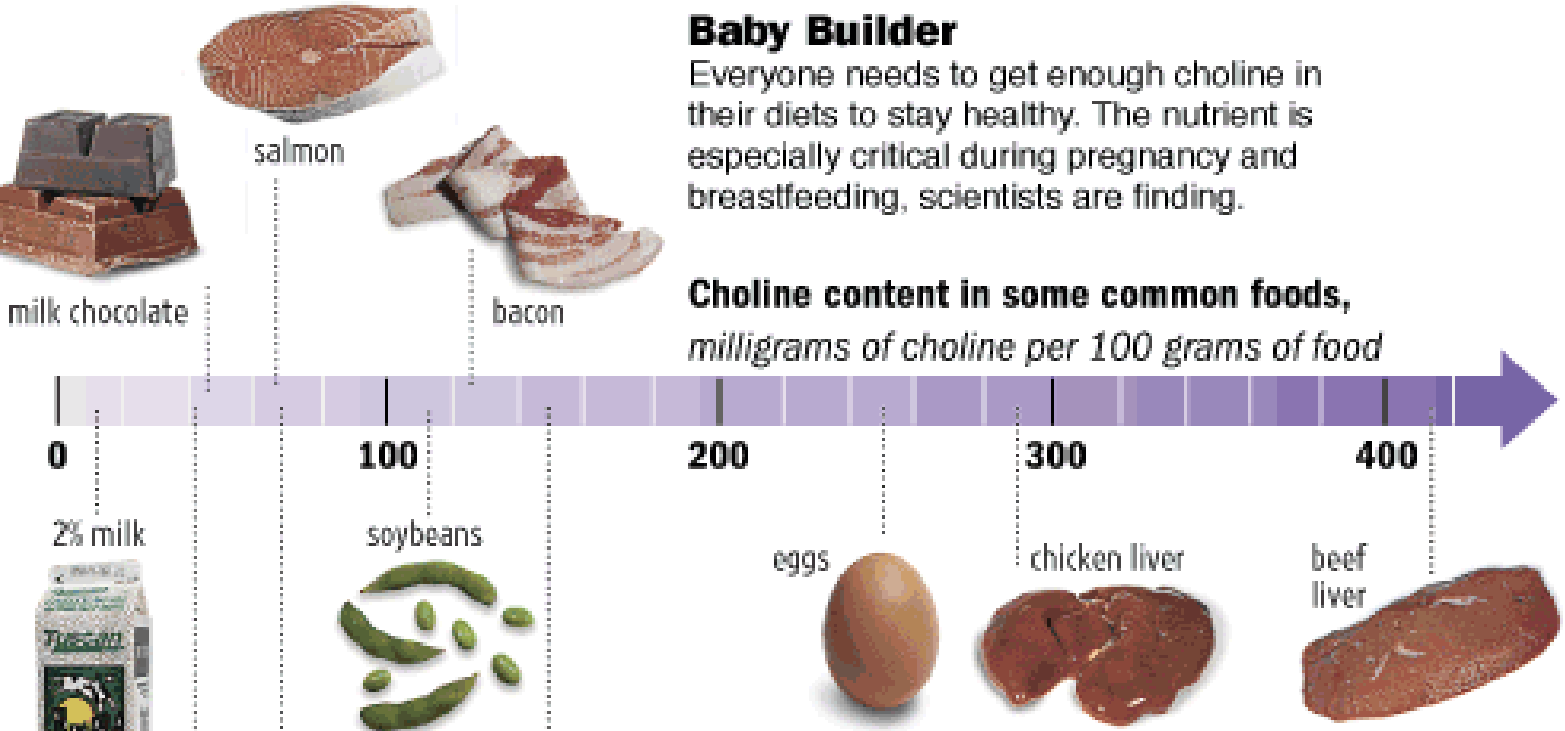
# Total Choline in Selected Foods



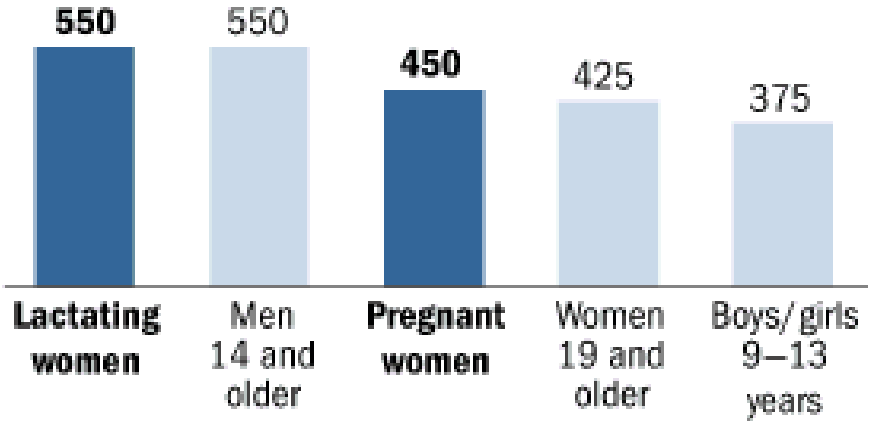
## Baby Builder

Everyone needs to get enough choline in their diets to stay healthy. The nutrient is especially critical during pregnancy and breastfeeding, scientists are finding.

**Choline content in some common foods,**
*milligrams of choline per 100 grams of food*




**Adequate intake levels of choline,** *in milligrams a day*




Sources: National Academies of Science; U.S. Department of Agriculture

# Foods Rich in Choline (mg/100g)

Salmon –smoked– 220mg/100g
- Chicken –roasted- 79mg/100g
- Salmon –cooked- 91mg/100g
- Tilapia – 83mg/100g
- Soy protein powder – 86mg/100g
- Peanut Butter – 66mg/100g
- Cocoa powder – 115mg/110g
- Skim Milk – 38mg/cup

Fried egg – 270/100g
- Hard-boiled egg – 230/100g
- Large Egg (one) – 120mg
- Beef Liver – 350mg/100g
- Chicken Liver – 330mg/100g
- Almonds – 52mg/100g
- Broccoli – 40mg/100g
- Brussels sprouts – 41mg/100g
- Cauliflower – 39mg/100g

USDA Database for Choline in Common Foods, Release Two, USDA-ARS, Jan 2008.

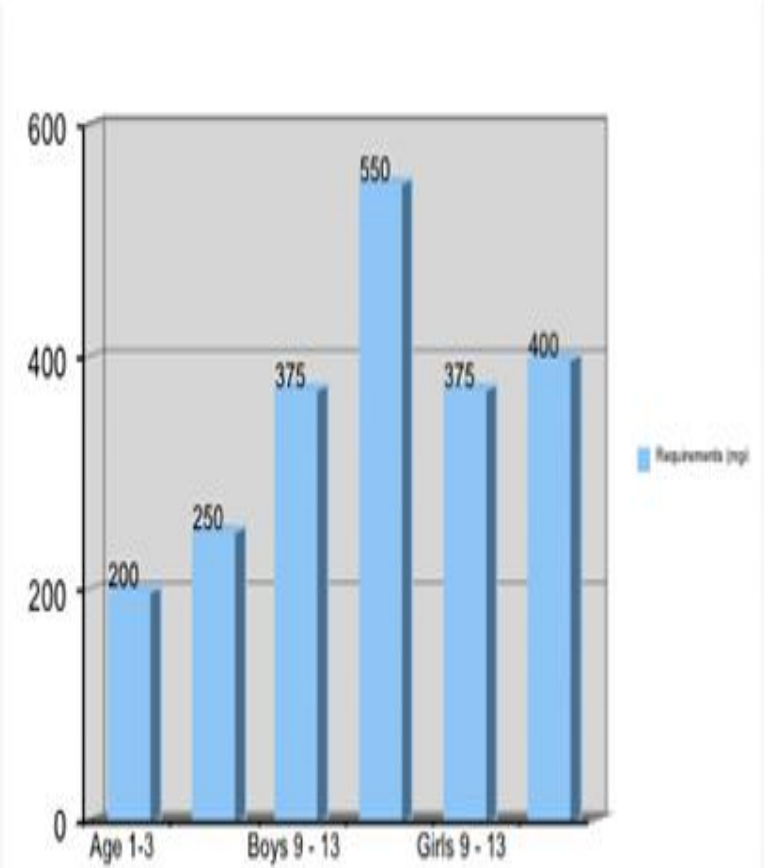
# Rich food sources of choline

(per 100 gram serving)

Beef liver 350 mg
Chicken liver 330 mg
Egg, hard boiled 230 mg
Salmon, smoked 220 mg
Salmon, cooked 91 mg
Soy protein powder 86 mg
Tilapia 83 mg
Chicken, roasted 79 mg
Peanut butter 66 mg
Almonds 52 mg
Brussels sprouts 41 mg
Broccoli 40 mg
Cauliflower 39 mg

Source: U.S. Dept. of Agriculture Database for the Choline Content of Common Foods, Release Two. Nutrient Data Laboratory, Agricultural Research Service, U.S. Department of Agriculture, January 2008.

# Choline Requirements by Age



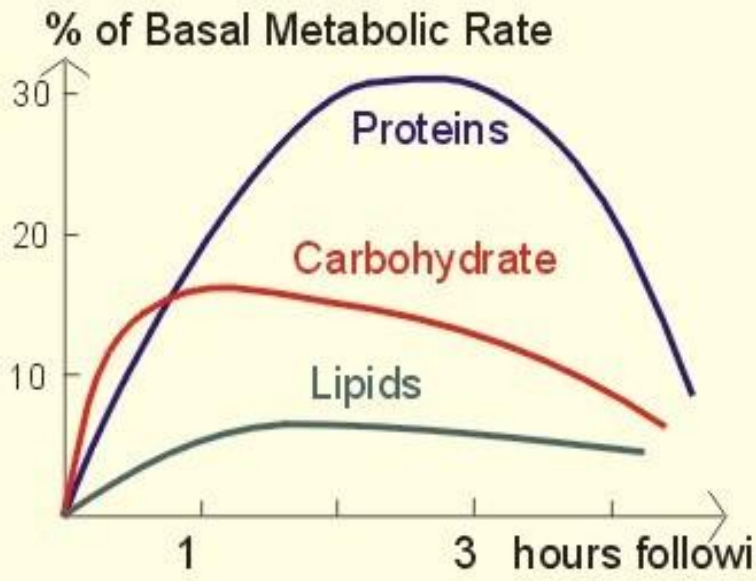

Institute of Medicine, Dietary Reference Intakes for Thiamin, Riboflavin, Niacin, Vitamin B6, Folate, Vitamin B12. Pantothenic Acid, Biotin, and Choline. 1998.

# Specific Dynamic Action

- Thermal effect of food (abbreviated as TEF), also known as specific dynamic action (SDA) of a food or dietary induced thermogenesis (DIT),
- It is the amount of energy expenditure above the resting metabolic rate due to the cost of processing food for use and storage.
- It is one of the components of metabolism along with resting metabolic rate and the exercise component.
- A commonly used estimate of the thermal effect of food is about 10% of one's caloric intake, though the effect varies substantially for different food components.
- For example, dietary fat is very easy to process and has very little thermal effect, while protein is hard to process and has a much larger thermal effect

# Dietary Thermogenesis

## Specific Dynamic Activity (SDA): Intake of food increases metabolism



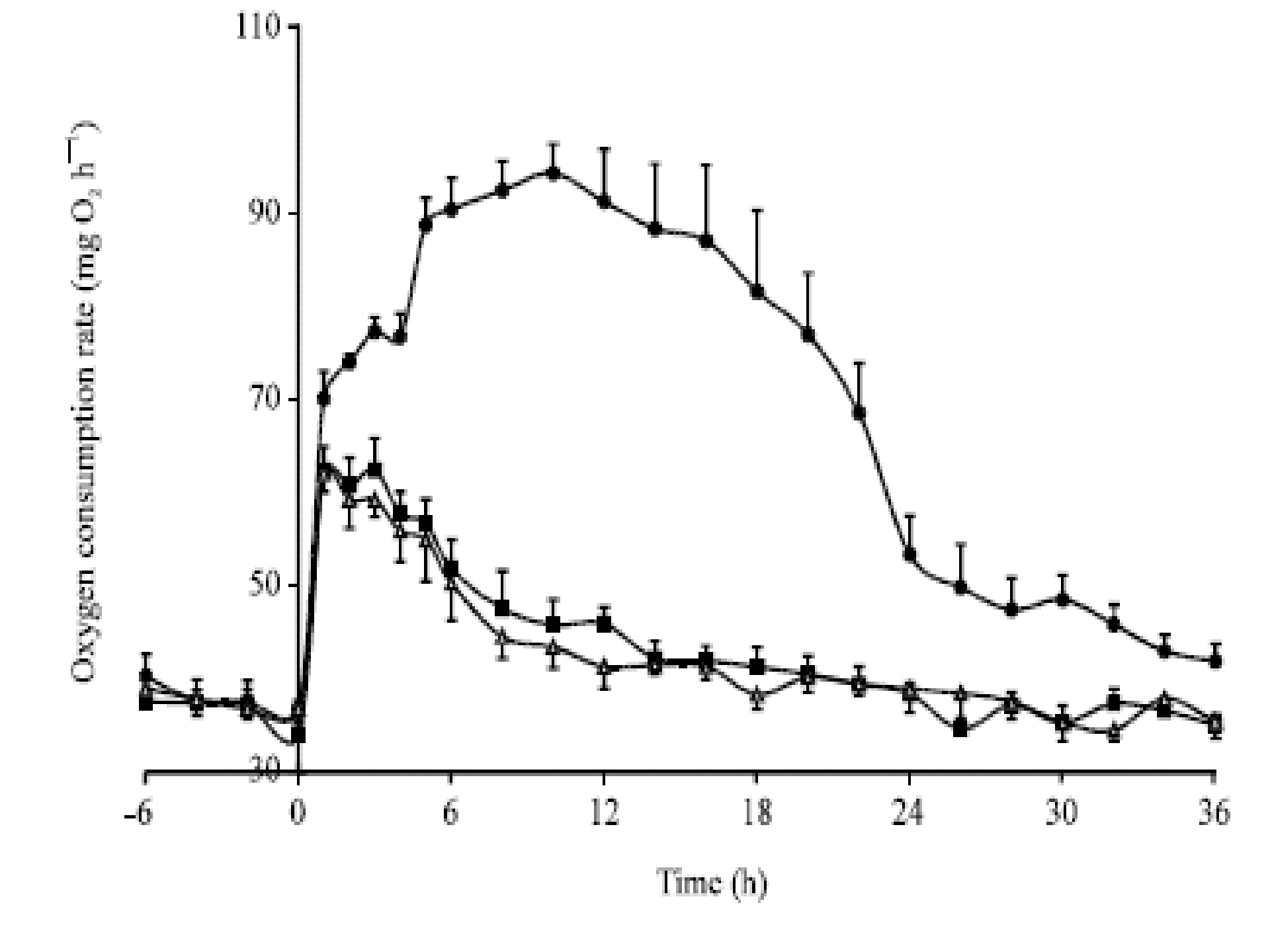

1. General causes of SDA:
   Mass balance
   Rise in temperature increases enzyme activity ($Q_{10}$ = 2-3)

2. Glucose - SDA:
   Obligate formation of glycogen and fatty acids.
   Muscular activation by adrenaline via $\beta_2$-receptors.
   Non-myogenic activation by noradrenaline via $\beta_1$- receptors.

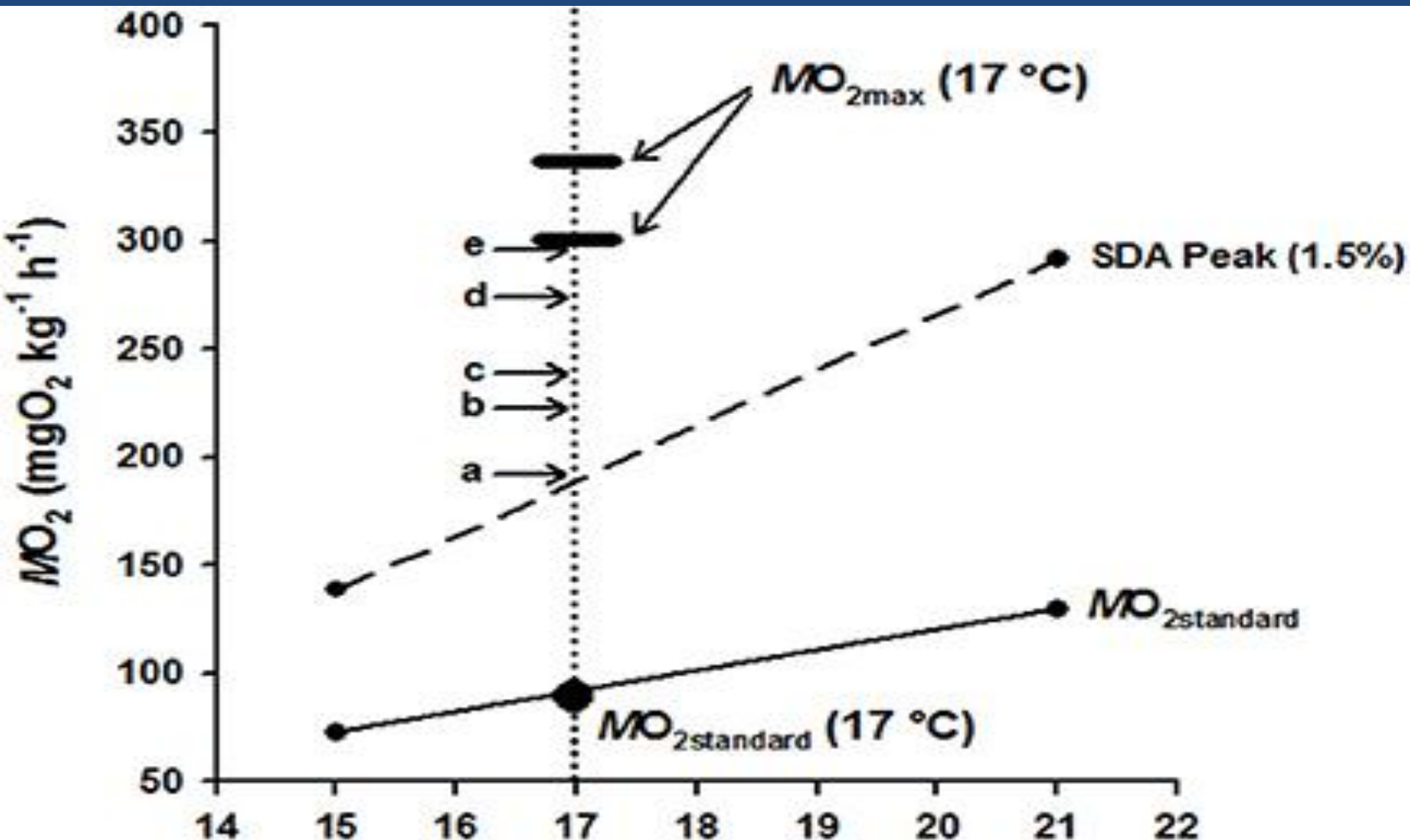
3. Protein-SDA (30%):
   Hepatic intermediary processes (amino acid degradation, urea formation)

Fig. 20-6

KMc


110
90
70
50
30
Oxygen consumption rate (mg $O_2$ $h^{-1}$)
-6
0
6
12
18
24
30
36
Time (h)

# Oxygen Consumption in SDA



# Nutritional Key Points

- Eggs are a very good source of inexpensive, high quality protein
- More than half the protein of an egg is found in the egg white along with vitamin B2 and lower amounts of fat and cholesterol than the yolk.
- The whites are rich sources of selenium, vitamin D, B6, B12 and minerals such as zinc, iron and copper. Egg yolks contain more calories and fat.
- They are the source of cholesterol, fat soluble vitamins A, D, E and K and lecithin - the compound that enables emulsification in recipes such as hollandaise or mayonnaise.

# Nutritional Key Points

- Some brands of egg now contain omega-3 fatty acids, depending on what the chickens have been fed.

- Eggs are regarded a 'complete' source of protein as they contain all eight essential amino acids; the ones we cannot synthesize in our bodies and must obtain from our diet.

- One large egg contains:

  78 calories
  6.3g protein
  5.3g fat
  1.6g saturated fat
  212mg cholesterol (see my blog below about cholesterol):

http://scientificlogic.blogspot.my/2010/05/eggs-are-bad-for-health.html

# Nutritional Key Points

- The nutritional value of eggs lies chiefly in their providing proteins of good biological value; an average-sized egg (60 g) provides approximately 7 g of proteins

- These proteins are rich in essential amino acids, with a very good balance between those amino acids, so that egg protein can be regarded as a reference protein.

- To exemplify, 2 eggs provide as much protein as 100 g of meat or 100 g of fish.

# Nutritional Key Points

- The energy value for an average egg (60 g) is approximately 376 kJ (90 kcal)
- The lipid content is 7 g, most of those lipids being contained in the yolk. 2/3 of the fatty acids are unsaturated. An egg also contains 180 mg of cholesterol
- An egg is rich in vitamins A, D, & E, and trace elements iron and zinc

# Health Concern

- The main safety concern of eggs is risk of salmonella food poisoning
- The best protection is to cook eggs at a high enough temperature for a long enough period of time, meaning poached, scrambled and hard boiled eggs carry a much lower salmonella risk

- Another safety concern regarding eggs is that they are a common food allergen, particularly among young children.

# Salmonella infections

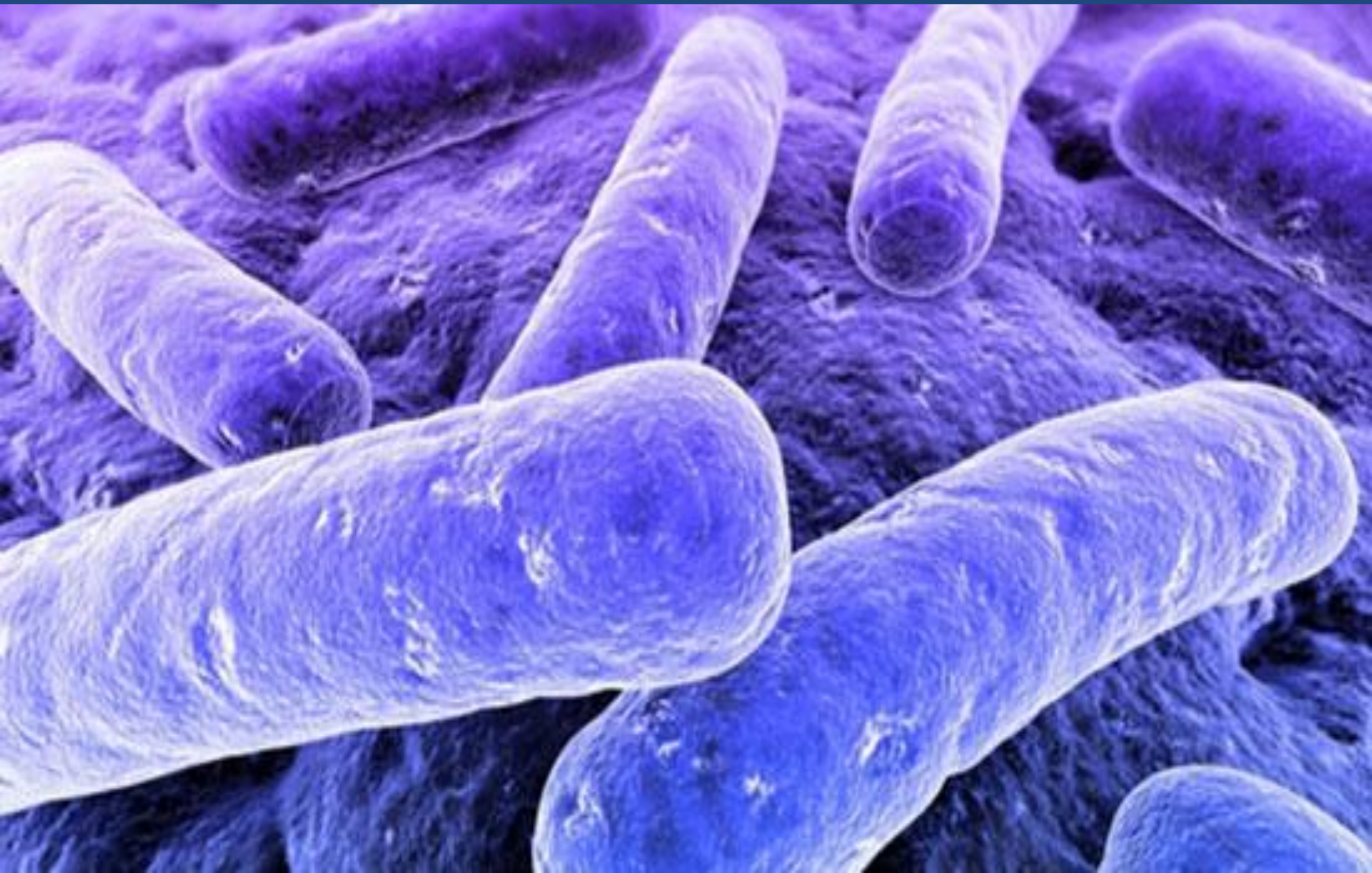
There are two species of Salmonella:

- *Salmonella bongori* and *Salmonella enterica*
- *Salmonella enterica* is further divided into six subspecies and over 2500 serovars
- Salmonella cause illnesses such as typhoid fever, paratyphoid fever, and food poisoning (Salmonellosis)

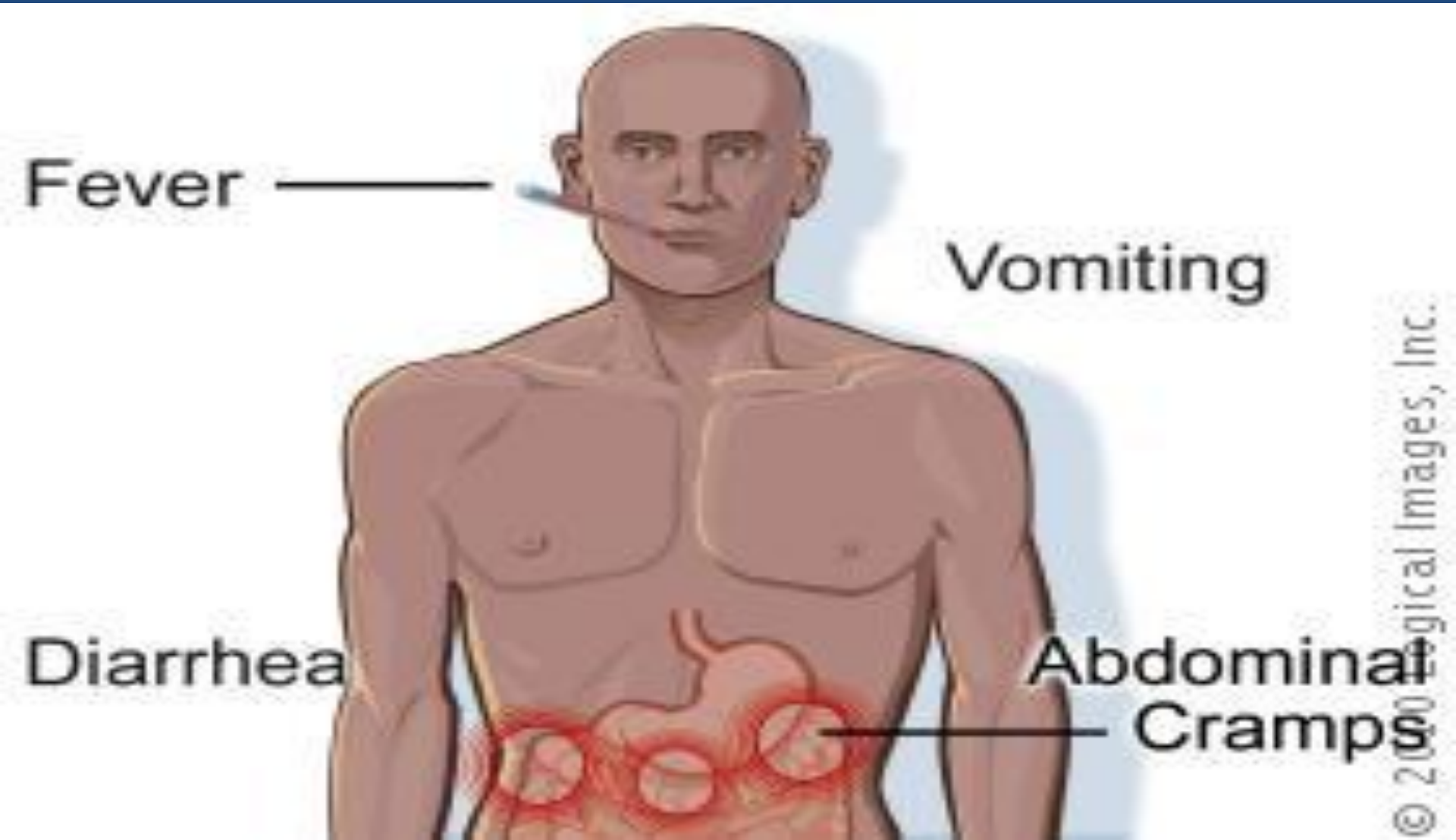
# Salmonella typhi

# Salmonella typhi

# Salmonella typhi



# Presentations of Typhoid



# Rose Spots

# Rashes of Typhoid

# Rashes of Typhoid

# Biotin

Biotin, also known as vitamin H or B7 is a water-soluble, sulphur-containing vitamin

It is often grouped along with the B-group of vitamins

Biotin can be produced in the body as well as obtained from foods

# Biotin

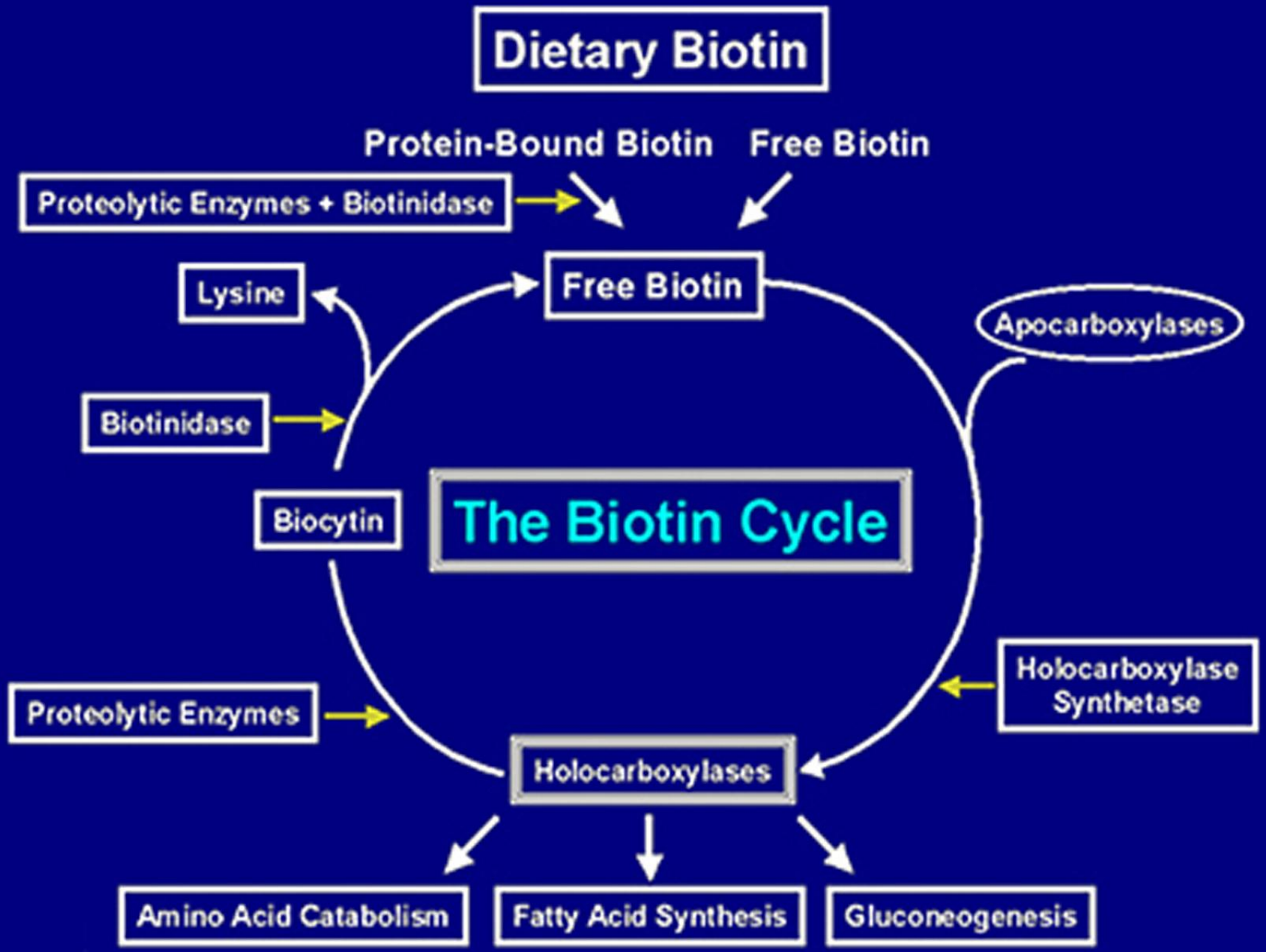
- Function

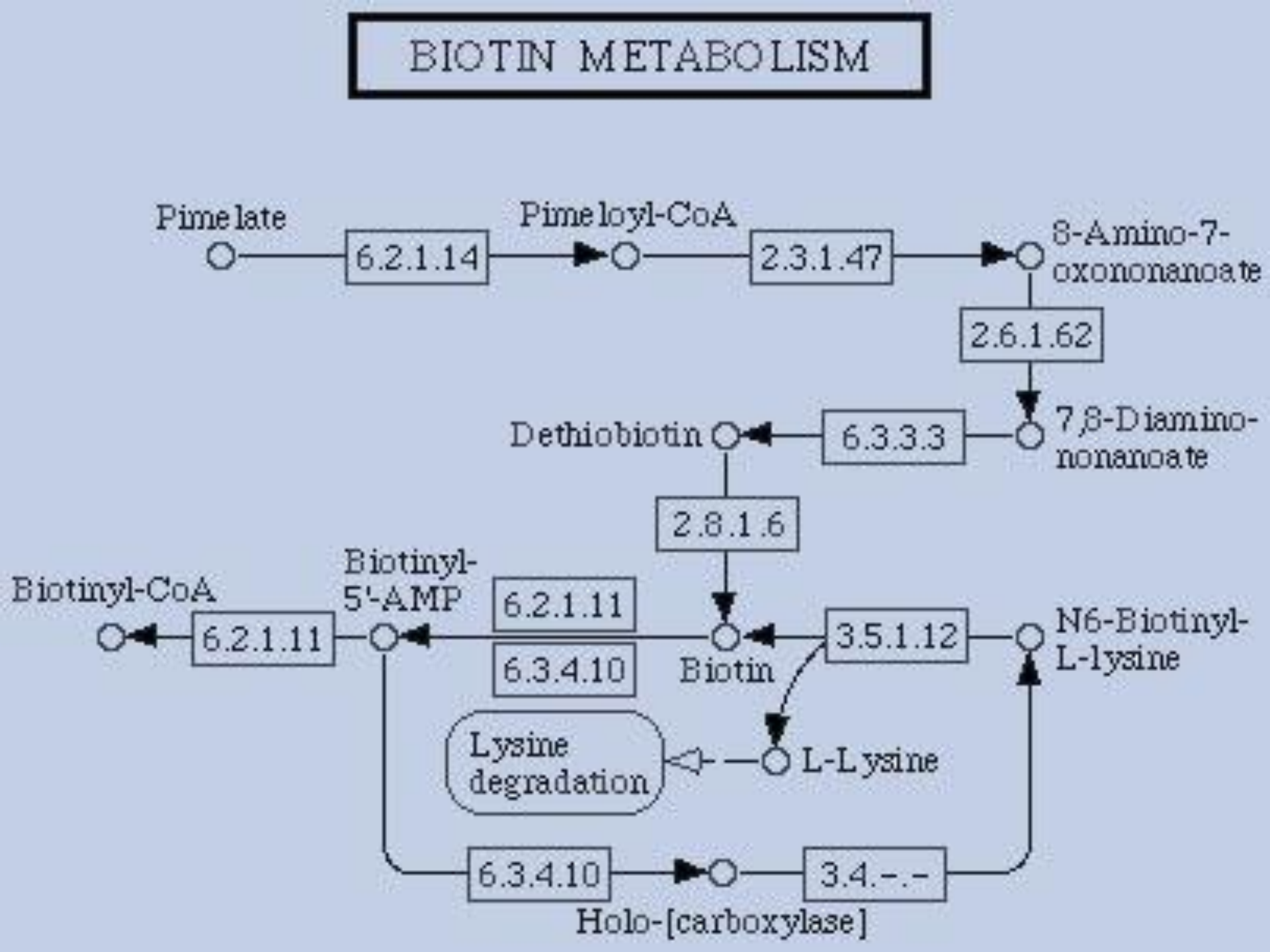
  Metabolism of all macronutrients

  Involves in energy production, fat synthesis, amino acid metabolism, and glycogen synthesis

- Natural Sources

  Produced by microorganisms in the intestines
  Found in most foods


Dietary Biotin
Protein-Bound Biotin
Free Biotin
Proteolytic Enzymes + Biotinidase
Free Biotin
Lysine
Apocarboxylases
Biotinidase
Biocytin
The Biotin Cycle
Holocarboxylase Synthetase
Proteolytic Enzymes
Holocarboxylases
Amino Acid Catabolism
Fatty Acid Synthesis
Gluconeogenesis

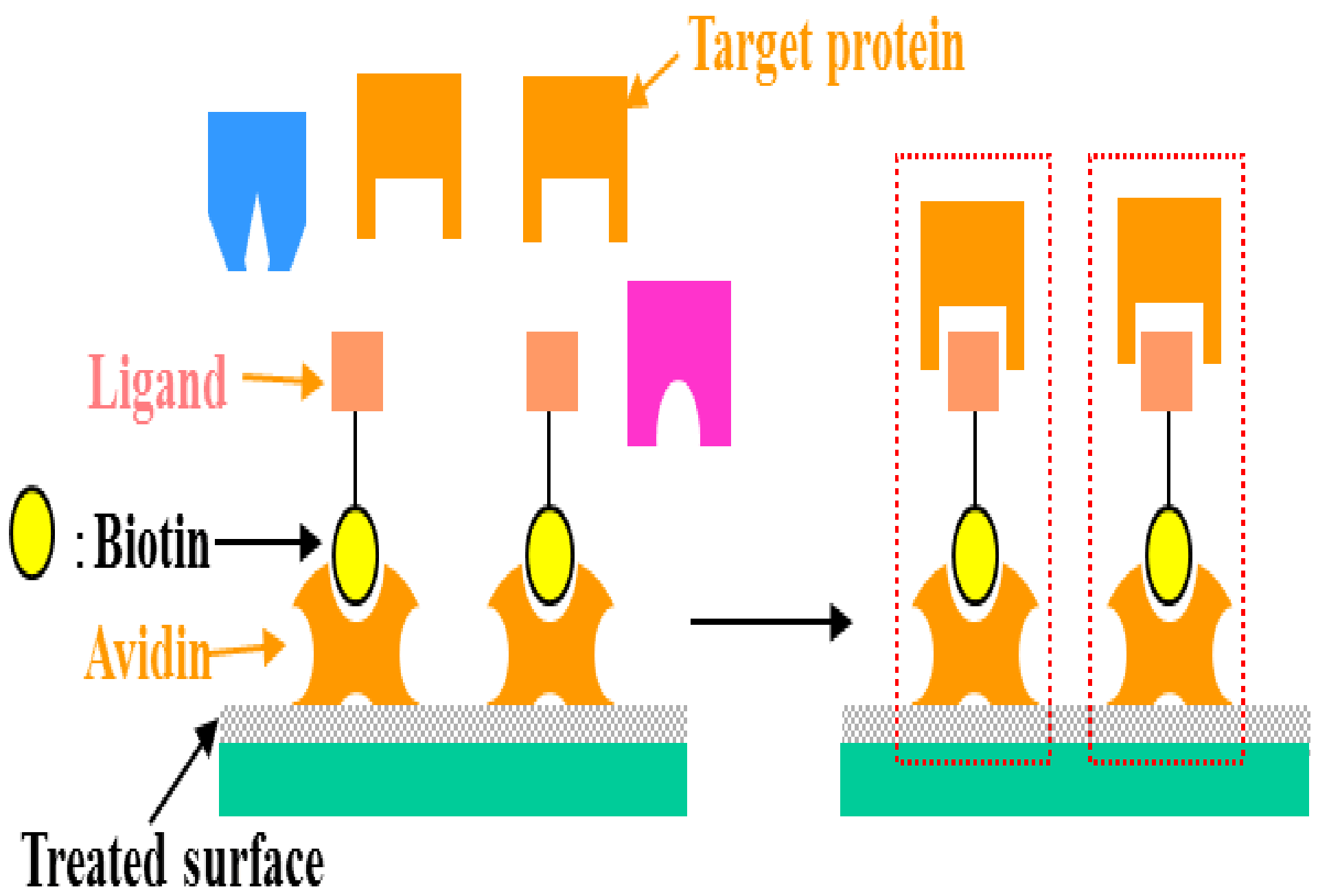

BIOTIN METABOLISM
Pimelate
6.2.1.14
Pimeloyl-CoA
2.3.1.47
8-Amino-7-oxononanoate
2.6.1.62
7,8-Diamino-nonanoate
6.3.3.3
Dethiobiotin
2.8.1.6
Biotinyl-CoA
6.2.1.11
Biotinyl-5'-AMP
6.2.1.11
6.3.4.10
Biotin
3.5.1.12
N6-Biotinyl-L-lysine
Lysine degradation
L-Lysine
6.3.4.10
3.4.-.-
Holo-[carboxylase]

# Biotin Deficiency

Natural biotin deficiency is not known

Similar clinical presentations as in thiamine and in riboflavin deficiencies

Avidin found in raw egg white can block the abortion of biotin


Target protein
Ligand
: Biotin
Avidin
Treated surface

# Biotin Deficiency

Deficiency symptoms include:

- brittle nails
- conjunctivitis
- depression
- dermatitis
- fatigue
- hair loss
- hallucinations
- loss of appetite
- muscle pain
- nausea
- neurological symptoms
- weakness

# Biotin Deficiency in Rats


Cornell University

# No Health Problem

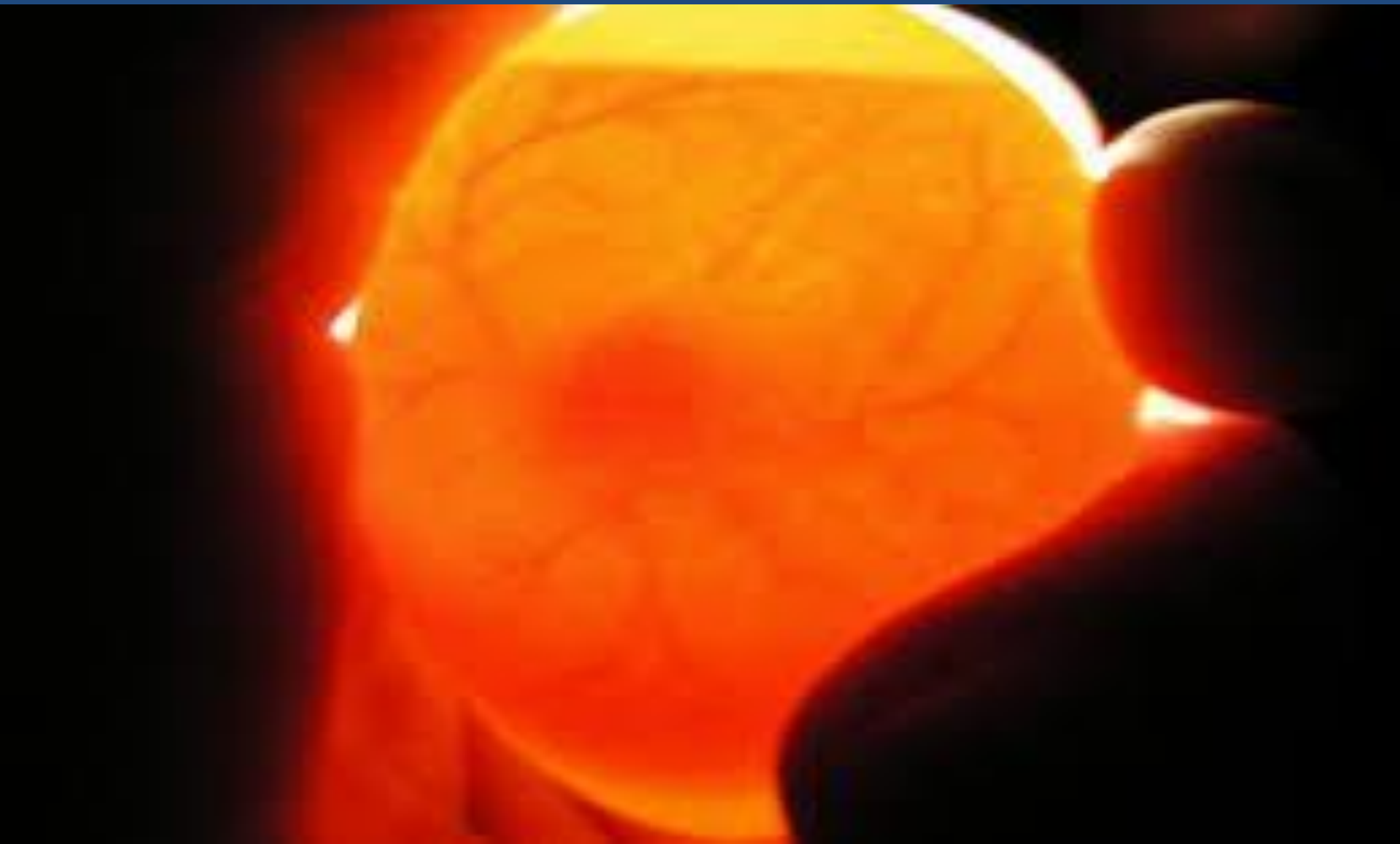
- There is no health problem with Salmonella infection and avidin-biotin blockers in eggs
- Avidin is thermo-labile. It is completely deactivated and destroyed by heat
- Just cook your eggs well

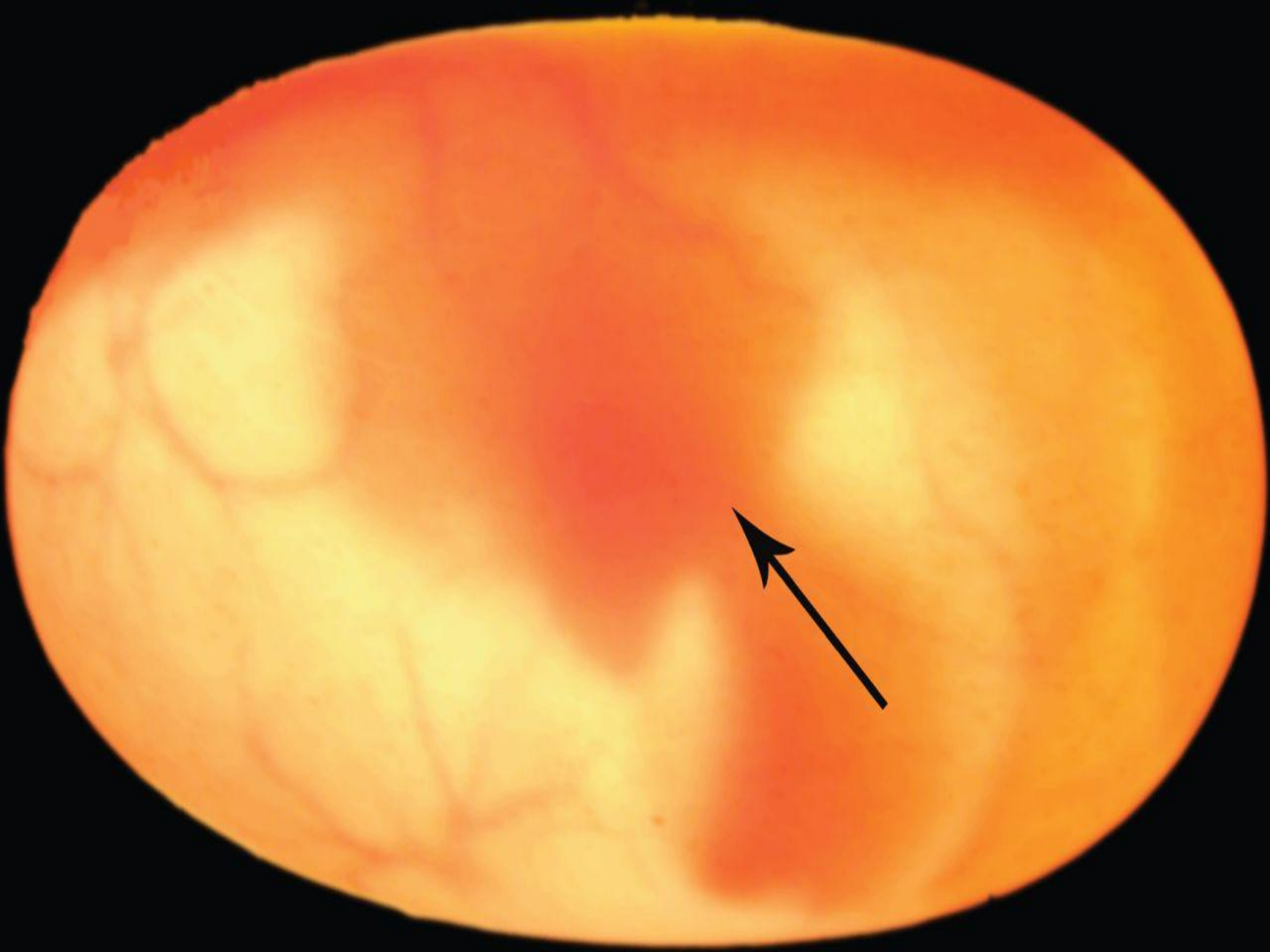
# Simple Home Test for Eggs (Float Test)

# Simple Home Test for Eggs (Float Test)

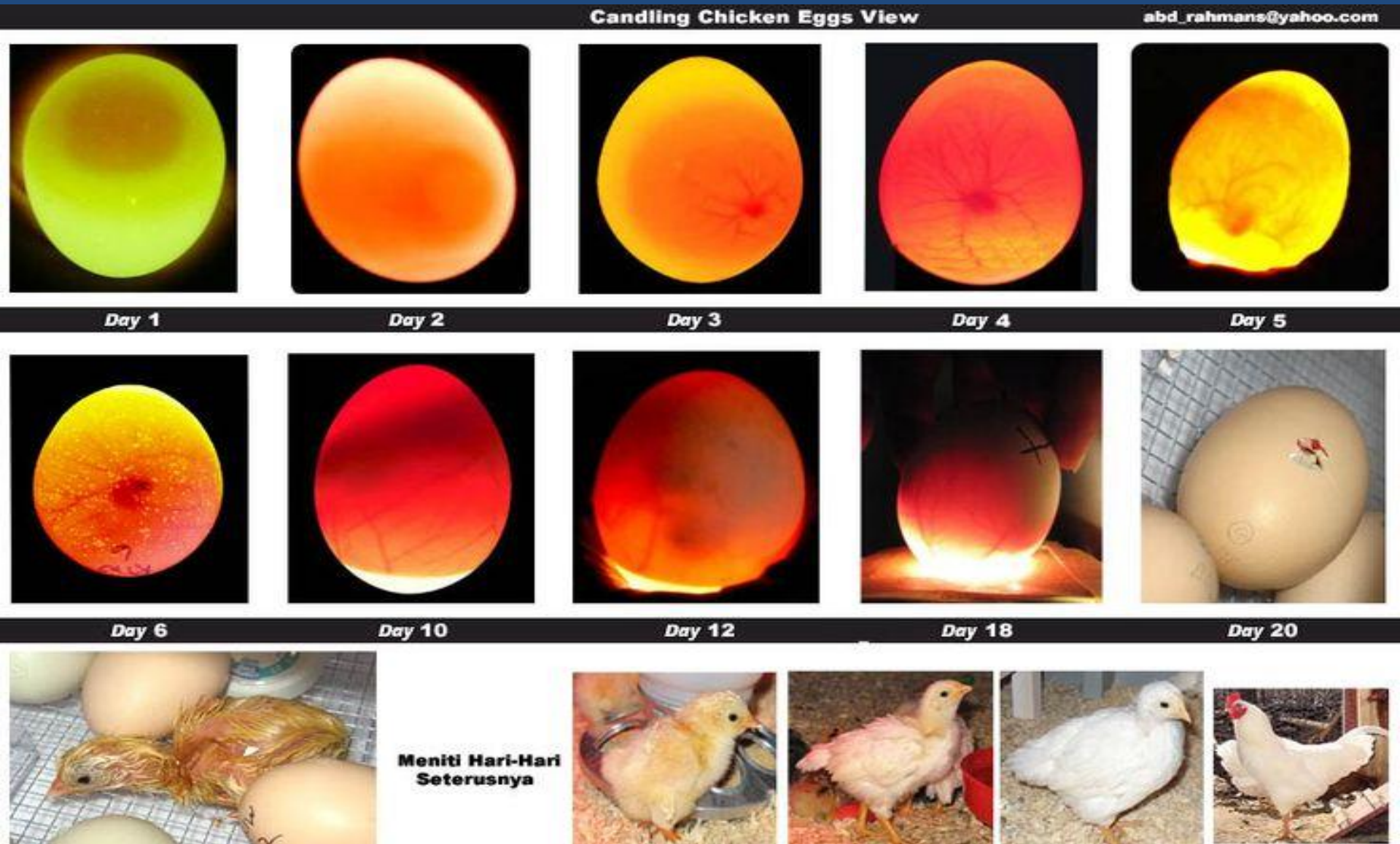
# Egg Candling

# Chick’s Embryonic Development

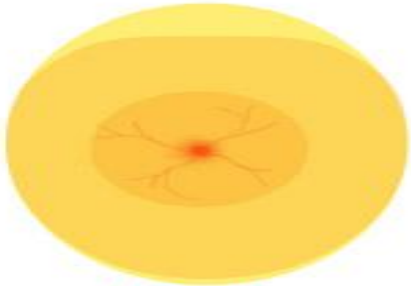




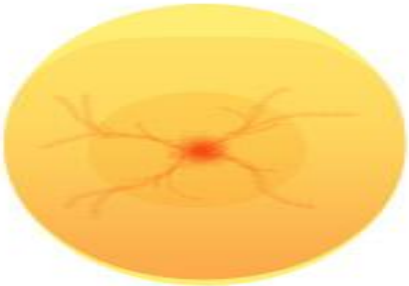
# Egg Candling



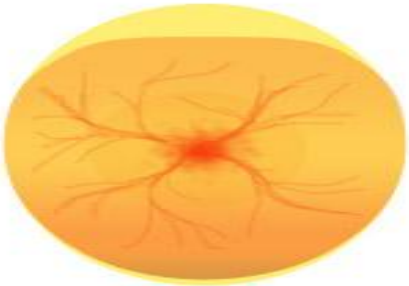
Day 2



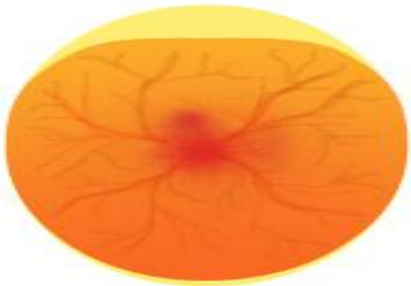
Day 4



Day 6



Day 8



Day 10

Day 12

Day 14

Day 16

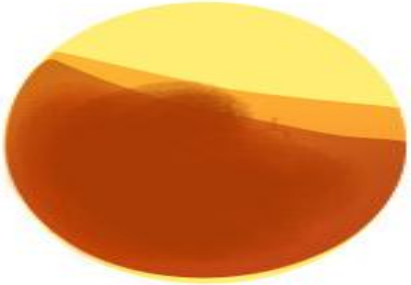
Day 18

Day 20

Day 22

Day 24

Day 26



Day 28

# Duck Egg Candling Chart

# Food Quality Control

- Physical Examination and Grading
- Chemical Analysis
- Microbiological Assays
- Organoleptic and Sensory Evaluation
- Statistical Analysis in QC

# Food Sensory Evaluation

# Organoleptic Evaluation

# Microbiological Assays

# Microbiological Assay of Eggs

# Laboratory Evaluation of Quality of Eggs

# Analytical Food Chemistry and Quality Control

# Food Quality Control
# Analytical Procedures

# Food Quality Control

# Food Microbiology
# Bacteriological Assays

# Summary

- Helps weight loss
- Increases muscle mass
- Lowers blood pressure
- Lowers risk of heart disease and stroke
- Reduces triglycerides and lowers risk of heart disease

  (Scientific Logic: Eggs are Good or Bad for Health: Dr Lim Ju Boo)
- One egg contain more than 100 mg of choline
- Builds cell membrane and brain signaling molecules and pathways
- Reduces risk of cataracts and macular degeneration
- Increases night vision and prevents blindness

# Summary

- Eggs protect against fatty liver, slow growth, macular degeneration (degeneration of the macula area of the retina in the eyes.
- This is responsible for central vision for reading, face recognition and detailed vision, edema (water retention), and various skin lesions
- Eggs  promote healthy growth of nails, hair and skin

# Summary

- Eggs are cancer-protective, especially for breast cancer
- Eggs are very rich in sulfur-containing amino acids methionine which is a very crucial amino-acid in blocking damaging free radicals
- These are directly linked to the pathogenesis of heart disease, cancers, DNA damage, and all degenerative disorders, and accelerated aging

# Summary

- Eggs are rich in tryptophan, selenium, iodine, and riboflavin (vitamin B2)
- Eggs selenium content is cardio-protective against Keshan disease, cardiomyopathies (diseases involving the heart muscles, cardiomegaly (enlarged heart), myocardial dysfunction (poor heart function) and death from heart failure
- Eggs are protective against Kashin-Beck disease (osteoarthropathy), myxedematous endemic cretinism (mental retardation)

# Thank You for Your Patience

## JU-BOO LIM

BSc (Medical Physiology & Chemistry)

Post-Graduate Dip Nutrition (Lond)

MSc (Food Tech. & Food Quality Control)

MD (Cal)  PhD Medicine (Lond)

Fellow Royal Society of Public Health

Fellow Royal Society of Medicine

British Postgraduate Award

Yudkin Prize

Dept of Nutrition

Queen Elizabeth College

University of London

England

# British Postgraduate Award

Nuffield Fellow
Dept of Medicine
University of Cambridge
England

British Postgraduate Award

Freedom From Hunger Campaign Prize

Dept of Food Science and Food Technology

University of Reading

England

# A Brief CV of Ju-Boo Lim

Formerly

Research Nutritionist and
Food-Medical Toxicologist

Massachusetts Institute of Technology
Cambridge
United Sates of America

# A Brief CV of Ju-Boo Lim

Formerly

Sr. Medical Research Officer
Institute for Medical Research
Ministry of Health
Malaysia

# Currently

Special Nutrition-Medical-Science Adviser

Chief Consultant
Technical Advisory Board

The Dynapharm Pharmaceutical International Group (DNG)

# Hobbies and Pastime

- Astronomy
- Nature Study
- Microscopy
- Plays the violin and the flute
- Reading books, articles and scientific journals
- Writing educational articles for blogs, magazines and newsletters
- Attending lectures and giving educational talks
- Participates in scientific-medical conferences and presents papers