

# Wonderful World

*A learning resource book exploring creation*



Jacque Bernadette

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JACQUE BERNADETTE



The Art Den  
Publisher

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✓ eBOOK 2 • ANIMALS	eBOOK 6 • FLOWERS, PLANTS, TREES
✓ eBOOK 3 • BIRDS, BUGS	eBOOK 7 • ELEMENTS, ROCKS, SOLAR SYSTEM
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## Foreword

*The Earth* is a phenomenally marvelous place in which we are privileged to be able to live. Many of us think that the earth is unique in the whole universe, in having the myriad of substances and features, ALL OF WHICH HAVE TO BE JUST AS THEY ARE to allow life, particularly human life to exist.

This book explores a whole gamut of the features of the earth and its inhabitants, with marvelous artwork to illustrate what is being communicated. The book is filled with a myriad of illustrations, descriptions and explanations of the details of the Earth's inhabitants, and of our planets composition and features. Many of the illustrations show the complexity and intricacy of the systems that comprise each life form. Studying each of these leads one to ask the question: how did they form? It is really inconceivable that they came about through random, undirected change from one generation of life to the next. They all fit into an exquisite design and to me the word "design" demands a designer.

Each book covers a different class of earth's inhabitants, starting with Book 1 with the most marvelous machine, the human body. It then moves down the complexity of organisms, discussing and illustrating each with suburb artistic illustrations. Book 2 covers animals and the following Books cover other living species, animal and plant. It then moves to our Earth, and finally the solar system.

The examples are to give you information, and then to make you think. For example, Jacque describes and illustrates the human circulatory system. She shows the heart, veins and arteries, and the many places they go. Now, think for a moment about all the different components of the circulatory system. There is the heart with its valves and timing mechanism, the veins and arteries, the kidneys, the liver, the lungs, the blood with its many components and types of cells, and the hundreds of miles of capillaries.

So considering the complexity of this one system, it is not even remotely possible that it came about, over millions of years, from millions of minor changes to a species, and slowly came together. Now, really, a system as complicated as the circulatory has to have everything in place, and working. You can't have a heart pumping away with no veins or blood, and expect these to be added in later generations. This is what is called the "irreducible minimum" meaning that the system cannot function at all unless ALL needed parts are in place and working.

And then Jacque describes all of the related body systems that interconnect with the circulatory system. The blood feeds the muscular system, the digestive system, the urinary system, and on and on. All related and working together.

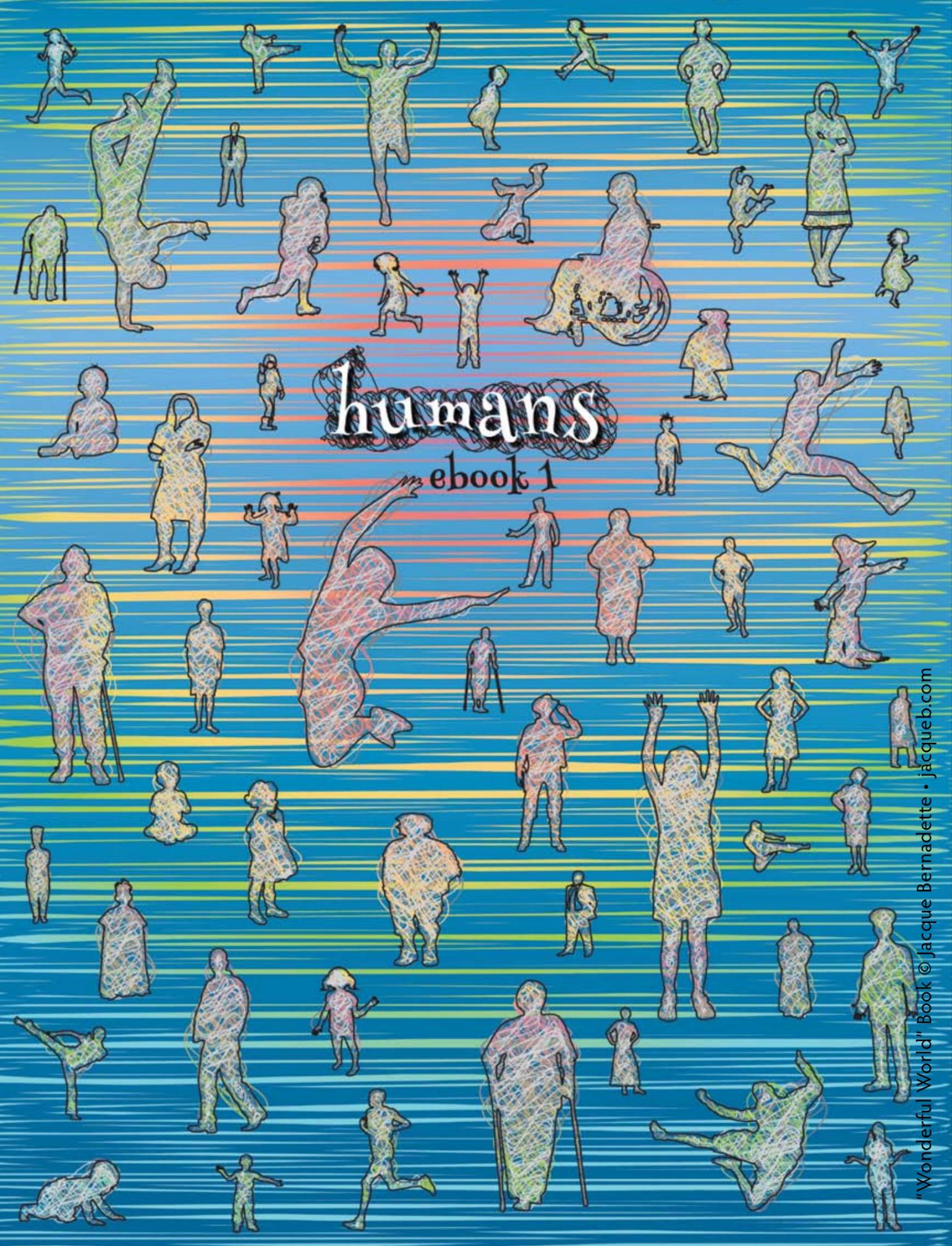
So this book gives a marvelous overview of planet Earth and its inhabitants. All seven books have many examples of the marvels that exist on our Earth. You did not buy this book to get my synopsis of its content. My hat's off to Jacque for putting it all together such as she has.

Henry L. Richter, PhD., former NASA/JPL space scientist/manager

*Books by Henry L. Richter, PhD.:*

*Spacecraft Earth: A Guide for Passengers (with David F Coppedge)*

*America's Leap Into Space: My Time at JPL and the First Explorer Satellites*



# humans

## ebook 1

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## contents

Skeletal System .....	2
Muscular System .....	4
Circulatory System .....	6
Digestive System .....	8
Endocrine System .....	10
Nervous System .....	12
Respiratory System .....	14
Immune/Lymphatic System .....	16
Urinary System .....	18
Female Reproductive System .....	20
Male Reproductive System .....	22
Integumentary System .....	24
DNA/Chromosomes .....	26
Intriguing Info .....	28
Glossary .....	29
Bibliography .....	33
Index .....	35
Author's Note .....	38



Hi there!  
I'm Sophie, the  
seahorse. Let's go on an  
adventure together! Look  
for me as you enjoy all the  
fascinating facts about  
creation. Let the  
journey begin!



We have **three types** of muscles in our body: **Skeletal**, **smooth**, and **cardiac**.

Meat on the Bones

# Muscular System

- Allows movement (with skeletal system)
- Helps maintain body temperature

• **Skeletal muscles** are joined to bones so we can move our bones and joints. They help us run and jump; clap our hands; talk, write, paint, and a ton of other stuff! Every time we move, it is because of our skeletal muscles.

• **Smooth muscles** are found inside of organs like our stomach, intestines, and blood vessels. They control our circulatory, digestive, excretory, and reproductive systems. They work naturally without us being aware of them.

• **Cardiac muscle** is found only in our heart; it is what pumps blood throughout our body EVERY SECOND of EVERY DAY of our lives. Unlike other types of muscle, cardiac muscle never gets tired. It also works naturally and constantly without ever pausing to rest. Cardiac muscle contracts (shrinks) to squeeze blood out of our heart, and relaxes to fill our heart with blood.

The heart is the hardest working muscle in our body. It beats 100,000 times a day! That's over 3,000,000,000 (billion) times in an average life. It keeps our blood flowing round and round to all our other muscles.

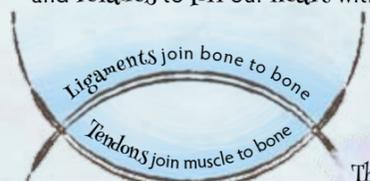
**Fingers DO NOT have any muscles!**

The muscles in our forearm and palm are joined to our finger bones by tendons (smooth, flexible strings). Our finger joints bend by the muscles pulling on these tendons.

**BILLIONS** of heart muscle cells work together for **ONE HEART BEAT.**

**Phenomenal!**

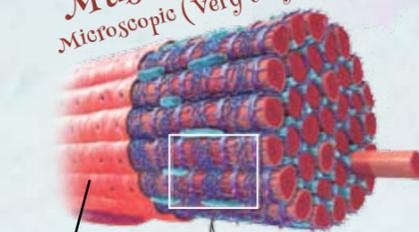
Thank you God for the awesome gift of our marvelous, glorious bodies!



Thousands of filaments pull together as one again and again for a muscle contraction. **Incredible!**

## Muscle Fiber

Microscopic (Very tiny)

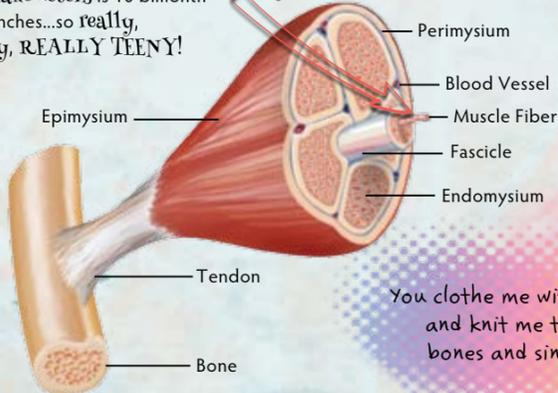


**Sarcolemma**  
• Fine, transparent, tubular sheath that surrounds our skeletal muscle fibers.  
• It is 10 nanometers thick. One nanometer is one billionth of a meter (39 in).

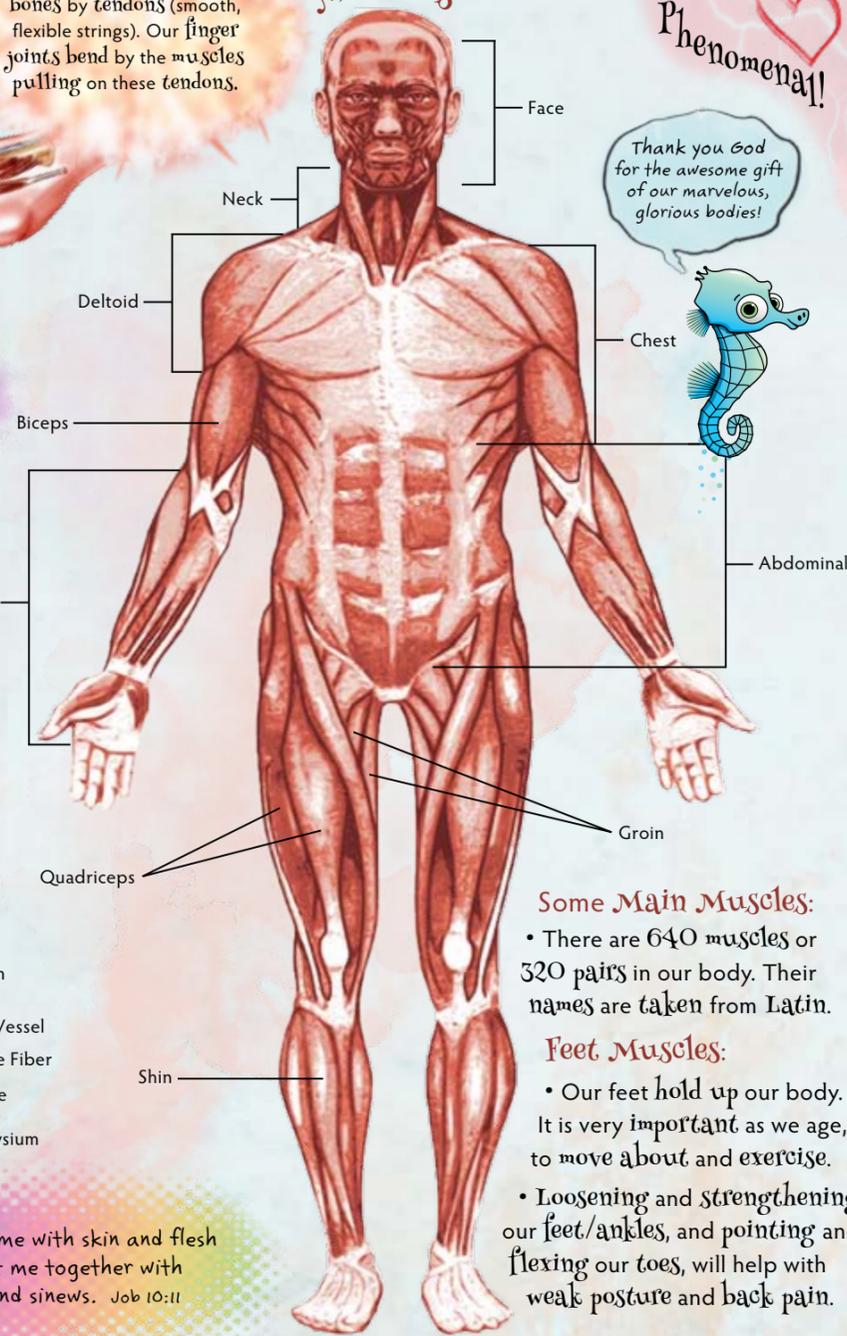
• 10 nanometers is 10 billionth of 39 inches...so really, really, REALLY TEENY!

**Sarcoplasmic Reticulum:** The dynamic calcium boss of muscle!

## Skeletal Muscle



You clothe me with skin and flesh and knit me together with bones and sinews. Job 10:11



### Some Main Muscles:

• There are 640 muscles or 320 pairs in our body. Their names are taken from Latin.

### Feet Muscles:

- Our feet hold up our body. It is very important as we age, to move about and exercise.
- Loosening and strengthening our feet/ankles, and pointing and flexing our toes, will help with weak posture and back pain.

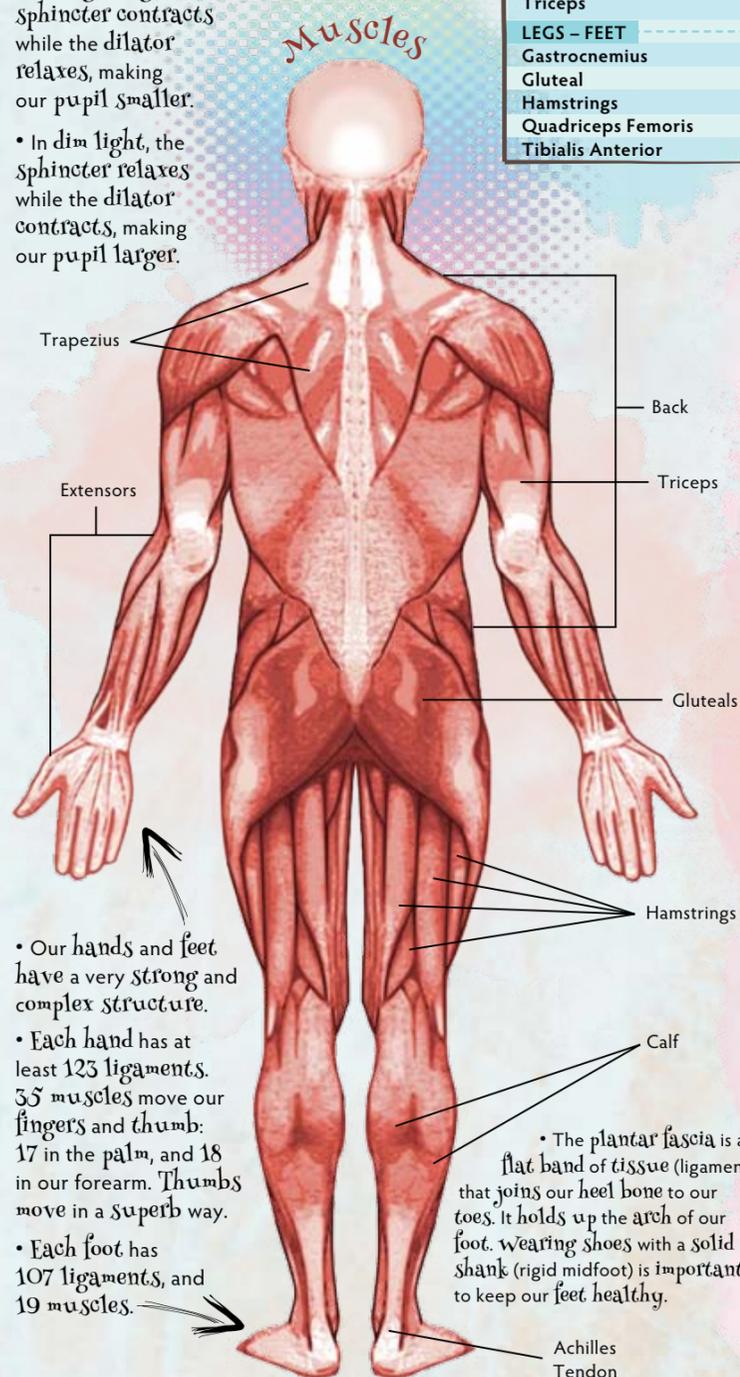
The **focusing muscles** of our eyes move around 100,000 times a day!



• These **smooth muscles**--iris sphincter and dilator--control the amount of light entering our eye which makes the size of our pupil grow or shrink. Our eyes are beautifully designed!

• In bright light, the sphincter contracts while the dilator relaxes, making our pupil smaller.

• In dim light, the sphincter relaxes while the dilator contracts, making our pupil larger.



• Our hands and feet have a very strong and complex structure.

• Each hand has at least 123 ligaments. 33 muscles move our fingers and thumb: 17 in the palm, and 18 in our forearm. Thumbs move in a superb way.

• Each foot has 107 ligaments, and 19 muscles.

• The plantar fascia is a flat band of tissue (ligament) that joins our heel bone to our toes. It holds up the arch of our foot. Wearing shoes with a solid shank (rigid midfoot) is important to keep our feet healthy.

NAME	PRONUNCIATION	FUNCTION
<b>HEAD - NECK</b>		
Buccinator	BUCK-sin-ay-tor	cheek; movements include smiling and whistling
Masseter	mass-SEE-ter	cheek and jaw; movements include biting and chewing
Sternocleidomastoid	stir-noh-KLIGH-doh-mass-toyd	tilts and rotates head, flexes neck
<b>TORSO</b>		
Abdominal Oblique	ab-DOM-uh-nl oh-BLEEK	compress abdomen and rotates torso
Diaphragm	DEYE-uh-fram	helps expand our rib cage, aids in breathing
Rectus Abdominis	RECK-tus ab-DOM-in-iss	abdominal; flexes trunk and lumbar vertebrae
Serratus	suh-RAT-uhs	aids in elevating and lowering our ribs in breathing
Transversus Abdominis	trans-VURS-uhs ab-DOM-uh-nuhs	supports chest and abdominal organs
<b>ARMS - HANDS</b>		
Biceps	BIGH-seps	bending and extending our arm
Deltoid	DELL-toyd	moves our shoulder
Extrinsic	ek-STRIN-sik	longer muscles that run from our forearm to move wrist
Intrinsic	in-TRIN-sik	lots of little muscles to move our hand and fingers
Latissimus Dorsi	lah-TIS-ih-mus DOR-sigh	pulls our arm back and down
Pectoralis	peck-toh-RAY-lis	moves our humerus (upper arm); stabilizes our scapula
Rotator Cuff	ROH-tey-ter KUHF	group of muscles that rotates and abducts our shoulder
Trapezius	trah-PEE-zee-us	moves our shoulder
Triceps	TRIGH-seps	extends our forearm and moves our shoulder
<b>LEGS - FEET</b>		
Gastrocnemius	gas-trok-NEE-mee-us	calf muscle that flexes our foot and our knee
Gluteal	GLOO-tee-ul	group of muscles that moves our hip
Hamstrings	HAM-strings	muscle group that extends our hip joint; flexes our knee
Quadriceps Femoris	KWAHD-rih-seps feh-MOHR-uhs	extends our thigh and knee, kicking
Tibialis Anterior	tib-ee-AY-lis an-teer-ee-er	pulling foot toward leg, walking on heels of our foot

To take one step, we use **200 muscles**.



Humans are born with all the **muscle fibers** we will ever have.

The **smallest muscles** are found in our middle ear: tensor tympani and the stapedius. The stapedius is the **smallest muscle** at just over one millimeter in length.



It takes **17 muscles** to smile...



...and **43 muscles** to frown.



Our **tongue** is made of a group of muscles that work together to allow us to talk and help us chew food.



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One Red Blood Cell can carry 1 billion molecules of oxygen

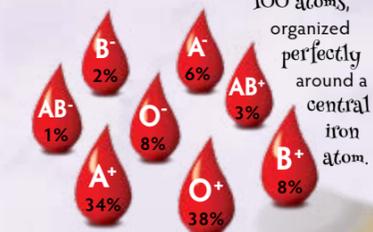
Helps Blood Circulate

# Circulatory System

(AKA Cardiovascular)

- Delivers oxygen & nutrients to tissues
- Protects our body from diseases

Human blood is colorless; it is the hemoglobin (a protein in red blood cells), that joins iron and oxygen together that makes blood red. Hemoglobin is a very complex, eight-helix twisted molecule of 100 atoms, organized perfectly around a central iron atom.



8 Major Blood Types & Ratios (There are 34 other blood types)

## Blood Cell Design

- Plasma (55%)
- White Blood Cells and Platelets (<1%)
- Red Blood Cells (45%)

Life is in the blood.

In Jesus we have redemption through his blood, the forgiveness of sins, in accordance with the riches of God's grace. Ephesians 1:7

## Heart

- Our heart has a breathtaking design. It is a dynamic and steady pump that works day and night. The muscles of our heart contract and relax to pump blood throughout our body.
- Blood follows an intricate pathway when it returns to our heart.
- The adult heart is about the size of a clenched fist and weighs about 11 ounces (312 g).
- It is found just behind and slightly left of our breastbone (sternum), between our lungs. Our heart rests in a wet pocket called the pericardial cavity which is surrounded by our ribcage. The diaphragm, a tough layer of muscle, lies below. So our heart is well protected!

### Aorta

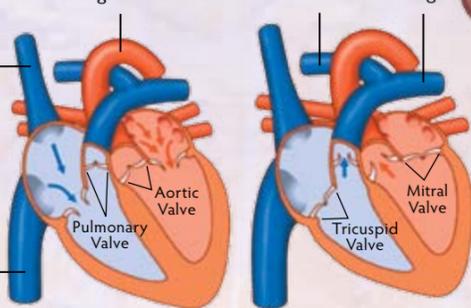
Artery that carries blood full of oxygen from our heart to organs and tissues

### Pulmonary Arteries

Carries blood low in oxygen from our heart to our lung

**Superior Vena Cava**  
Vein that carries blood low in oxygen from our head and upper body into our heart

**Inferior Vena Cava**  
Vein that carries blood full of oxygen from the lower body into our heart



- There are 4 main valves in our heart: aortic valve, pulmonary valve, mitral valve, and tricuspid valve.
- Laughter REALLY is good for our heart! A good, rip-roaring belly laugh can send 20% more blood rolling through our bodies!

## 4 Parts of Blood

### Plasma

- It's the fluid part of blood.
- It's straw colored and made of 90% water and contains nutrients, protein, hormones, and waste.

### White Blood Cells

- Colorless or white cells that help protect our body from infection and disease.

### Platelets

- Tiny cells that help us stop bleeding if we get a cut.

### Red Blood Cells

- They contain hemoglobin protein which carries oxygen throughout our body.
- They also carry carbon dioxide away from tissue to our lungs where it is exhaled.

### Red Blood Cells are special...

- They have no center (nuclei) like most other cells. More room for oxygen!

### Capillary

Tiny Blood Vessel (So teeny that blood cells need to line up single file just to go through them.)

### Heart

Muscular organ with 4 chambers; 2 atriums and 2 ventricles.

Pumps 2,500 gallons of blood full of oxygen through our vessels.

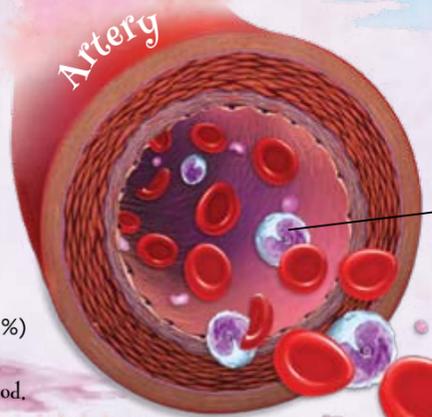
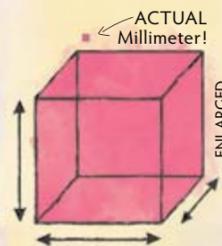
### Vein

Carries blood low in oxygen back to our heart

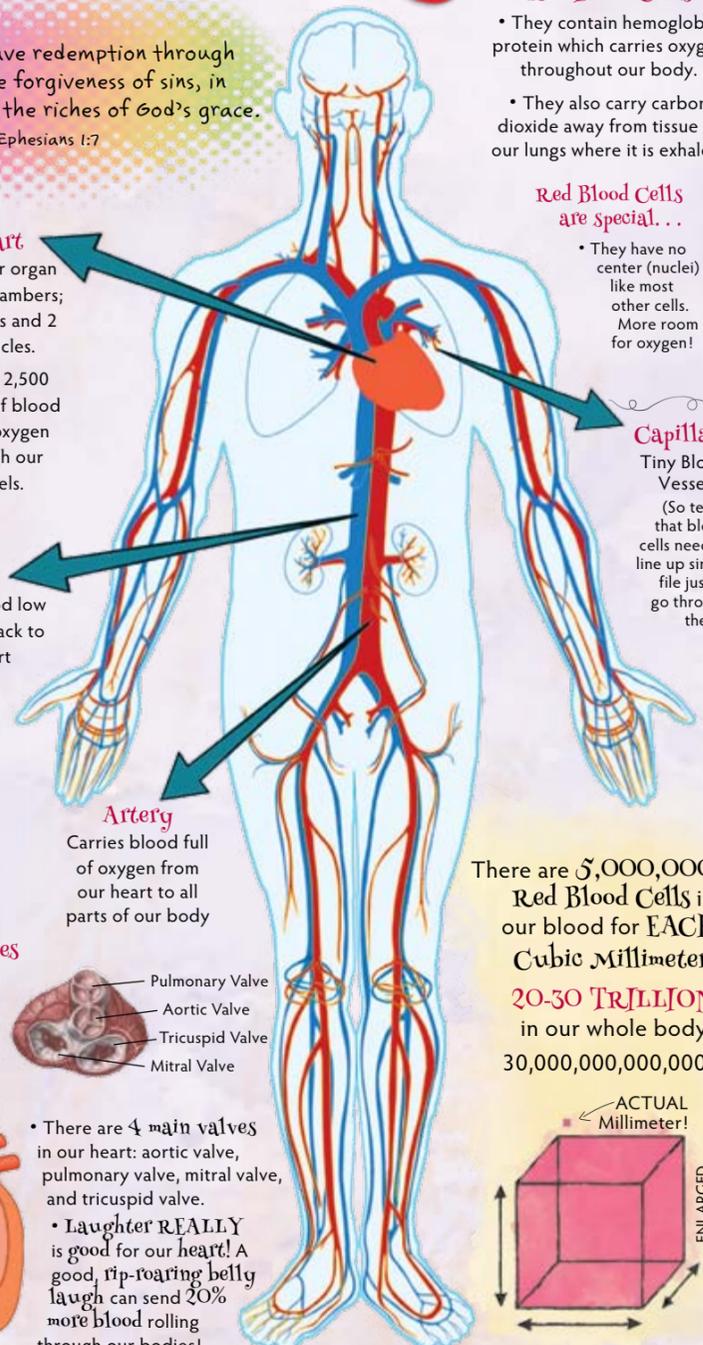
### Artery

Carries blood full of oxygen from our heart to all parts of our body

There are 5,000,000 Red Blood Cells in our blood for EACH Cubic Millimeter!  
**20-30 TRILLION** in our whole body!  
30,000,000,000,000!

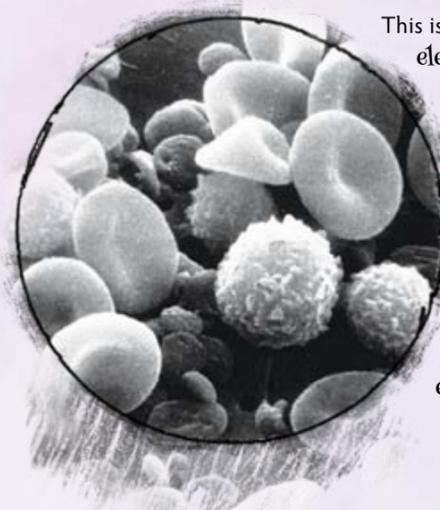


Artery



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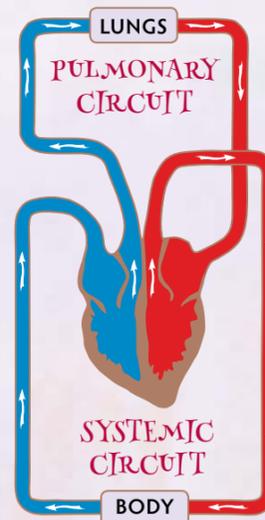
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This is a scanning electron microscope (SEM) image from normal circulating human blood. 2 million red blood cells are made each second!

Wowee! Capillaries are so small that blood cells can only move through them one at a time! They are 1/10th the diameter of a human hair or 1/3000 of an inch (8 microns)!

- We have about 1.5 gallons (5 L) of blood in our body.
- In less than a minute our heart pumps that blood to EVERY cell in our body.
- Blood full of oxygen leaves our aorta 1 mile an hour.



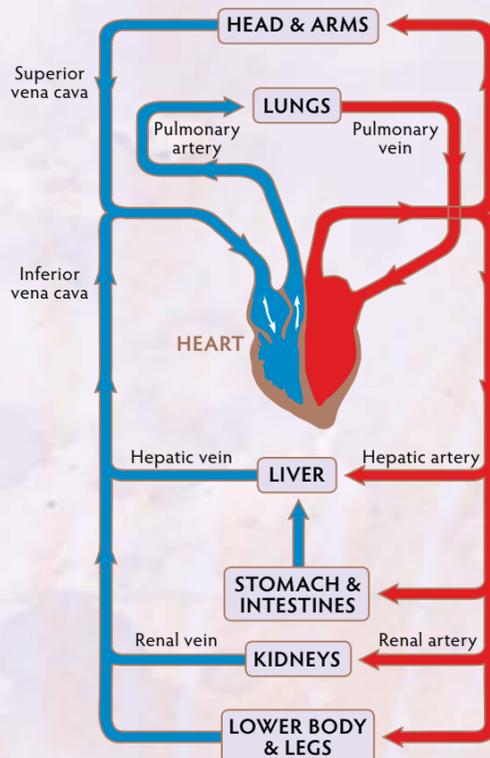
## BLOOD VESSELS

Blood travels through our system of blood vessels many times each day. Blood vessels measure about 60,000 miles (96,560 km).

**60000**

Our capillaries, the smallest of our blood vessels, makes up 80% of this length!

- Blood Low in Oxygen (Deoxygenated)
- Blood Full of Oxygen (Oxygenated)



- Arterioles are our smallest arteries that carry blood from arteries to capillaries.
- Venules are very small veins that connect our capillaries to larger veins.
- As blood flows through our body, the size of the vessel reduces from artery/vein, to arteriole/venule, and then to capillaries.

## BLOOD VESSELS

Artery	Capillary	Vein
Carries blood away from our heart	Transfers gases, nutrients and waste	Carries blood back to our heart
Carries blood full of oxygen	Carries blood low in oxygen and full of oxygen	Carries blood low in oxygen
Aorta is the largest artery	Links arteries and veins	Has a valve
Small opening (lumen)	Very small opening	Big opening

Exception: Pulmonary veins take blood full of oxygen from our lungs to our heart.



## Fascinating Facts:

Our heart is made of 73% water!

- Our heart does not really beat! The fantastic pulsing happens because our heart makes its own electrical impulses through our cardiac conduction system. Cardiac muscle cells send signals to our heart muscle causing it to contract.
- The thumping and beating sound we hear is made by valves clapping open and closed. There are four main valves in our heart that work like gates, allowing blood to flow in one direction with each heartbeat.
- Our blood is ALWAYS RED but our veins are blue because red and blue have different wavelengths. Our veins look blue because the light goes through our skin, is absorbed and reflects back to our eyes.
- The blood in our bodies are different shades of red. Blood full of oxygen, like arteries carry, are bright red. Blood low in oxygen, like veins carry, are dark red.
- Red blood cells die after 120 days going around inside our body. No worries though — our bone marrow makes NEW red blood cells constantly to replace the red blood cells that die.



Turns Food into Fuel

# Digestive System

• Turns Food and Liquids into Fuel our Body Needs  
• Digests and Absorbs Food and Gets Rid of Waste

Our Digestive Tract is about 30 feet (9 m) long!

## Fascinating Facts

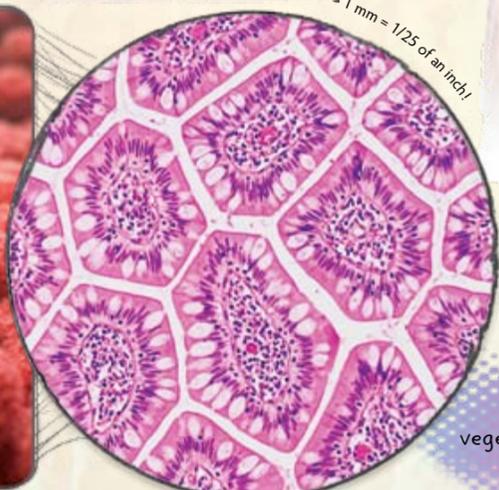
Six Main Things Happen in our Digestive System to Bring Energy and Nutrients to our Body:

- 1 Eating [Ingestion], 2 Secretion, 3 Mixing and movement,
  - 4 Large pieces of food into small pieces [Digestion], 5 Nutrients from food go through our body [Absorption], 6 Pooping [Excretion].
- Our **MOUTH** makes 2-4 pints (1-2 liters) of spit (saliva) every day. Most people eat over 4 pounds (2 kg) of food each day.
  - Muscles contract (shrink) and relax in our **ESOPHAGUS** to push food down to our stomach. It works even if we eat upside down!
  - Our **STOMACH** doesn't do most of the digestion. It churns food, and mixes it with gastric juices, breaking up food bits and turning them into chyme (thick liquid). Gastric juice is made up of water, electrolytes, hydrochloric acid, enzymes, and mucus. Our stomach wall has 3 layers of muscles and can hold 3 pints (1.5 liters) of food.
  - Our **SMALL INTESTINE** is 2/3 of our digestive tract length. If it was laid out flat it would be longer than an adult giraffe! Here's where most of the digestion and absorption of nutrients takes place. Our small intestine uses powerful enzymes to absorb the nutrients and pass them into our bloodstream.
  - The main job of our **LARGE INTESTINE** is to get water out of food. Our large intestine has a lot of different kinds of bacteria. It gets its name because of its width, not its length.
  - Our **LIVER** is the largest organ in our body and weighs 3.2-3.7 pounds (1.44-1.66 kg). The liver filters (cleans) 3 pints (1.4 liters) of blood every single minute. All the blood leaving our stomach and intestines passes through our liver. Our liver does more than 500 jobs and almost every organ in our body is helped by our liver. Our liver is needed for survival.
  - Our **PANCREAS** has taste buds just like our mouth does. They start working from the glucose (sugar) in our diet. Our pancreas then releases insulin, a hormone that lets cells in our body use the glucose as fuel. Eating healthy foods helps our pancreas: Blueberries, Cherries, Cruciferous Veggies, Garlic, Onions and more.

### Magnified Villi Lining of our Small Intestine.

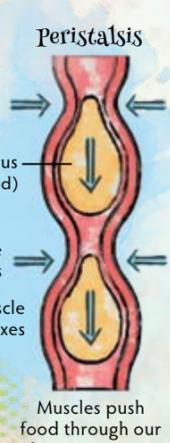
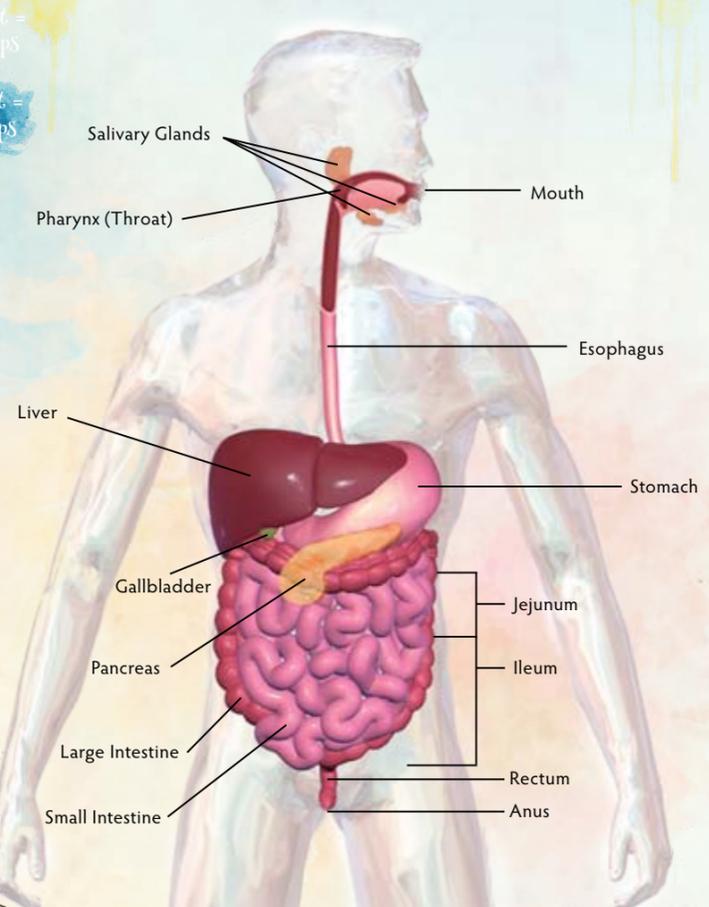
Villi are small, finger-like structures in our small intestine. They help to absorb digested food. Each villus has microvilli which increase the outer area of our intestinal walls and lets nutrients to be taken in more quickly.

Each villus is 1 mm long. Microvillus; 1/1000th of a villus. 1 mm = 1/25 of an inch.



Better a small serving of vegetables with love than a fattened calf with hatred. Proverbs 15:17

ORGAN	LENGTH	WIDTH
Esophagus	10 in (25.4 cm)	.78 in (2 cm)
Stomach	10 in (25 cm)	6 in (15.2 cm) at widest point
Duodenum	10 in (25.4 cm)	1.5 in (3.8 cm)
Ileum	11.5 ft (3.5 m)	1.2 in (3 cm)
Jejunum	8 ft (2.4 m)	1 in (2.5 cm)
Small Intestine	22 ft (6.7 m)	1 in (2.5 cm)
Large Intestine	5 ft (1.5 m)	2-3 in (5-7.6 cm)
Pancreas	6 in (15.2 cm)	.78-1.18 (2-3 cm) tail to head
Gallbladder	3 1/2 in (9 cm)	1 in (2.5 cm)



Muscles push food through our digestive system

ORGAN	FUNCTION	FOOD BITS BROKEN DOWN
Mouth	Uses saliva (spit) to break down food.	Starches
Esophagus	Passes food to stomach.	None
Stomach	Breaks down food into a liquidy mix.	Protein
Small Intestine	Digestion and absorption of food.	Carbohydrates, protein, starches
Cecum	Connects our large and small intestines.	None
Large Intestine	Absorbs fluids and minerals. Passes waste.	Carbohydrates, protein, starches
Liver	Makes bile. Cleans germs from blood.	Fats
Pancreas	Helps digest food. Balances blood sugar levels.	Carbohydrates, protein, fats
Gallbladder	Holds and gets rid of bile.	None
Rectum	Stores and removes poop.	None
Anus	Opening for removing poop.	None

Superb Design! The acid juice of our stomach does not dissolve our stomach tissue. For most people, the stomach mucosa is able to repel the juice, although food and other tissues cannot.

NAMES and HOW to SAY THEM	
Amylase	AM-uh-leyz
Chyme	kahym
Duodenum	doo-uh-DEE-num
Epiglottis	ep-ih-GLAH-tus
Esophagus	ih-SOF-eh-guss
Gallbladder	GAWL-blad-er
Gastric	GAS-trik
Ileum	ill-ee-um
Intestine	in-TESS-tin
Jejunum	je-joo-num
Pancreas	PAN-kree-uhs
Pharynx (Throat)	FAR-inks
Rectum	REK-tum
Saliva (Spit)	suh-LYE-vuh
Trachea (Windpipe)	TRAY-kee-ah
Villi	vill-EYE

### Mouth

1 Digestion begins before we eat, when we smell food or see it. Saliva, or spit, begins to form. When we chew and taste our food, saliva increases and it contains an enzyme called amylase that begins to digest the starch from food into smaller bits. This helps make our food mushy so our body can absorb and use it. Plus, "juices" are made that will help to further break down food. Chewing our food more into a mush helps with our digestion. Our tongue helps out, moving our food around while we chew with our teeth. When we're ready to swallow, our tongue pushes a tiny bit of mushed-up food toward the back of our pharynx (throat), and into the opening of our esophagus, the second part of our digestive tract.

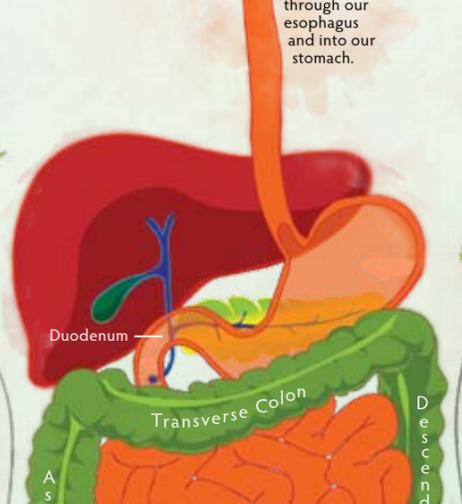
Teeth, designed for cutting and grinding food.

### Throat and Esophagus

2 Food goes from our mouth to our throat (pharynx). Our throat runs from the back of our nose down into our neck. When food goes down our throat, it closes our trachea (windpipe) in the back of our throat. Our windpipe carries air to our lungs. When we swallow mushed-up food or liquids, the epiglottis (a stretchy flap) closes down over the opening of our windpipe so food enters our esophagus and not our windpipe. If your food "went down the wrong way", the epiglottis didn't close and we cough to clear our windpipe. Branching off our throat is our esophagus, which is a muscular tube, that moves in a wavy way (peristalsis) to slowly squeeze food through our esophagus to our stomach, the third part of our digestive tract.

### Stomach

3 Our stomach, which is a stretchy sack, is attached to the end of our esophagus. The stomach's job is to hold food we have eaten, to break down our food into a liquidy mix, and to empty that liquidy mix slowly into our small intestine. Our stomach is like a mixer; mashing and grinding food into smaller pieces. It does this with help from our muscular stomach walls and gastric juices. Our stomach has a tough lining - it is able to hold up with the highly acidic gastric juices needed to break down our food. Gastric juices help digestion and also help kill bacteria that might be in our eaten food. The stomach empties our food and juice mixture into our small intestine, the fourth part of our digestive tract.



### Small Intestine

4 Breaks down food mixture even more (chyme), so our body can take in all the vitamins, minerals, proteins, carbohydrates, and fats—with a little help from the accessory organs (see liver, pancreas, and gallbladder below). Made up of three segments: duodenum, jejunum, and ileum. C-shaped first part is our duodenum that connects to our stomach. Coiled middle part is our jejunum. Third part is our ileum that leads into our large intestine. Our ileum absorbs mainly vitamin B12, other water soluble vitamins, bile salts, and nutrients that were not absorbed in our jejunum. The inner wall of our small intestine is covered with millions of microscopic (very teeny) finger-like bumps called villi. On to our large intestine.

### Large Intestine

5 Our large intestine absorbs fluids (1-1.5 quarts/liters) and vitamins in undigested food and passes waste. Our large intestine includes the cecum, appendix, colon, rectum, and anal canal. Our cecum absorbs digestive fluids passing out our ileum, and passes waste on to our colon. Our appendix is designed to protect good bacteria in our stomach. Our colon has four parts: ascending, transverse, descending, and sigmoid. The majority of water absorption takes place here, and any salts needed by our body are also absorbed. Our rectum gets waste (poop) from our colon. Poop stays here until we are ready to go to the bathroom. We get rid of poop by pushing it through our anus.

### Liver, Pancreas, Gallbladder

6 After our stomach empties food and juice mixture into our small intestine — our liver and pancreas juices break down food more so it can be used by our body. Our liver has many jobs, and two of them are to make and send out bile juice, and to process our blood coming from our small intestine that has the nutrients just absorbed. Our liver cleans this blood before sending it to the rest of our body. Our pancreas changes the food we eat into fuel for our body's cells, and also makes hormones (including insulin and glucagon) to balance our blood sugar levels. Our gallbladder is a pouch that stores bile between meals until our body needs it. At mealtime, bile is sent to our intestine and mixes with the fat in our food.

It takes 1-3 days for food to pass through our body.

Cecum: Pouch joining the small intestine and colon.

Appendix: Has lots of germ-fighting cells!

Rectum

Ascending Colon

Sigmoid

Best way to help our digestive system so poop will move through easily:  
• Drink plenty of water\*  
• Eat healthy foods rich in fiber: fruits, vegetables, and whole grains  
• Move. Do anything that you find fun!  
\*WATER IS NEEDED FOR DIGESTION

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Our hypothalamus makes us feel hunger and thirst. It also helps our immune system fight disease. There are over 50 hormones, many made by our endocrine cells, most of which are in glands.

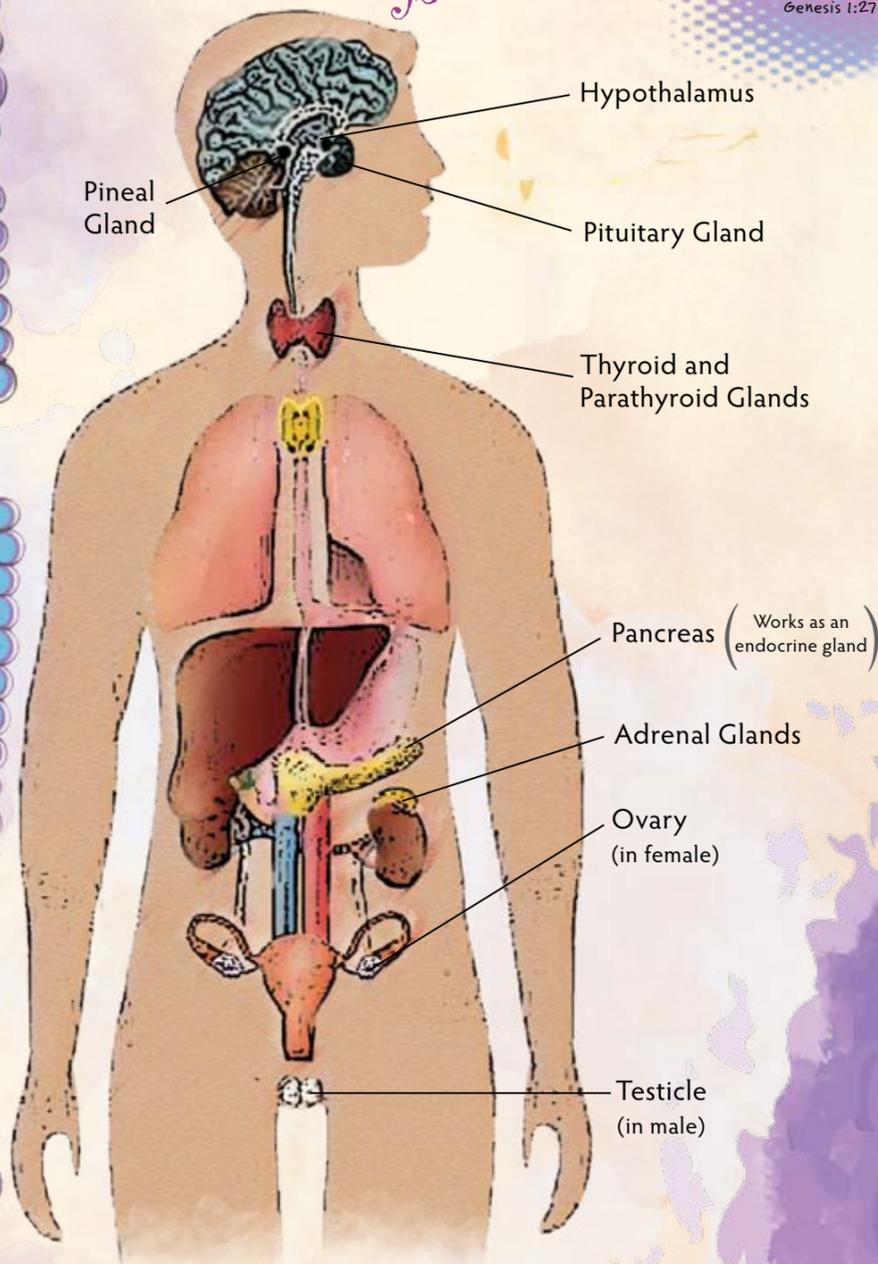
Group of Glands

# Endocrine System

- Makes Hormones
- Pulls Together Chemicals
- Balances Bodily Functions

So God created mankind in his own image, in the image of God he created them; male and female he created them.  
Genesis 1:27

The major glands that make up our endocrine system include...



Stress kicks our endocrine system into hyperdrive. Constant stress upsets our body.

- It is important to learn how to deal with stress, to relax, and balance our lives.
- Some ways to help with the pressures of life; sharing our worries and concerns with someone we trust, being grateful, deep breathing, laugh, move (go for a walk around the block—our glorious bodies were made to move).
- We do not need to carry our burdens alone. Entrust them into the hands of our loving Lord and Savior, Jesus Christ.

Do not be anxious about anything... (Philippians 4:6-7)

Our endocrine system involves almost every cell, organ and function of our bodies.

It is made up of a system of glands that sends forth chemicals called hormones to help our bodies work well.

These glands send out hormones to balance many bodily jobs; growth and metabolism to name two.

Many different hormones move through our bloodstream but **EACH TYPE of HORMONE** is created and designed to affect only certain cells.

Endocrine glands let-off more than 20 major hormones straight into our bloodstream where they can be carried to cells in other parts of our body.

Our endocrine system helps guide the following actions and systems:

- Controls our Mood
- Growth and Development
- Homeostasis (balancing our body systems inside)
- Metabolism (turns our food into energy)
- Reproduction (Procreation)
- Response to Stress and Injury
- Tissue Action

The Endocrine Glands are our body's main hormone makers. There are some other organs not in the endocrine system that also make and release hormones such as the brain, heart, kidneys, liver, lungs, and skin.

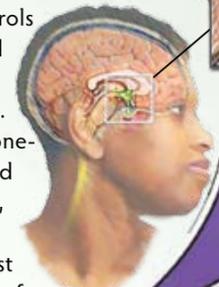
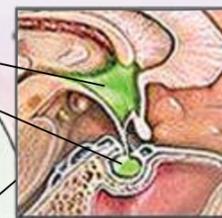
Endocrine glands release their hormones without ducts (tubes), right into our bloodstream.

Like the nervous system, the endocrine system is an information signal system; but rather than using neurons (nerve cells), it uses hormones (chemical messengers). Each hormone has their

OWN unique job. Incredible!

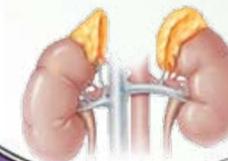
## Hypothalamus and Pituitary Gland

Our hypothalamus is a set of special cells and is the main link between our endocrine and nervous systems. It controls our appetite, body temp and metabolism. Our pituitary gland is no bigger than a pea. It controls many other hormone-releasing glands: our thyroid gland, our adrenal glands, the ovaries, and the testicles. It is the most important part of our endocrine system.



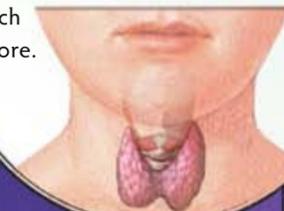
## Adrenal Gland

Triangular-shaped glands found on top of each kidney. They make different hormones which balance our body's metabolism, balance salt and water in our body, our immune system, and much more.



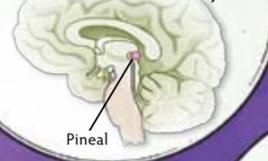
## Thyroid Gland

Makes hormones that balance our metabolism, heart rate, blood pressure, digestion, muscle tone, and much more.



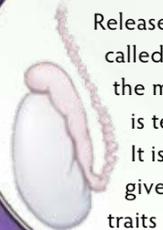
## Pineal Gland

Makes melatonin which balances our sleep-wake cycle known as the circadian rhythm.



## Testicle (in male)

Releases hormones called androgens; the most important is testosterone. It is what helps give the special traits of a man.



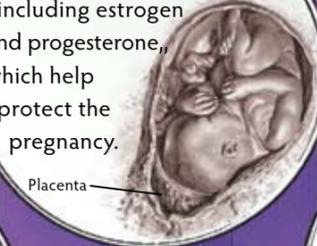
## Heart

Makes a hormone (ANP) when blood pressure is high. ANP lowers blood pressure by making blood vessels bigger.



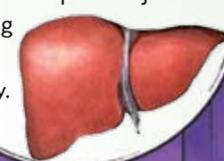
## Placenta

Makes several hormones including estrogen and progesterone, which help protect the pregnancy.



## Liver

Makes and releases different hormones that carry out important jobs in running our body.



## Digestive

The hormones CCK, secretin, and gastrin are made by the digestive organs. They balance the pancreatic juice, bile and gastric juice from food in the stomach. CCK also lets us know when we're full after eating a meal.



## Parathyroid Glands (2 pairs in thyroid)

Releases hormones which balance calcium levels in our blood and bone metabolism.



## Ovary (in female)

Makes hormones; estrogen and progesterone. These hormones give the unique traits of a woman and help with baby creation.



## Pancreas

Sends out the hormones insulin and glucagon to balance blood sugar levels all through our day.

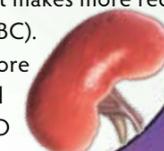


## Skin

Gets hormonal signals from other glands, and it makes hormones and enzymes. Skin has a beautiful, complex design. DHT (5 $\alpha$ -dihydrotestosterone) is an important hormone that is made in the skin. DHT is the rascal we can blame for oily skin breakouts. Our skin is mostly the one for making this strong hormone.

## Kidneys

Make EPO hormone to help low levels of oxygen in our blood. EPO goes to red bone marrow where it makes more red blood cells (RBC). More RBC = more oxygen and then EPO stops.



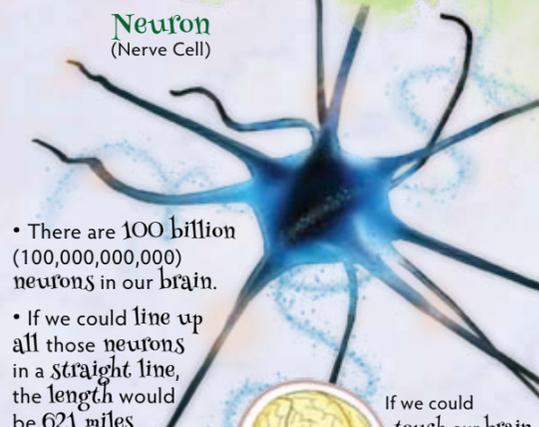
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Sends Messages to Body

# Nervous System

- Network that Sends Messages Back and Forth from Brain to Body
- Via the Spinal Cord; Runs from Brain, Back and Nerves to Body



• There are 100 billion (100,000,000,000) neurons in our brain.

• If we could line up all those neurons in a straight line, the length would be 621 miles (1000 km), if each neuron was 10 microns long.

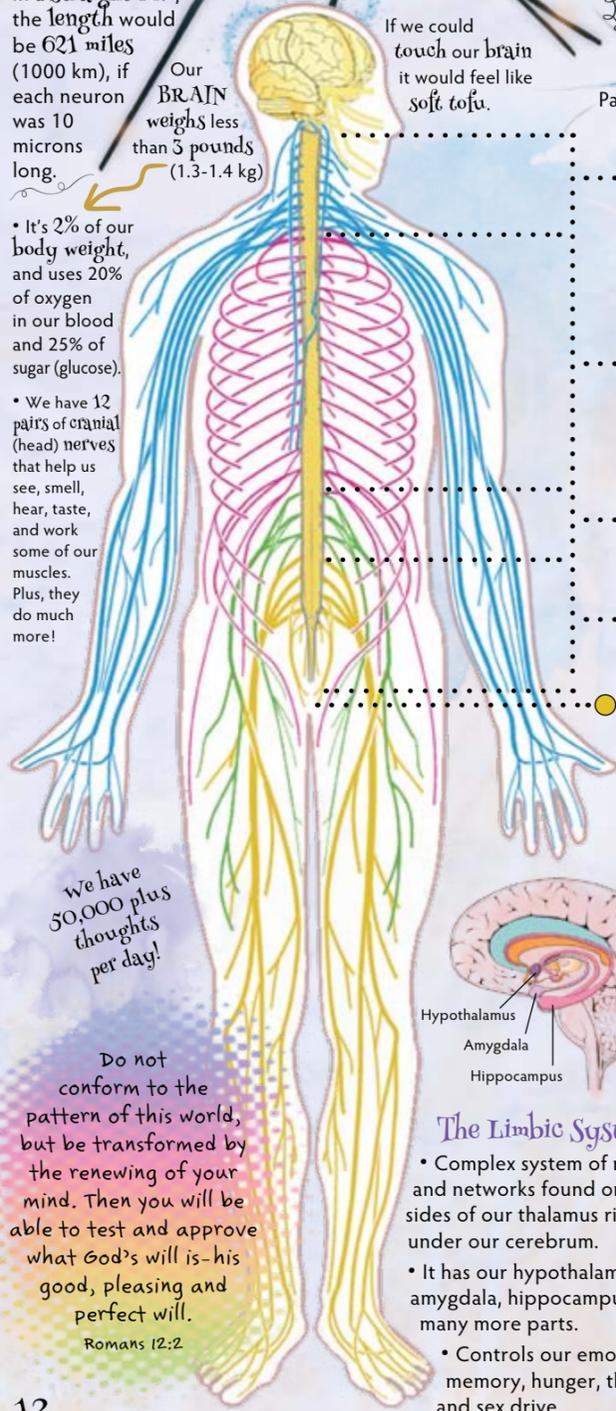
• It's 2% of our body weight, and uses 20% of oxygen in our blood and 25% of sugar (glucose).

• We have 12 pairs of cranial (head) nerves that help us see, smell, hear, taste, and work some of our muscles. Plus, they do much more!

We have 50,000 plus thoughts per day!

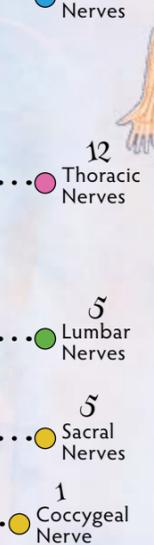
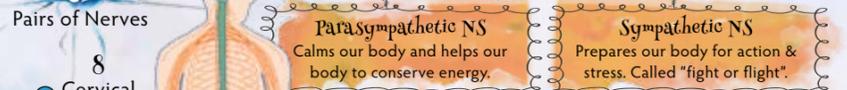
Do not conform to the pattern of this world, but be transformed by the renewing of your mind. Then you will be able to test and approve what God's will is—his good, pleasing and perfect will.

Romans 12:2



If we could touch our brain it would feel like soft tofu.

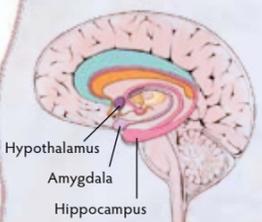
Our BRAIN weighs less than 3 pounds (1.3-1.4 kg)



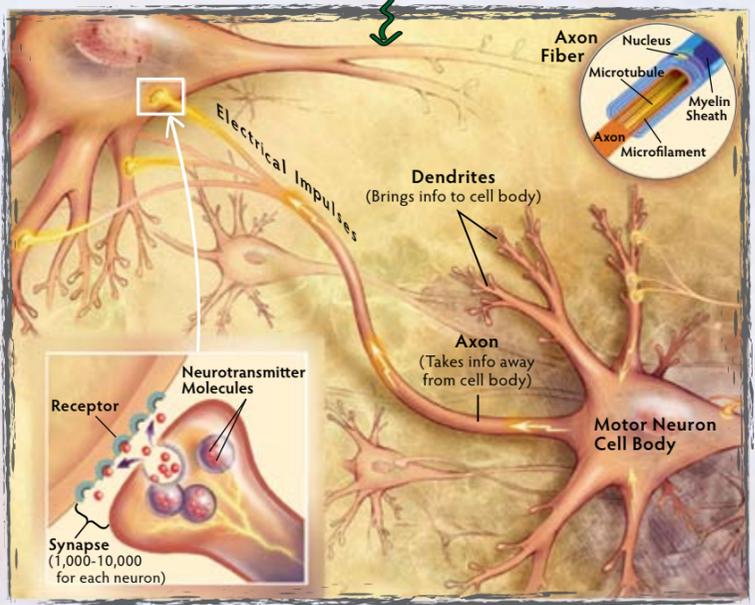
• The Nervous System, our body's electrical wiring, is a complex selection of nerves and specially designed neuron cells that spread signals between different parts of our body. It controls everything we do: breathing, walking, thinking, and feeling...  
• We can only see nerves with a microscope.

• The name for brain freeze (when we eat that ice cream too fast) is "Sphenopalatine ganglioneuralgia".  
• Glial cells surround neurons to keep them apart. They also give nutrients and oxygen and kill germs. There are 10 times+ more glial cells than neurons. A LOT!

• Neurons send information to other cells through axon fibers. Chemicals called neurotransmitters are let go at gaps called synapses. Traveling takes only a fraction of a millisecond! Really fast!  
• Microfilaments are thin. Microtubules are thick, strong spirals of thousands of subgroups. These subgroups are made of tubulin protein; named this because they look like a tube.  
• Each nerve is made up of many cells called neurons. There are 3 kinds of neurons: motor, sensory, and interneurons. Motor neurons are inside our spinal cord and axons are outside of our spinal cord, which control organs, mainly our muscles and glands.



• Complex system of nerves and networks found on both sides of our thalamus right under our cerebrum.  
• It has our hypothalamus, amygdala, hippocampus, and many more parts.  
• Controls our emotions, memory, hunger, thirst, and sex drive.

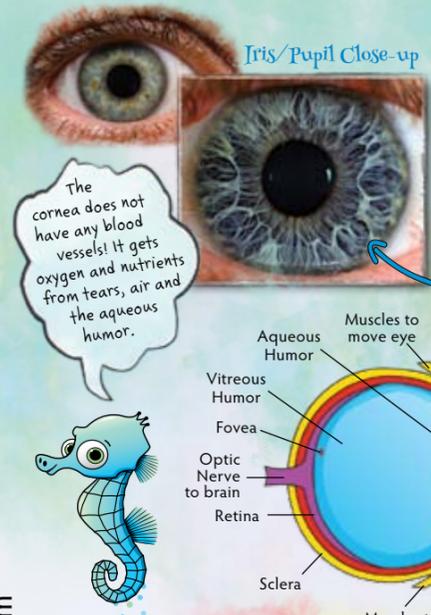
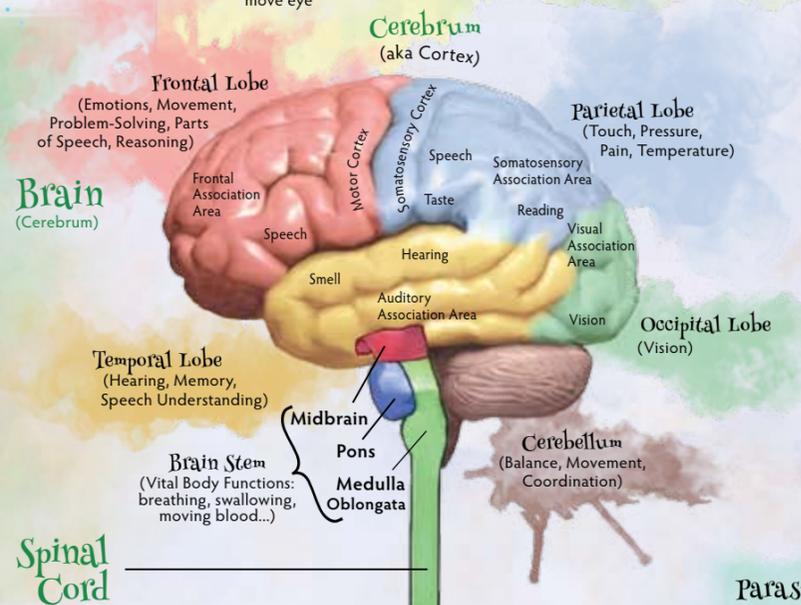
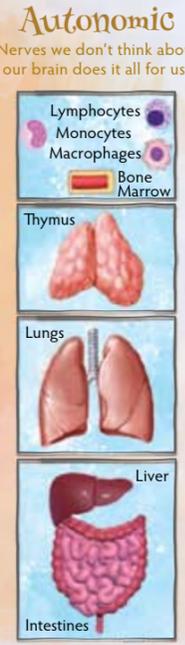


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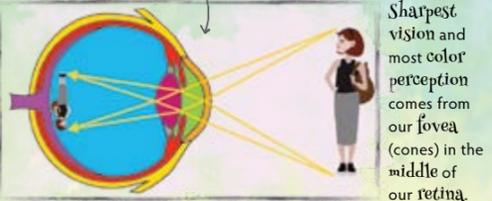
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## Central Nervous System

## Peripheral Nervous System

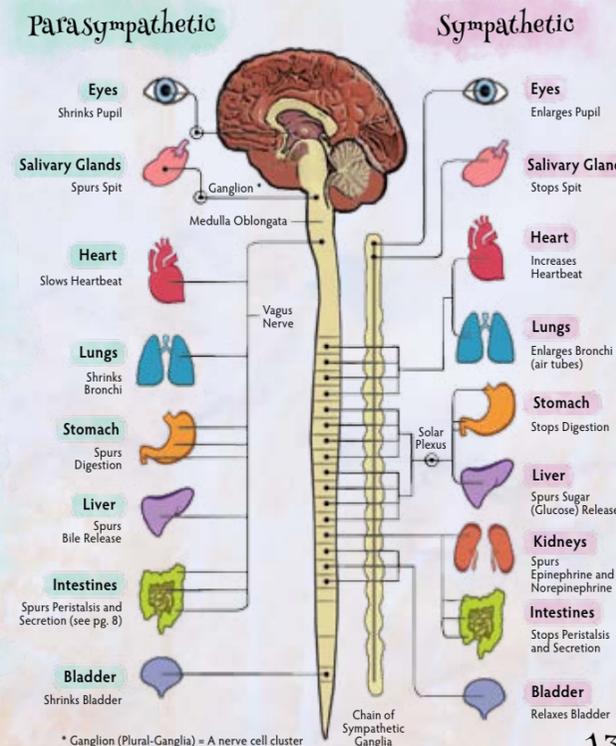
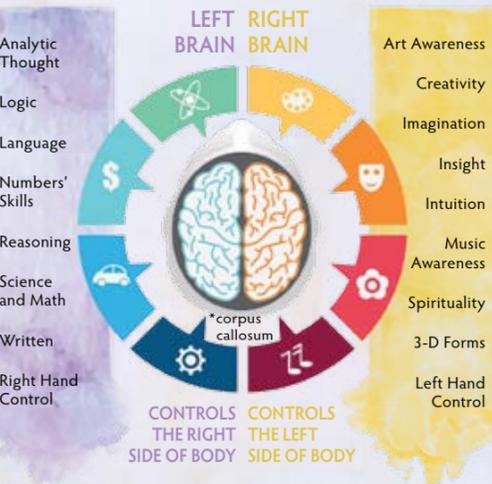


• Our eyes are the most wonderfully designed and astonishingly complex organs in our body... after our brain. Our brain is the most complex 'machine' that ever existed!  
• We blink every 3-4 seconds. For a whole day we will blink up to 28,800 times! Every time we blink a tiny bit of tear fluid comes out of our upper eyelid. This tear fluid washes away germs and dust in our eyes.  
• The Iris is the colored part and controls the size of the pupil and so the amount of light reaching the retina.  
• Our pupil is the black hole in our iris. It gets smaller in bright light; and gets bigger in darkness to let in more light.  
• The cornea is what covers and protects our eye. It is where light is focused.  
• The lens is clear and helps focus light on the back of our eye.  
• There are 4 Groups of Eye Muscles: 1) Extra-ocular muscles that move our eyes (each eye has 6). 2) Iris muscles. 3) Eyelid muscles. 4) Ciliary muscles; joined to the lens and focuses light on retina.



• 126 million cells meet on a 1 million fiber optic nerve!  
• The vitreous humor is a clear gel that fills 80% of our eyeball and gives our eye its shape.  
• The aqueous humor nourishes our cornea and lens and keeps up fluid pressure.

Our cerebrum has left and right halves. It makes up 85% of our brain's weight. A band of nerve fibers\* in the middle helps the two sides to communicate.

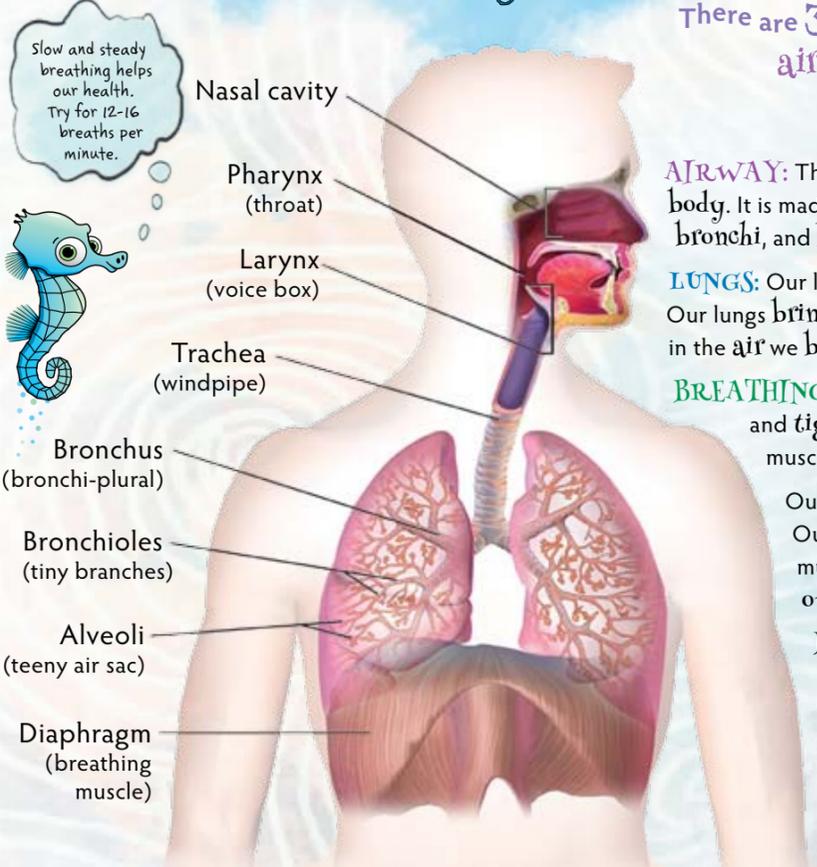


# Respiratory System

(AKA Breathing)

• Includes Nose, Throat, Voice Box, Windpipe, and Lungs  
 • Inhale Oxygen In and Exhale Carbon Dioxide Out

There are 3 Major Parts of the Respiratory System:  
 airway, lungs, and breathing muscles



Slow and steady breathing helps our health. Try for 12-16 breaths per minute.



**AIRWAY:** The airway moves air between our lungs and our outer body. It is made up of our nose, mouth, pharynx, larynx, trachea, bronchi, and bronchioles.

**LUNGS:** Our lungs are the working parts of our respiratory system. Our lungs bring oxygen into our body and get rid of carbon dioxide in the air we breathe out.

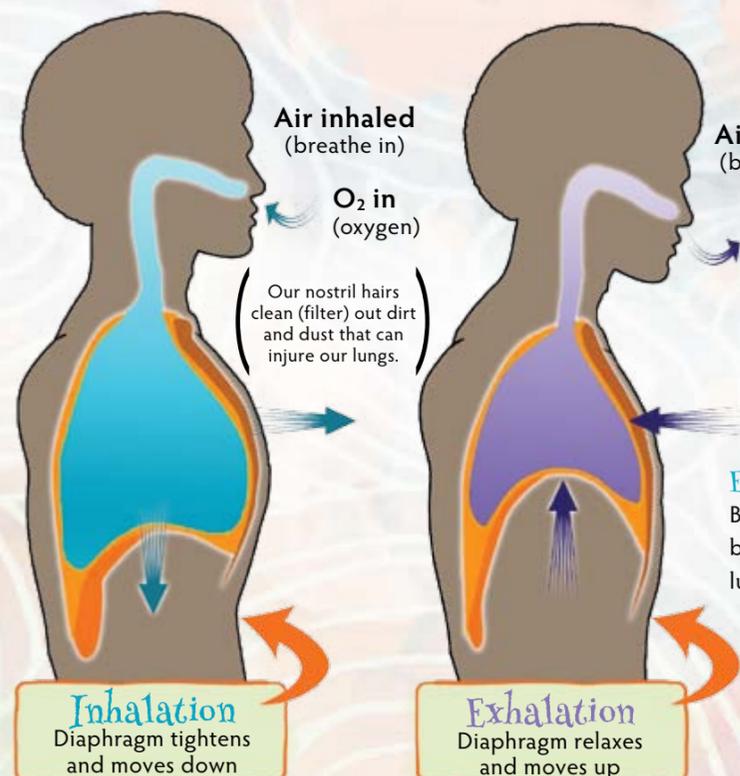
**BREATHING MUSCLES:** Muscles near our lungs help open (expand) and tighten (contract) our lungs which lets us breathe. These muscles are the diaphragm, intercostal, and abdominal.

Our diaphragm is a dome-shaped muscle below our lungs. Our intercostal muscles are between our ribs. These muscles work together like a pump, pushing air into and out of our lungs as we breathe.

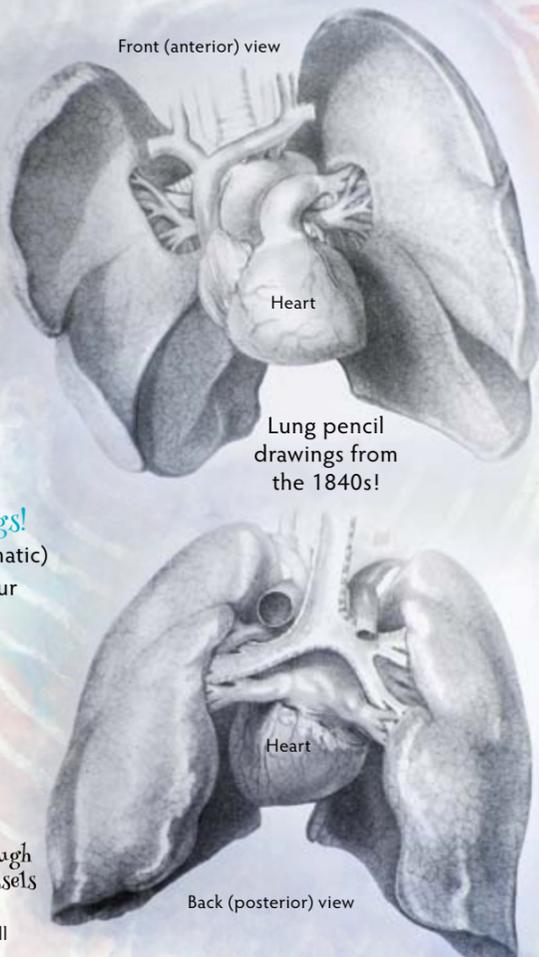
Below our diaphragm are abdominal muscles. They help us breathe out when we're breathing fast (as we exercise).

Taking deeper breaths, we use more air sacs in our lungs, which lets us take in more oxygen to feed our muscles.

Breathe slow and steady for good health!



Nasal breathing keeps the right balance of oxygen and carbon dioxide (CO<sub>2</sub>) in our blood. Inhaling through our nose and exhaling through our mouth causes CO<sub>2</sub> loss which can lead to narrowing of our blood vessels that give blood to our brain. Plus, breathing in and out through our nose will keep our gums and mouth moist and filters out dirt and dust. Try practicing breathing through your nose. Sometimes we will need to breathe through our mouth when we are moving more or if our nose is stuffy.



**Exercise our Lungs!**  
 Belly (or diaphragmatic) breathing boosts our lung power.

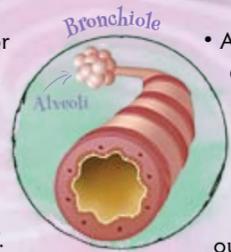
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## Fascinating Facts

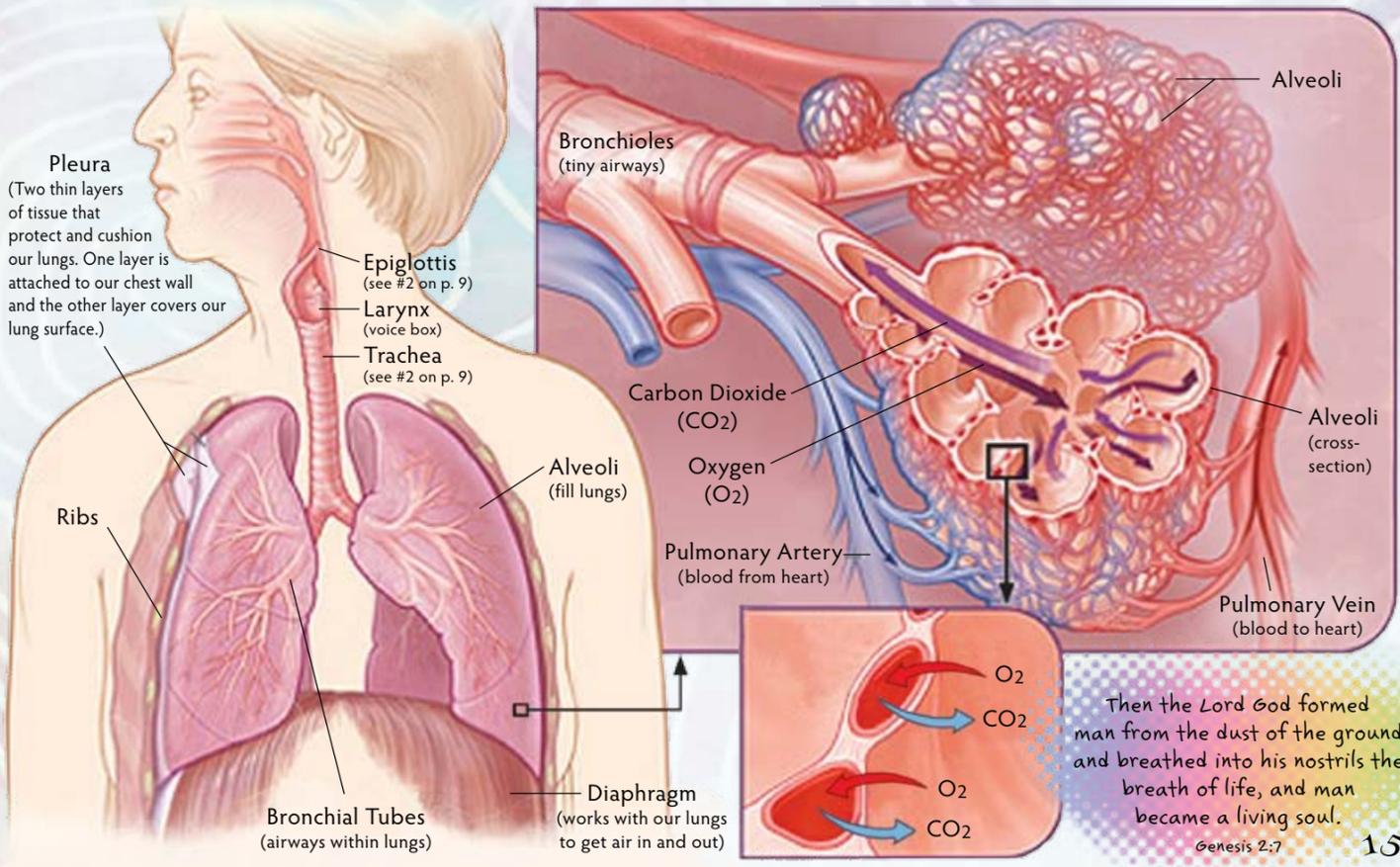
- When we breathe in air (inhale) through our nose, that oxygen passes our sinuses, which are hollow spaces in our skull. Sinuses help balance the temperature and humidity of the air we breathe.
- Our lungs are needed for talking... not just breathing! We could not talk without air. Our larynx (voice box), has two tiny ridges called vocal cords across it. If our vocal cords are closed and air flows between them, the vocal cords vibrate and make sounds like talking, singing, laughing, shouting, or burping.
- The air then goes down our windpipe (trachea). There are tiny hairs called cilia on the way down our windpipe which move gently to keep mucus and dirt out of our lungs. The air then goes through the series of branches in our lungs; bronchi, bronchioles.
- At the bottom of our windpipe, there are 2 large tubes called bronchi. One tube goes to the left lung and the other heads over to the right lung.



- Each bronchus (the name for one bronchi), branches off into smaller tubes called bronchioles (think of branches on a tree). Each bronchiole is the thickness of a human hair. There are 30,000 bronchioles in each lung.
- There are clumps of teeny tiny air sacs called alveoli at the end of each bronchiole. There are 600 million alveoli in our lungs! Each alveolus (the name for one alveoli), has a mesh-like covering of very tiny blood vessels called capillaries. It is the alveoli that let oxygen from the air pass into our blood. All of our body cells need oxygen.
- We have two lungs. Our left lung is a bit smaller than our right lung. This extra space on the left leaves room for our heart. What a superb design!
- Our ribs cover our lungs to keep them safe. We have 12 pairs of ribs (24 total) in our rib cage. (Some have 11 or 13 pairs.)



- As we breathe in, our diaphragm contracts (tightens), flattens out, and moves down. Our lungs then have more room to grow larger as they fill up with air.
- When we breathe out (exhale), our diaphragm relaxes and moves up, pushing air out of our lungs. Our rib muscles become relaxed, making a smaller space in our chest.
- The air we breathe out has wastes and carbon dioxide, and it is warm also. As air goes through our body, it picks up heat along the way.
- Breathing is moving oxygen-rich air into and out of our lungs. Respiration is how our body cells use oxygen to make energy and then exhale carbon dioxide; a waste product of the respiration process.
- Moving is really good for our lungs. Our bodies were designed to move. When we do activities like biking, running, or dancing, our lungs need more air to give our cells the extra oxygen they need. When we breathe more deeply, our lungs become stronger and better at giving our body the air it needs to work well.

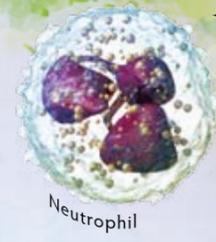


Then the Lord God formed man from the dust of the ground and breathed into his nostrils the breath of life, and man became a living soul.  
 Genesis 2:7

Fights Against Germs

# Immune System

- Made Up of Cells, Tissues, and Organs
- Drains Excess Fluid from Tissues



## White Blood Cells (aka leukocytes)

Our Immune System is made up of cells, tissues, and organs that work together to protect (care for) our body. Some of the important cells are white blood cells that help protect our body against illnesses and fight germs. All white blood cells are made and copied from bone marrow cells known as hematopoietic stem cells (which can renew itself).

**LYMPH NODES:** There are 500-600 lymph nodes throughout our body and abdomen. Most are in our armpits and groin. Our lymph nodes work as lymph filters that enter from many afferent (incoming) lymph vessels. Our lymph node fibers act as a net to catch any junk or cells that are in our lymph. Lymphocytes and macrophages attack and wipe out any germs caught in the fibers. Efferent (outgoing) lymph vessels then carry filtered lymph out of the lymph node and toward lymphatic ducts.

**LIVER:** Works as an organ of our immune system through the action of the Kupffer cells that forms the lining of the sinusoids (small blood vessels). Kupffer cells are fixed macrophages that form part of the phagocyte system as well as macrophages in the spleen and lymph nodes. They eat bacteria, parasites, worn-out blood cells and dead or dying cells. They can clean a large amount of blood very quickly.

**APPENDIX:** Has a lot of infection-fighting lymphoid cells and it is designed to protect good bacteria in our stomach.

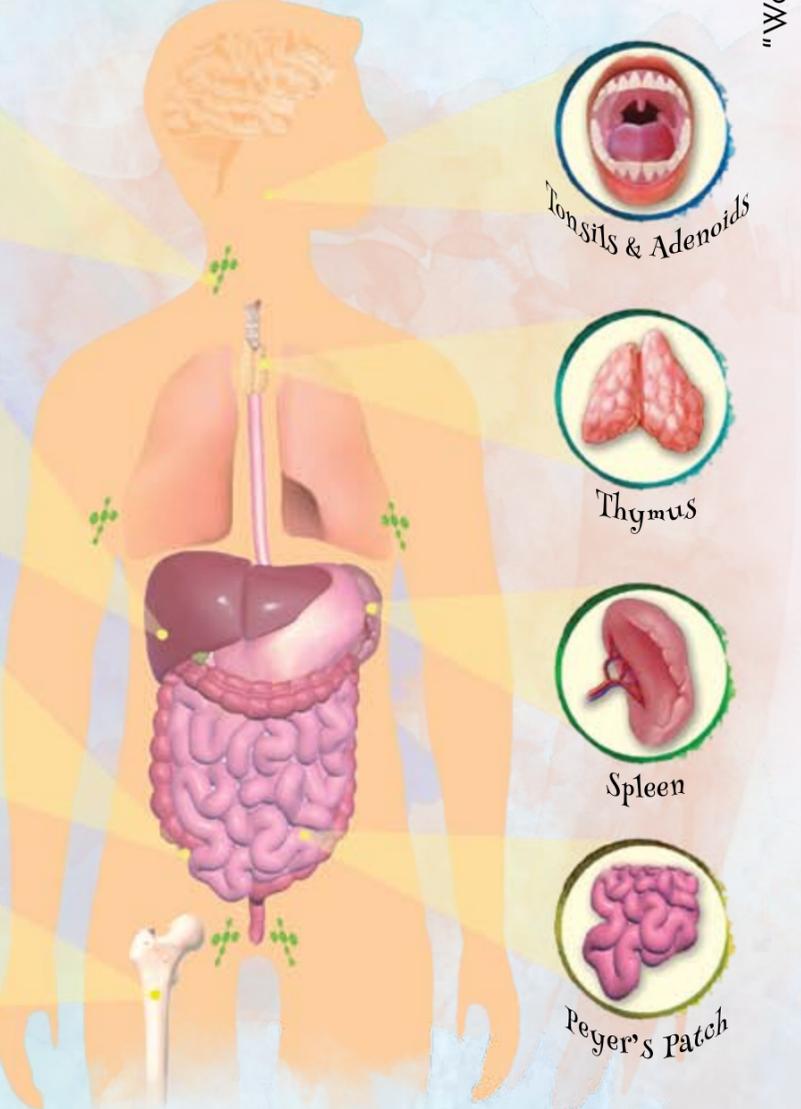
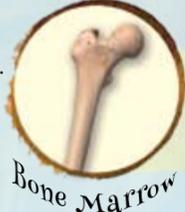
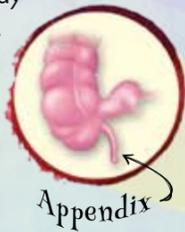
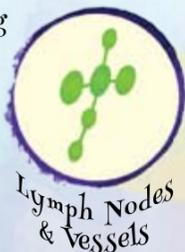
**BONE MARROW:** The yellow tissue in the center of our bones that makes white blood cells.

**TONSILS & ADENOIDS:** Our tonsils are in the back of our throat. Our adenoids are higher up, behind our nose. They trap germs and dirt coming in through our nose and mouth.

**THYMUS:** Makes and trains T-cells (T-lymphocytes; a very helpful type of white blood cell) in the developing fetus and in childhood. T-cells spread throughout our body to other lymphatic tissues to fight infections.

**SPLEEN:** Cleans the blood by removing old or injured blood cells and platelets. It helps our immune system by killing germs and other different things.

**PEYER'S PATCH:** Small groups of lymphatic tissue found throughout our ileum region of our small intestine. They help stop germs growing in our intestines.



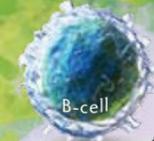
Our body is made up of 37 trillion+ living cells in our immune system, blood, bones, and muscles! Every year, most cells are replaced by a new cell.

Keeps Body's Fluids Balanced

# Lymphatic System

- Made Up of Capillaries, Vessels, Nodes, and Ducts
- Above Collects and Moves Lymph (Colorless Fluid)

Our Lymphatic System is an important part of our Immune System. The Immune System is our body's guard against infections: germs, viruses, fungi and other parasites. Our Lymphatic System moves infection-fighting cells (lymphocytes) and gets rid of cell remains and other things. It also moves fats from our small intestine to our blood. It has tiny vessels that move a colorless fluid called lymph (limf) and white blood cells from the body tissues back to the bloodstream with the help of valves. Lymph nodes clean lymph fluid, catching bacteria and viruses. This bacteria is wiped out by our special white blood cells called lymphocytes.



B-cells and T-cells are two kinds of lymphocytes. Our lymphocytes start in our bone marrow and either stay there and grow into B-cells, or they go to our thymus gland where they grow into T-cells. B-cells make antibodies (kind of like a medicine) that attack bacteria and toxins. T-cells help destroy infected or cancerous cells. So B-cells attack invaders outside our cells and T-cells attack invaders inside our cells.

**Dendritic cells** are bone marrow developed white blood cells and make up part of our immune system. They are in our skin, the lining of our nose, lungs, stomach, and intestines.

Dendritic cells are on the lookout for bacteria and viruses and they form from monocytes.

**Antibodies** (also known as immunoglobulins), made by our immune system, are large Y-shaped proteins which find and help get rid of viruses and bacteria. Every different antibody knows a unique different irritant (virus, bacteria...).

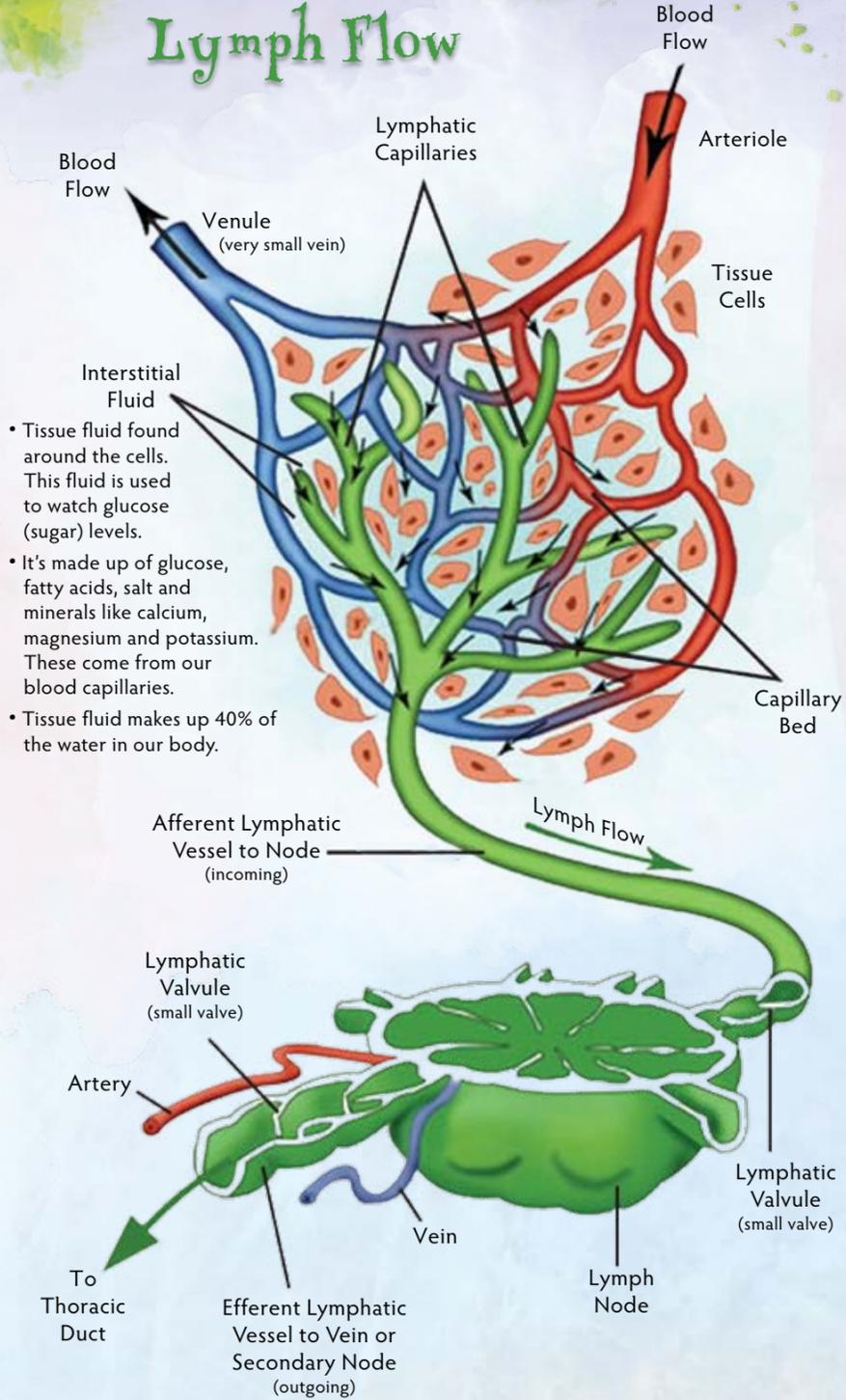
We can help our immune system by eating healthy foods, washing our hands to stop germs, exercising, and getting enough sleep.

We can help our lymph (lymphatic) system by exercising, dealing with stress, drinking plenty of water, breathing deeply, take in less sugary foods, and eating unsalted nuts and seeds.

*we have one body. Small changes each day can help our body last a lifetime.*

Then God saw everything that He had made, and indeed it was very good...  
Genesis 1:31

## Lymph Flow



- Tissue fluid found around the cells. This fluid is used to watch glucose (sugar) levels.
- It's made up of glucose, fatty acids, salt and minerals like calcium, magnesium and potassium. These come from our blood capillaries.
- Tissue fluid makes up 40% of the water in our body.

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Releases Fluid from Body

# Urinary System

(AKA Renal)

- Releases wastes filtered from blood and tissue fluids
- Maintains proper fluid balance in our body

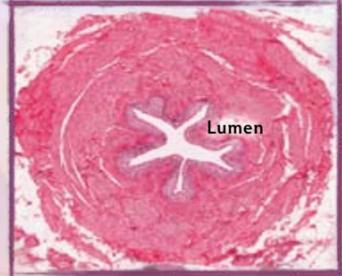
It is made up of our **kidneys, ureters, urinary bladder, and urethra**

- Our Urinary System gets rid of urine (pee) and other wastes from our blood. It also balances out water and salt in our body, and keeps up blood pressure.
- Pee is a liquid made by our kidneys, then passes through our ureters, is stored in our bladder and exits through our urethra.
- Our kidneys' main job is to clean (filter) wastes from our blood to make pee. Blood flows into the three layers of our kidneys and is cleaned through very tiny filters called nephrons. (See Fascinating Facts)

- Our ureters, blood, lymphatic vessels, and nerves, leave and enter through our kidneys' inner layers.
- Our ureters are thin tubes that link our kidneys to our bladder. At our bladder's entrance, our ureters are surrounded by valves which stop pee from flowing back toward our kidneys.
- Our ureters are VERY complex! The wall of our ureter is made up of three layers. The outer layer of adventitia is hairy (fibrous) and has many small branches of arteries, venules, and nerve fibers.

- The middle layer is smooth muscle which can shrink and grow (see Peristalsis on p. 8) to push pee from our kidneys to our bladder. The inner layer is called lumen, which has a lot of folds for pee to go through, and is lined with mucosa (sheath).
- Our bladder is a hollow sac that holds pee until we need to go to the bathroom.
- Our urethra is a tube that runs from the bottom of our bladder to the opening where pee goes out of our body.

## Ureter under the microscope



### What is pee made of?

Depends on what we eat, drink, or breathe.

95% Water

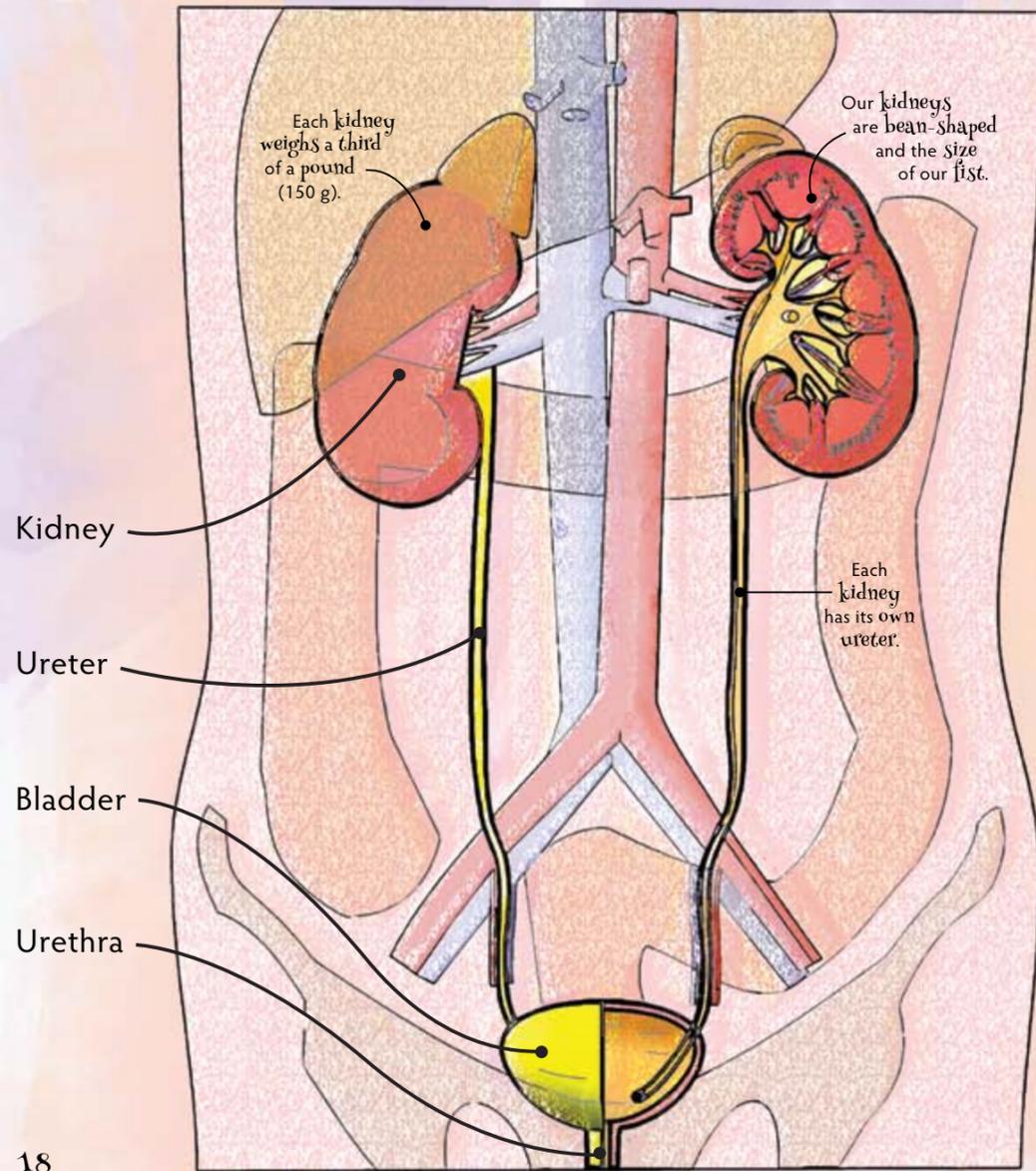
Urea: waste from broken down proteins

Salts, Minerals

Uric Acid, Dead Blood Cells, Toxins, Ammonia, Hormones, Creatinine, and Urochrome (what makes pee yellow).

Just as a body, though one, has many parts, but all its many parts form one body, so it is with Christ.

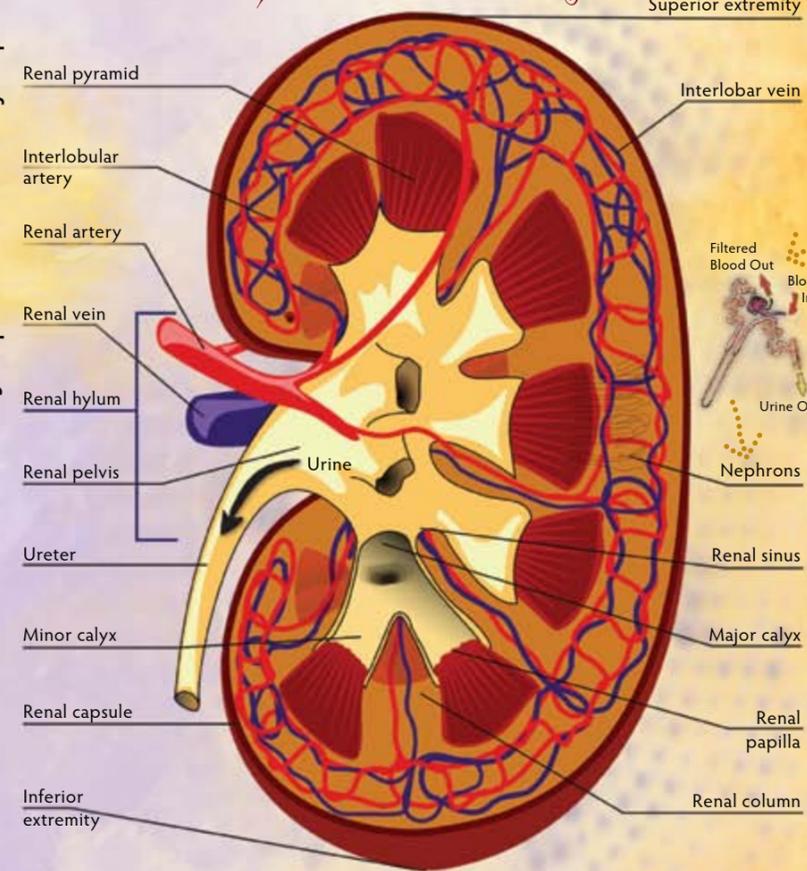
1 Corinthians 12:12



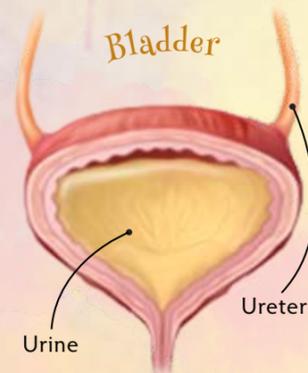
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## Design of our Kidney



PART	LENGTH	WIDTH
Kidney	4 in (10 cm)	2.5 in (6 cm) [1.2 in (3 cm) thick]
Ureter	12 in (30 cm)	.25 in (6 mm)
Bladder	2-3 in (5-7.5 cm)	1.5 in (3.8 cm)
Urethra-Female	1.5 in (4 cm)	.25 in (6 mm)
Urethra-Male	8 in (20 cm)	.125 in (3 mm)



- Our bladder is very flexible and designed well. As our bladder fills, it swells and stretches and thins out, so it can hold a lot of urine. As it fills, our brain blocks messages from the spinal cord to our bladder, which stops our bladder from emptying.
- During the day, a healthy bladder can hold about 1.5-2 cups (350-475 ml) of urine. At night, it can hold about 4 cups (950 ml). If we drink between 6-8 glasses of water daily, we can pee 5 or 6 times a day.
- We feel the need to pee when our bladder is about one-quarter full.

## How to keep everything flowing...

Drink enough fluids during the day.

(For sure when it is warm out or when exercising or playing.)

Take in less salt and caffeine. Run, walk, play...

## Fascinating Facts

about our Kidneys

- Each kidney weighs about 5 ounces (142 g).
- Our kidneys have a higher blood flow than our brain, heart, or liver. About 25% of the blood pumped by our heart goes to our kidneys.
- One kidney has more than a MILLION (1,000,000) nephrons (NEH-fronz). Nephrons are very tiny filters that clean our blood, get rid of waste, and balance minerals if they get low. Nephrons are very tiny, and can only be seen with a microscope.
- The blood in our body gets recycled (filtered) 400 times a day through our kidneys. And our kidneys take care of 190 quarts (180 liters) of blood in one day. Or the same amount as 48 gallons (182 liters) of milk! Which in turn, will make nearly 1-2 quarts (1-2 liters) of urine.
- Our left kidney is a bit higher than our right kidney because our liver on the right side of our body is a larger size.



If you have ever seen a kidney bean (think chili), that is what our kidneys are shaped like. Each kidney is about the size of our fist or computer mouse.

- Our kidneys touch the muscles of our back but our kidneys are protected by our ribs and by a layer of fat that holds them in place.
- Eating mostly healthy foods, drinking enough fluid, and keeping our weight down is important—eating too many fatty foods, sugar, refined carbs, and meats, or not getting enough water (dehydration), can cause kidney stones.
- Our body can work with only one kidney if something were to happen to the other one.
- Sometimes kidneys are not working, so a person has to be on dialysis (read about this at your local library or online). This takes several hours a day and this is usually done 3 days a week. Think of ways you can brighten your friend or family member's day while they are going through their dialysis sessions.
- Our kidneys do so much. They help balance our blood pressure. They control our body's chemical balance. They spur bone marrow to make red blood cells, which keeps our bones healthy. Plus, they make our pee (urine).

Pee should be mainly clear with a tinge of yellow. The darker it gets, the more dehydrated we are.



For us to pee, an intricate track of nerves send messages between our bladder, brain, and our spinal cord. GREAT DESIGN!

Makes, Nourishes and Carries Eggs

# Female Reproductive System

- Made Up of Internal Organs and External Parts
- Makes Eggs and Supports Developing Fetus

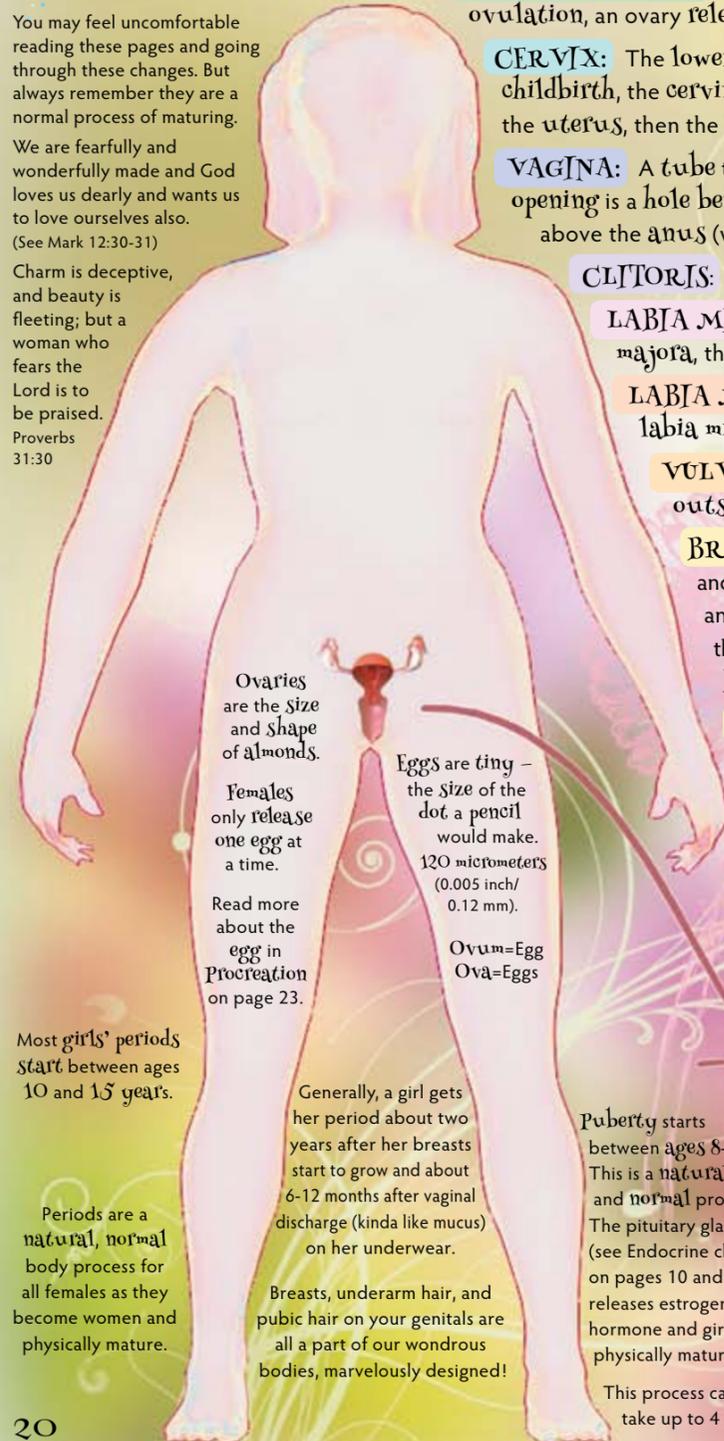
A group of organs in a female's lower belly and pelvis



We each grow and develop differently. We are all one-of-a-kind—NO TWO of us are exactly alike! Even identical twins' fingerprints are unlike. CELEBRATE and LOVE the ONE and ONLY YOU!

You may feel uncomfortable reading these pages and going through these changes. But always remember they are a normal process of maturing. We are fearfully and wonderfully made and God loves us dearly and wants us to love ourselves also. (See Mark 12:30-31)

Charm is deceptive, and beauty is fleeting; but a woman who fears the Lord is to be praised. Proverbs 31:30



Ovaries are the size and shape of almonds.

Females only release one egg at a time.

Read more about the egg in Procreation on page 23.

Eggs are tiny – the size of the dot a pencil would make. 120 micrometers (0.005 inch/ 0.12 mm).

Ovum=Egg  
Ova=Eggs

Most girls' periods start between ages 10 and 15 years.

Periods are a natural, normal body process for all females as they become women and physically mature.

Generally, a girl gets her period about two years after her breasts start to grow and about 6-12 months after vaginal discharge (kinda like mucus) on her underwear.

Breasts, underarm hair, and pubic hair on your genitals are all a part of our wondrous bodies, marvelously designed!

Puberty starts between ages 8-14. This is a natural and normal process. The pituitary gland (see Endocrine chapter on pages 10 and 11) releases estrogen hormone and girls physically mature.

This process can take up to 4 years.

**OVARIES:** There are two ovaries, one on either side of the uterus. Ovaries make eggs (ova) and hormones: estrogen and progesterone. These hormones help girls grow, and make it possible for a woman to have a baby.

**UTERUS:** A hollow, pear-shaped organ. The uterus (womb) is where a baby grows.

**FALLOPIAN TUBES:** Each fallopian tube goes from the uterus to the ovary. During ovulation, an ovary releases an egg into the fallopian tube that is next to it.

**CERVIX:** The lower one-third of the uterus that opens into the vagina. During childbirth, the cervix widens to about 4 inches (10 cm) so the baby can travel from the uterus, then the vagina, and out into the world!

**VAGINA:** A tube that joins the uterus to the outside of the body. The vaginal opening is a hole between the legs, below the urethra (where pee comes out) and above the anus (where poop comes out).

**CLITORIS:** A small sensory organ right above the vagina.

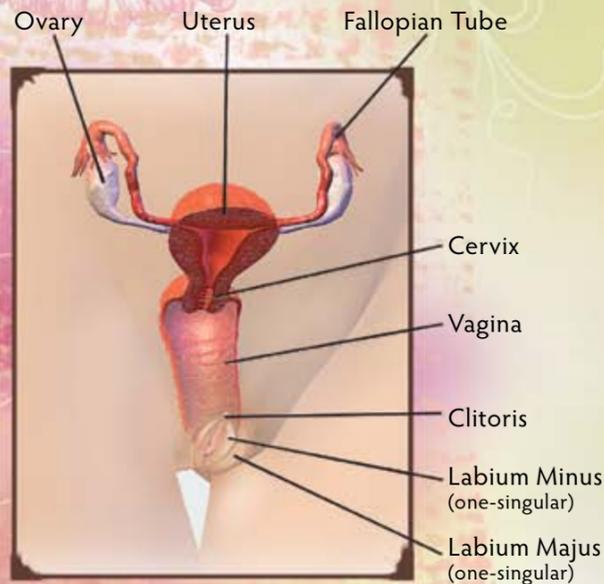
**LABIA MINORA:** The two inner flaps of tissue, just inside the labia majora, that surround the vaginal opening.

**LABIA MAJORA:** The two outer flaps of tissue that surround the labia minora and vagina. They protect the vaginal opening.

**VULVA:** The shared name for the female genitals found at the outside opening of the vagina and urethra.

**BREASTS:** Special organs that contain mammary glands, milk ducts, and fat. In the center is a nipple that gives milk if a woman is pregnant and nursing. The darkened band of skin around the nipple is called the areola, which protects the tissues underneath during breastfeeding. Breastfeeding is normal and healthy for baby and mom.

**MAMMARY GLANDS:** Glands found in the breasts that make milk to feed an infant. They start working during pregnancy and until milk is no longer needed for the baby.



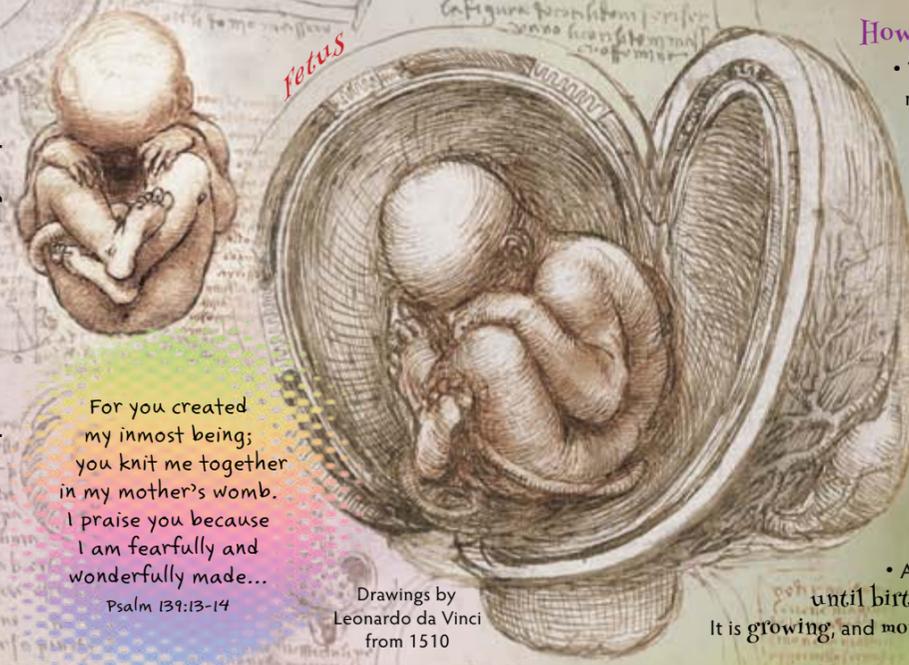
## How a Baby is Made

• When an egg (from a female) and the sperm (from a male) join, it is called conception, and this is when a baby's life begins. This tiny new fertilized egg is called a zygote (zi-got), which has 50,000 genes from each parent. Fertilization happens in the fallopian tube.

• This new combined egg has all the genetic information to form a new human baby! The color of our eyes, hair, and skin. The intricate fine lines of our one-of-a-kind fingerprints. Our body type, whether we are female or male, how tall we are, and our skin tone.

• From day 2, this new baby is called an embryo. This tiny human being travels down the fallopian tube and then implants (embeds) in the womb in 7-10 days and begins to take in nutrition from mom.

• At about eight weeks from the date of conception up until birth, nine months later, this unborn baby is called a fetus. It is growing, and moving, and kicking to get out into this wonderful world.



For you created my inmost being; you knit me together in my mother's womb. I praise you because I am fearfully and wonderfully made...

Psalms 139:13-14

Drawings by Leonardo da Vinci from 1510

## Fascinating Facts about Breasts and Bras

- As a girl moves toward being a woman, there are lots of changes that happen to her body. Besides the changes named on these pages, breasts will start growing between the ages of 8-15. ONLY humans have a permanent breast.
- No two breasts will look exactly the same. This is quite normal. There are many female shapes and sizes, and all of them are beautiful.
- As your breasts develop, you may want to wear a bra. Bras protect breast tissue when you are exercising and playing sports.
- It is important to find the right size bra for you so it will not pinch, or slide around.

One way to figure out your BRA SIZE . . .

- **BAND SIZE:** Run a tape measure snugly just under your breasts (around your ribcage). This will be a number (28, 30, etc.). Round to the nearest whole number. If the number is even, add 4 inches to that number. If odd, add 5 inches. (Because bras can stretch over time.)
- **CUP SIZE:** Measure across the fullest part of your breasts. Subtract your band size number from breast number for your cup size. This will be a letter and is the part of the bra that hold the breasts. [Ex. 33" (breast) - 32" (band) = 1" so a 32A]

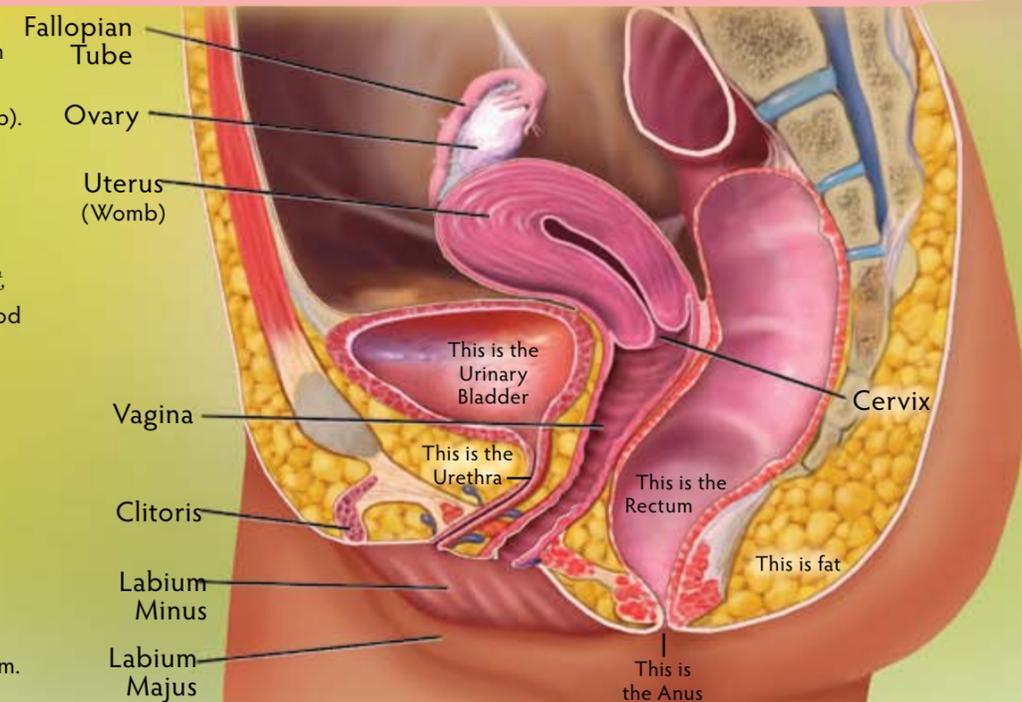
DIFF. IN INCHES	0"	1"	2"	3"	4"	5"	6"	7"
CUP SIZE	AA	A	B	C	D	DD	DDD, F	G

- **BRA SIZE:** Put the band size number and the cup size letter together (for example: 28AA, 32A, 34B, 34C...).
- Different brands and styles of bras will fit differently. Adjust the band that goes around the chest and adjust the bra straps to fit to your body. A well-fitted bra will have the back of the bra run straight across your back and the bra straps will lift your breasts comfortably.
- You may want to use a sports bra for your first bra. This will help keep your breasts from jiggling around when you are active playing sports or exercising.

**PERIOD (Menses):** If a girl or woman menstruates (loses blood), she has a flow of blood from her uterus (womb). This happens monthly when a girl or woman is not pregnant. Periods last from 3-7 days. You can use pads or tampons to absorb your menstrual flow. Sometimes pain and unpleasant feelings happen just before your period called PMS (premenstrual syndrome).

**OVULATION:** When the ovaries release an egg as part of a girl's or woman's cycle. If the egg is not fertilized within a day, it dies. This happens about 10-14 days before having a period.

**MENOPAUSE:** When ovaries stop making estrogen, the hormone that controls the female reproductive system. A woman will no longer have a period. This happens around 48-54 years old.



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# Male Reproductive System

Makes, Nourishes and Carries Sperm

- Made Up of Internal Organs and External Parts
- Makes Sperm to Create a New Human Being

A group of organs in a male's pelvis and outside their body

You may feel uncomfortable reading these pages and going through these changes. But always remember they are a normal process of maturing.

We are fearfully and wonderfully made and God loves us dearly and wants us to love ourselves also.

(See Mark 12:30-31)

Submit yourselves therefore

to God. Resist the devil,

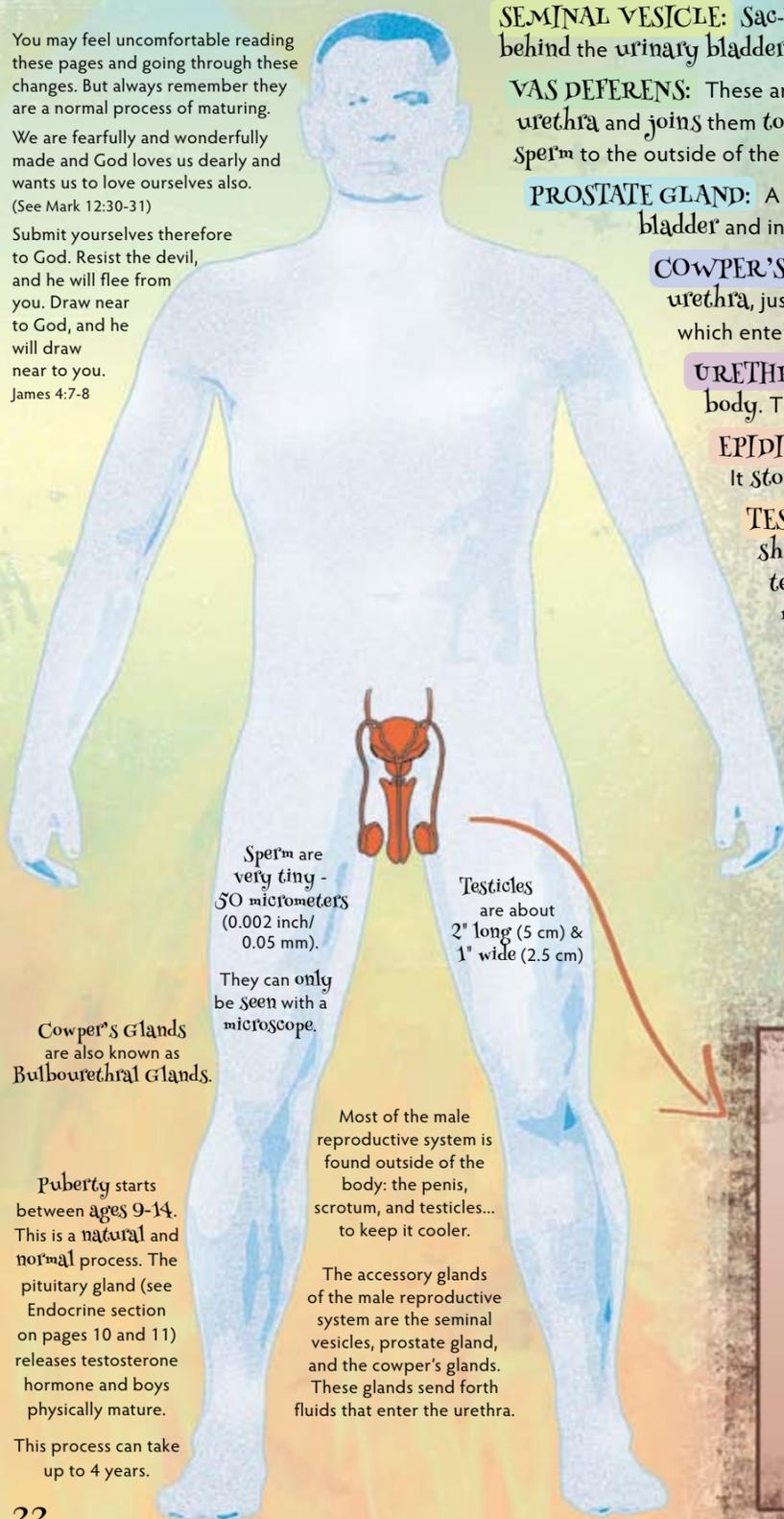
and he will flee from

you. Draw near

to God, and he will draw

near to you.

James 4:7-8



**SEMINAL VESICLE:** Sac-like pouches which are joined to the vas deferens and lie behind the urinary bladder. They make and release a fluid that makes part of semen.

**VAS DEFERENS:** These are muscular tubes that are between the epididymis and urethra and joins them together. It is where sperm is stored. It carries urine or sperm to the outside of the body.

**PROSTATE GLAND:** A walnut-sized gland. It is found below the urinary bladder and in front of the rectum. It makes a fluid that helps sperm.

**COWPER'S GLANDS:** Pea-sized glands found on the sides of the urethra, just below the prostate gland. They make a clear fluid which enters directly into the urethra and balances out any acidity.

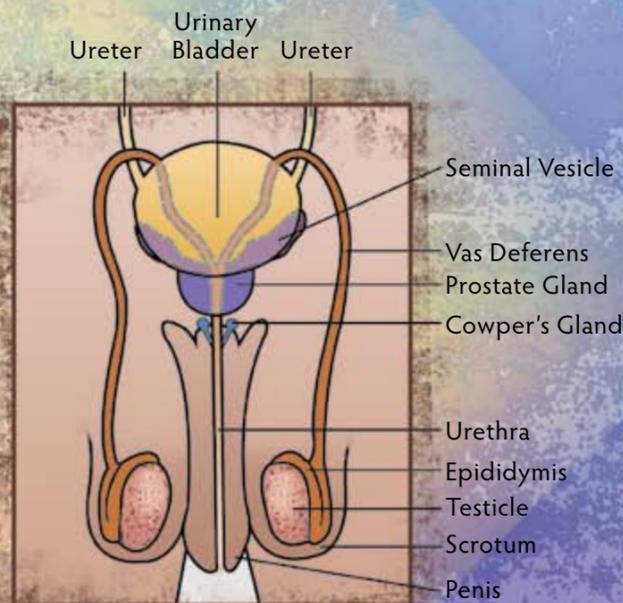
**URETHRA:** A tube mostly used to carry urine outside the body. The urethra also passes semen.

**EPIDIDYMIS:** A coiled tube lying on the back of the testicles. It stores and carries sperm cells. It also matures the sperm.

**TESTICLES:** They are the size of large olives and oval in shape. They are found inside the scrotum and make the testosterone hormone. Small tubes inside the testicles make sperm cells. The spermatic cord, which is made up of tissues and fibers, is joined to the testicles. This cord lets semen through and provides blood to the testicles.

**SCROTUM:** A loose pouch of skin that holds the testicles. It has many nerves and blood vessels.

**PENIS:** The outside reproductive organ of the male. It has 3 main parts: root, body, and the glans. The root is joined to the abdomen. The body is tube-shaped. The glans is the cone-shaped part at the end.



Sperm are very tiny - 50 micrometers (0.002 inch/ 0.05 mm).

Testicles are about 2" long (5 cm) & 1" wide (2.5 cm)

They can only be seen with a microscope.

Cowper's Glands are also known as Bulbourethral Glands.

Most of the male reproductive system is found outside of the body: the penis, scrotum, and testicles... to keep it cooler.

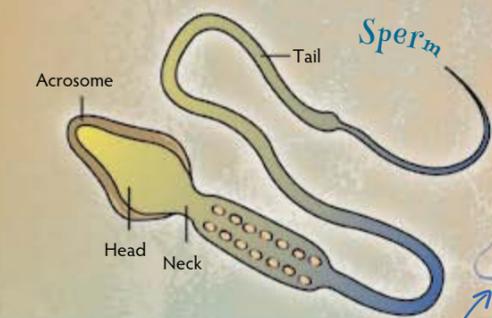
The accessory glands of the male reproductive system are the seminal vesicles, prostate gland, and the cowper's glands. These glands send forth fluids that enter the urethra.

Puberty starts between ages 9-14. This is a natural and normal process. The pituitary gland (see Endocrine section on pages 10 and 11) releases testosterone hormone and boys physically mature.

This process can take up to 4 years.

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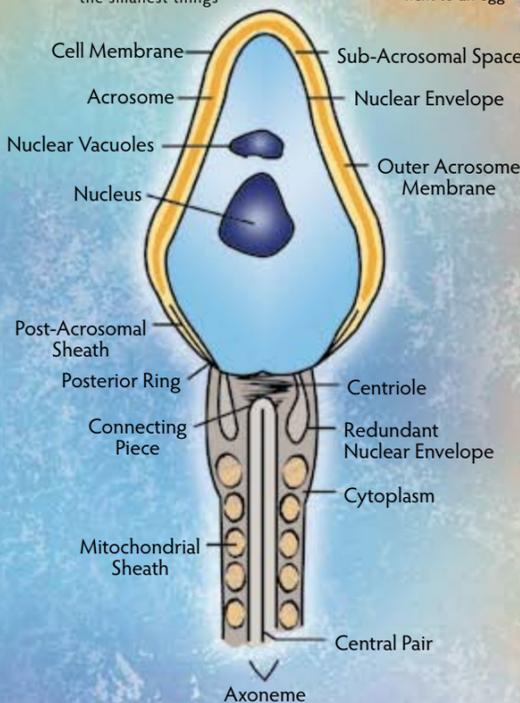
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## Sperm Detail

Wondrous design of even the smallest things

How small sperm looks next to an egg



Do you not know that your bodies are temples of the Holy Spirit, who is in you, whom you have received from God? You are not your own; you were bought at a price. Therefore honor God with your bodies.

1 Corinthians 6:19-20

**MENOPAUSE:** This is actually called low testosterone (androgen) in the aging male. Testosterone is the hormone that controls the male reproductive system.

**SEMEN:** The fluid that holds sperm. It is made in the seminal vesicle and prostate gland. Its job is to carry and protect the sperm until one of them can fertilize an egg from a woman.

**SPERM:** Millions of sperm (where woman only release one egg at a time) are in one tablespoon of semen. It only takes one sperm to fertilize an egg from a woman.

## PROCREATION . . . aka Reproduction

• All living things reproduce; that is their purpose. In humans, the female and male reproductive systems must work together to make a baby.

• Females and males have their own unique reproductive system.

They are different in construction and shape, and both are designed to make, feed, and carry either the egg or sperm.

• An egg cell and sperm are each entirely different—EGGS: large, round, released one at a time, unable to move on their own, lot of cytoplasm (think chicken egg!), nucleus has X chromosome. SPERM: small, straight, released in millions, able to move fast, very little cytoplasm, nucleus has either an X or Y chromosome.

• A fertilized egg has 46 chromosomes—half from the egg/half from the sperm. The paired genetic material from the female and male creates a new human.

• The gender, or sex of a baby is decided by the pairing of these 'sex' chromosomes. Females have two X chromosomes, and males have an X and Y chromosome (see more info on chromosomes on pages 26 and 27).

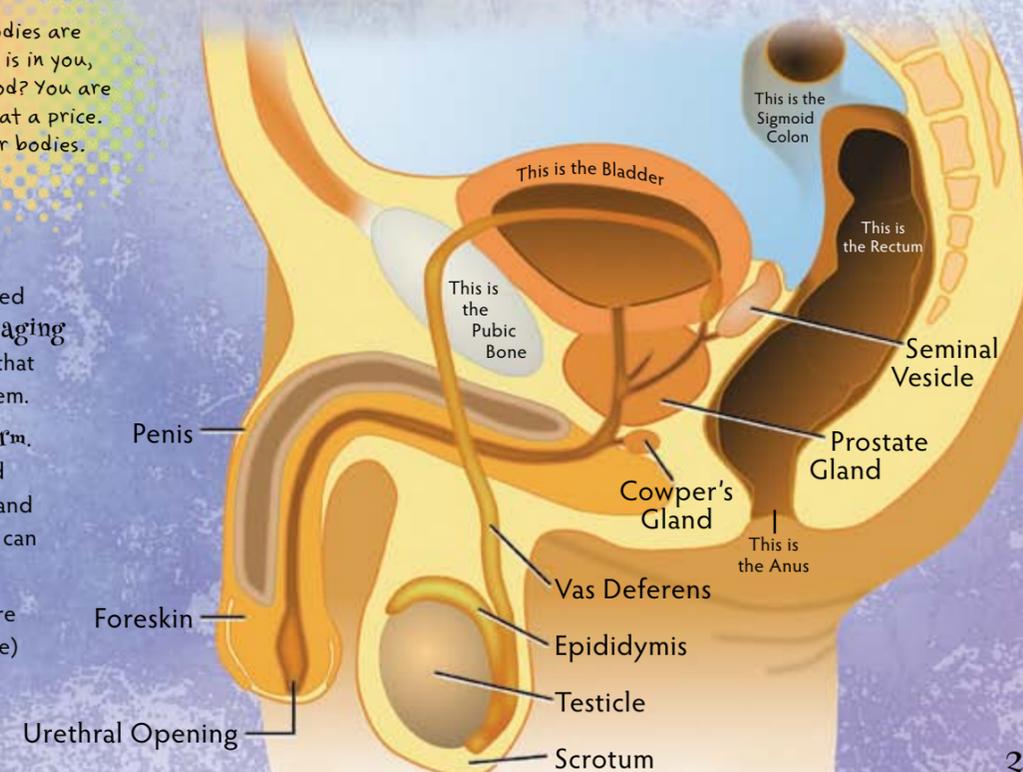
• As sperm have tails, they quickly can reach a woman's cervix ovaries. So not only do you need only one sperm to become pregnant, the sperm can enter the "danger zone" fertilization zone fast. Sperm can survive inside a woman's body up to 7 days.

• The sperm use their tails to travel first out of the testes to the epididymis, where they finish their growth. It takes them 4-6 weeks to swim through the epididymis. Then they move to the vas deferens.

The seminal vesicles and prostate gland make a whitish fluid called seminal fluid, which mixes with sperm to make semen. Semen is pushed out of the male's body through his urethra. Each time this happens, it can have up to 500 million sperm.

• Even though it only takes one sperm to fertilize an egg, that does not always mean the woman will get pregnant. The egg still must travel down the fallopian tube and implant into the uterus lining. This can take up to one week, and several things can stop implantation from happening.

Sex is a wonderful blessing given to us by the Lord that helps us show intimacy with our spouse.



# Integumentary System

- Skin Protects our Body from Disease
- Skin is the Largest Organ in our Body

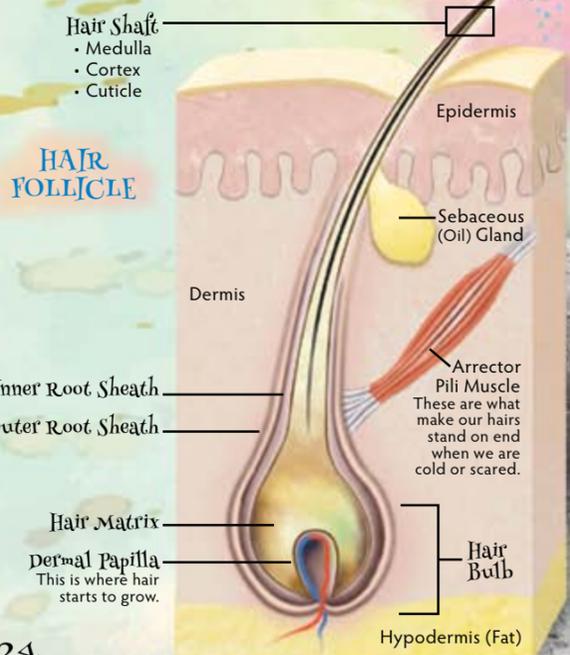
## HAIR

- We have hair on our skin and head, in our nose, in our ears, and around our eyes (eyebrows and eyelashes).
- Hair doesn't grow on the palms of our hands, the soles of our feet, or on our lips.
- Each hair shaft, which is the hair we see outside our body, is made up of 3 layers.
- The inner layer is the medulla; it is soft and made of rounded cells. The middle layer is the cortex and it has special cells called melanocytes, which make melanin and this gives hair its color. The outer, scaly layer is the cuticle which protects the inner layers and gives hair its shine.



- Two types of melanin in hair; eumelanin which is in darker hair and pheomelanin which is in lighter hair. Gray hair is from fewer pigment cells around to make melanin.
- A sebaceous gland on each hair follicle lets out sebum which coats our hair with oil.
- Once hair is outside our scalp, the cells inside are not alive anymore.
- Hair follicles contain DNA (see pages 26-27). Hair can be tested to find out paternity (who our dad is) and sometimes DNA is used as proof in a crime investigation.
- Thick hair grows out of large follicles and thin hair is from narrow follicles.
- Hair grows at different rates in each person; about 1/2 in (12 mm) per month.

EACH hair on our body grows out of a sac-like pit in our skin called a follicle. Tiny blood vessels at the bottom of every follicle feed our hair root to keep it growing. There are millions of follicles on our body from which our hairs grow.



HAIR SHAFT under a microscope (the outside cuticle layer is what we see)

## NAILS

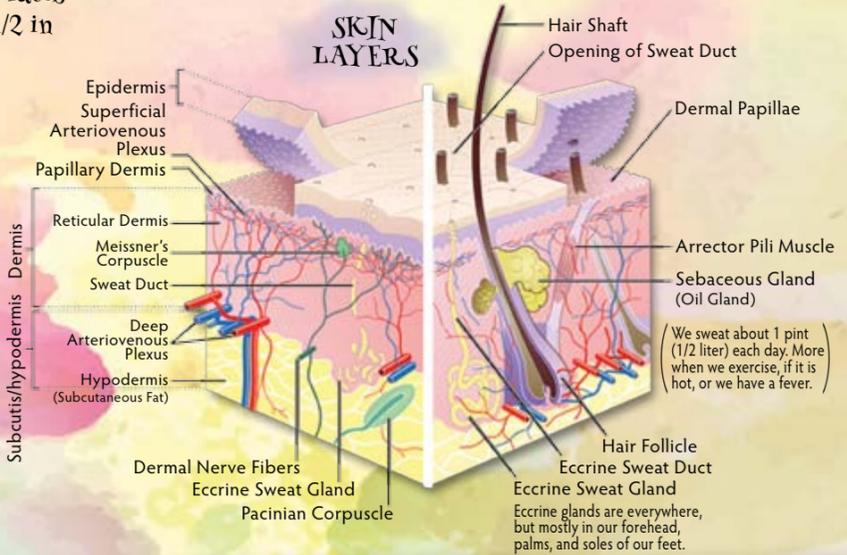


- Fingernails grow from the matrix and are mostly made of keratin, a very strong protein (that is also in skin and hair). As new cells grow in the matrix, the older cells (thousands each day) are pushed out, and then flatten out to make our fingernails.
- Our fingernails and toenails can help us know about our health, just as hair can because they are closely related. Our nails can show arthritis, melanoma, psoriasis, stress, and more.

## EXOCRINE GLANDS

- Most of the glands in our body are exocrine glands. Exocrine glands are one of two types of glands in our body, the other being endocrine glands (see pages 10-11), which release their stuff right into our bloodstream.
- Some different kinds of exocrine glands are sweat, salivary (spit), mammary (milk), ceruminous (earwax), lacrimal (tears), sebaceous (oil), and mucus.

Thick (hairless) Skin      Thin (hairy) Skin



100 trillion microbes live in and on our body in harmony

We sweat about 1 pint (1/2 liter) each day. More when we exercise, if it is hot, or we have a fever.

# SKIN COLORS

There is neither Jew nor Gentile, neither slave nor free, nor is there male and female, for you are all one in Christ Jesus. Galatians 3:28

Every SQUARE INCH of skin has THOUSANDS of cells, HUNDREDS of sweat glands, oil glands, blood vessels, and THOUSANDS of nerve endings.

All 7 billion+ people in the world look a little different (unless you are identical twins) because of the massive amount of info put in the genes of our unique cells.



- Melanin gives skin our wonderful different colors. Eumelanin is skin shades from dark brown to black. Pheomelanin is skin shades from red to yellow.
- Melanin gives eyes our color. Eyes are blue or green when the cells are deep in the eye. Eyes are brown when the cells are close to the top.
- Skin Color is mainly from the melanin pigment, but oxygenated hemoglobin, reduced hemoglobin, and carotenes also play a part.
- The hemoglobin pigment gives blood its color, and this plays the second part on our skin color. When it is mixed with oxygen, a bright red happens—think rosy cheeks as in light-skinned people.
- In reduced hemoglobin (less red blood cells), light-skinned people will have a bluish color and look very pale. Most common cause of this is because of anemia (low iron).
- Carotenes are the weakest pigments in our skin. They make skin a yellowish color when we eat too many carrots and oranges. In people with darker skin, too much carotene cannot be seen because of the melanin pigment.

## SKIN

- Skin is our body's largest organ. It keeps our body safe from chemicals, disease, and ultraviolet light. It also helps keep our bodies at just the right temperature, and lets us have a sense of touch. A HUGE network of nerve endings tells our brain how things feel when we touch them.
- Our skin is made up of three layers (see image on page 24). The very top layer of skin (what we see) is the epidermis. It protects the two layers below and the rest of our body. It's made of dead skin cells and it's waterproof! It's as thick as a piece of paper at .004 inches (1/10 mm). Skin is thinner under our eyes and thicker on our back.
- The second layer of skin is the dermis. It has hair follicles, sweat glands, sebaceous (oil) glands, blood vessels, nerve endings, and a bunch of different kind of touch receptors.
- The third layer is the hypodermis. It is mostly fat.
- Blood vessels bring oxygen and nutrients to our skin cells. There are sebaceous glands in our skin (just like in our hair) that send out sebum, to oil and waterproof it.
- Our skin will absorb a good bit of the personal care products we use; so good to know what the ingredients are. (Our forehead and scalp absorbs chemicals 4 times greater than our forearms.)

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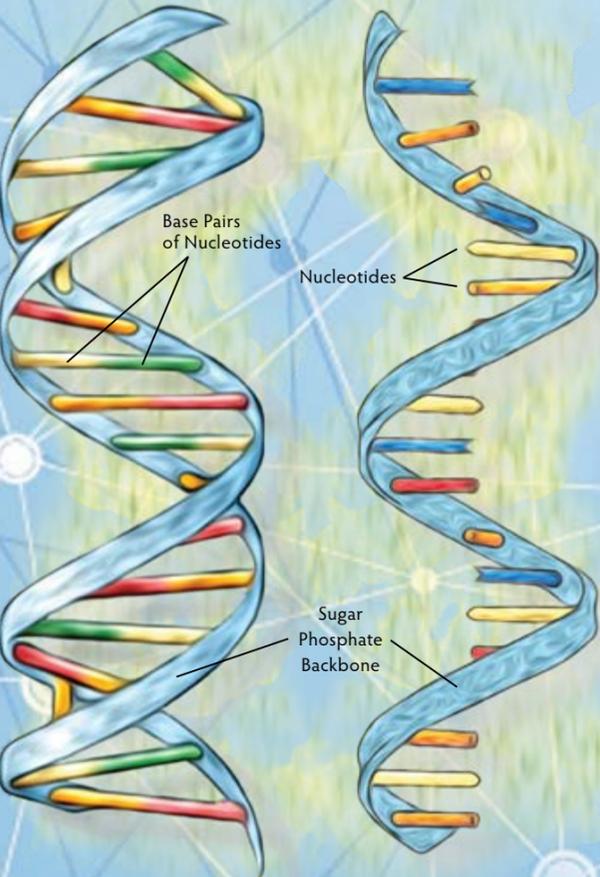
Material Found in Everything

# DNA

- Very Complex Molecule for Life to Happen
- DNA makes RNA makes Protein

## DNA, RNA & Proteins,

DNA is the most intelligent molecule in the world! Genetic info in humans differ from animals, plants, rocks... A fish cannot change into an amphibian without something changing in its genes. It would have to add some new info. (So a fish could not grow hair and have opposable thumbs.)



- DNA and RNA, along with proteins, are the living macromolecules that are necessary for all forms of life. There are four major macromolecules: proteins, carbs, lipids, and nucleotides.
- A molecule (mol-uh-kyool) is a group of atoms joined together, and macromolecules are molecules that have a very large number of atoms.
- A DNA macromolecule is a nucleotide made of three molecule sub-units: a base, a sugar, and a phosphate. There are four types of nucleotide bases: Guanine (G), Cytosine (C), Adenine (A), and Thymine (T). RNA uses Uracil (U) instead of thymine. Bases make-up both DNA and RNA.
- The sides of the DNA 'ladder' are where the joined chain of sugar and phosphate molecules are. The sugar and phosphate parts link the nucleotides magnetically together and make the sides of the DNA 'ladder'.
- Here is one sample DNA chain with complementary (matching) strands. As nucleotides join across the strand, they make a chain.

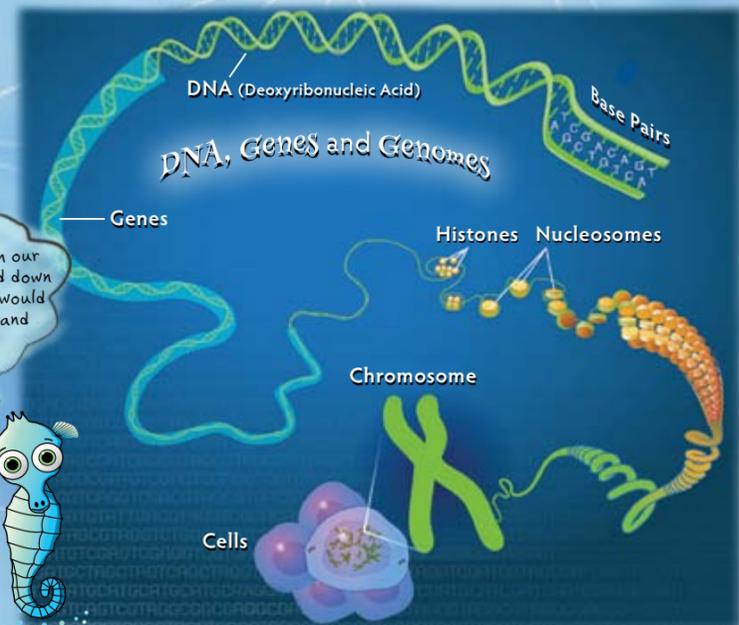
Main Strand: ATTGACTTGCCTGTATTGT  
 Matching Strand: TAACTG AACGGACATAACA

- Each base has a matching base: A will have T and G will have C. The order of these bases in a line is what decides our genetic code. The 'string' (sequence) of three nucleotides form a unit of genetic code in a DNA or RNA molecule and these letters are called a codon. A codon string could look like this: ATC GGA TGA GAC AAT CAG TAC
- A gene tells a cell how to make a distinct protein. Proteins are used by the cell to do fixed jobs, and to live and grow. Proteins are hard workers and we have different proteins which help us.
- A length that makes an instruction is a gene which tells a cell how to make a distinct protein. Proteins are tools used by the cell to do fixed jobs, and to live and grow. Proteins are hard workers and we have distinct proteins which help us. Some are building blocks; some are tools.
- Each cell does a different job, too. We can think of the cell kind of like a computer and the DNA is the program or code.
- DNA is a necessary molecule for life. Everything alive that was made by our Creator, was created with a unique (one-of-a-kind) DNA coding. And that is for EACH and every living thing.

(A genome is a person, animal, plant, or organism's whole set of DNA, including all of its genes.)

- DNA is short for Deoxyribonucleic (dee-AHK-see-ryebow-noo-klay-ik) Acid. RNA is short for Ribonucleic (ryebow-noo-klay-ik) Acid.
- DNA looks like a long twisted ladder which is called a double helix. RNA has a single helix.
- DNA was first found out only a short time ago in 1869 by Friedrich Miescher. He called it Nuclein.
- DNA is in nearly every living thing: amphibians, animals, birds, bugs, fish, flowers, food, humans, plants, reptiles, and trees... DNA can only be seen with a very strong microscope.

If DNA from our body were laid down in a single line, it would go to the sun and back MANY times!



• 99.9% of DNA is the same in everyone. It's that 0.1% which makes us all ONE-OF-A-KIND!

Found in Nucleus of Cells

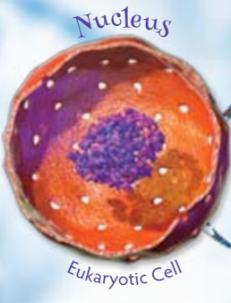
# Chromosomes

- Carries genetic information
- Very small thread-like shapes

Your eyes saw my unformed body; all the days ordained for me were written in your book before one of them came to be. Psalm 139:16



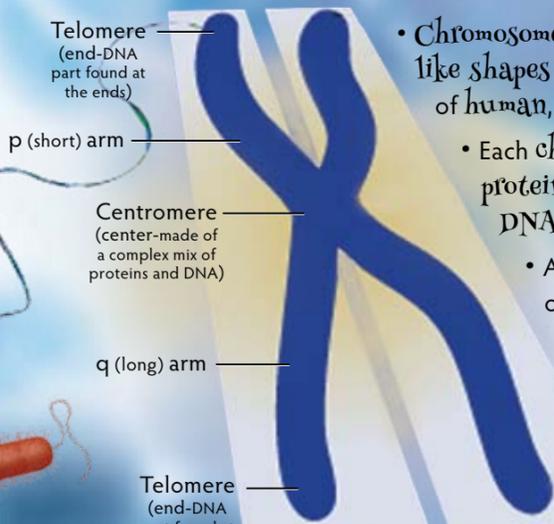
DNA is found in the chromosomes of the nucleus in a cell and it moves genetic info. RNA is found in the cell but not in the nucleus.



The nucleus of a cell is made up of basic proteins (Chromatin) and a mixture of nucleic acids (DNA & RNA).

Prokaryotic Cells have no nucleus; like bacteria.

## CHROMOSOME



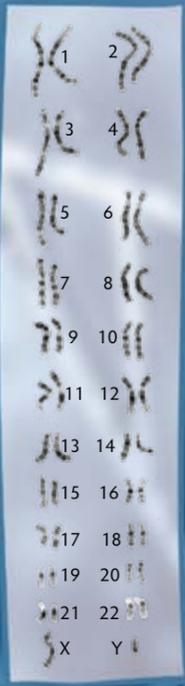
- Chromosomes are very small thread-like shapes found inside the nucleus of human, animal and plant cells.
- Each chromosome is made of protein and a single molecule of DNA (deoxyribonucleic acid).
- A human cell has 23 pairs of chromosomes. 22 pairs (autosomes) look the same in both females and males. The 23rd pair are sex chromosomes: X (female) & Y (male). XX XY

## CHROMOSOME

- A chromosome is an organized package of DNA found in the nucleus of the cell.
- DNA holds the precise directions that make each type of living creature unique and they travel from parents to their children.
- Females get an X chromosome from each parent. Males get an X from their mother and a Y from their father.
- Each and every one of us are one-of-a-kind!

## 4 DIFFERENT TYPES

- Acrocentric, Metacentric, Submetacentric, Telocentric
- Acrocentric - q arms longer than p arms
- Metacentric - p arm and q arm equal in length
- Submetacentric - centromere offset from center
- Telocentric - centromere at end of chromosome



**3 billion** base pairs (sets of genetic "letters") in our human genome.

Most of our cells have a nucleus that hold **46 chromosomes.**

The miracle of life at the microscopic, cellular level is a fascinating, spectacular, complex process! There are still new and wonderful things discovered about it all the time.

Each person usually has one pair of sex chromosomes in EACH cell.  
**Females:** Two X chromosomes  
**Males:** One X and One Y

**Chromatid:** Each of the two strands into which a chromosome divides along its length after a cell splits.  
**Chromatin:** Group of DNA and proteins that builds chromosomes within the cell nucleus.  
**Histones:** Group of basic proteins in chromatin.  
**Nucleosome:** Chromatin subunit made of a short length of DNA wrapped around a histone core. It is a ball of 8 histones.

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# Intriguing Info

## Divine Proportion of the Human Body

Divine Proportion is a mathematical ratio found by dividing a line into two parts so that the longer part divided by the smaller part is also equal to the whole length divided by the longer part.

It is found in the human body; face, arms, hands, fingers, legs, feet . . .

Before I formed you in the womb I knew you, before you were born I set you apart...  
Jeremiah 1:5

Divine Proportion is also known as Phi, Golden Ratio & Fibonacci Number



Top of Head-to-Waist + Waist-to-Foot

### Fibonacci Sequence

(Ties directly into Divine Proportion)

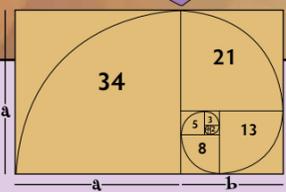
A simple series; it is a built-in numbering pattern in almost everything.

0, 1, 1, 2, 3, 5, 8, 13, 21, 34, 55 and so on forever.

Each number is the sum of the two numbers before it.

(So, 0+1=1, 1+1=2, 1+2=3, 2+3=5, 3+5=8, 5+8=13 . . .)

Here is a golden spiral and a golden rectangle.



Top of Head-to-Chin + Chin-to-Waist

Shoulder-to-Knee + Knee-to-Feet

Shoulder-to-Waist + Waist-to-Hip

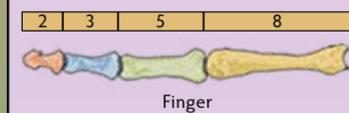
Elbow-to-Wrist + Wrist-to-Finger

Waist-to-Hip + Hip-to-Knee

All the extraordinary systems of our body work well together in the most incredible, ingenious design.

Phi = 1.618

The width of our arms stretched out is equal to the height of our whole body.



Divine Proportion appears in animals, math, nature, physics, science, and the universe.

Check out animals (ants, dolphins, honey bees, sand dollars, sea stars, sea urchins...), DNA molecules, faces, flower petals, hurricanes, pinecones, plants, seed heads, shells, spiral galaxies, tornadoes, tree branches, and so much more . . .

Vitruvian Man drawn in 1490 by Leonardo da Vinci

Phi is used in architecture, fashion, logos, websites & more...

## Our bodies are a complex mosaic of astounding, extraordinary design!

### BRAIN

Our brain is 75% water. At just 2% dehydration, it affects our attention, memory and reasoning.

### HAIR

There are 100,000+ hair strands on our head (for most). Hair is the fastest growing tissue in our body.

### EYES

Our eyes have 2,000,000+ working parts! We can see 2,500,000+ colors. Blinks 25,000+ times a day!

### EARS

Our ears are more than just vital for hearing; they also help us keep our balance.

### NOSE

Our nose has special cells which help us smell. Our nasal cavity floor is also the roof of our mouth.

### MOUTH

Humans are the ONLY living thing that cannot swallow (eat) and breathe at the same time.

### BODY

99% is made of oxygen, carbon, hydrogen, nitrogen, calcium, & phosphorus. There's 60+ elements total.

### SKIN

The thickest skin is found on the bottom of our feet. The thinnest skin is found on our eyelids.

### ARMS

The gripping power in our hands comes from muscles in our lower arm, joined by tendons to hand bones.

### HANDS

Each has more bones (27) than anywhere else in our body. They're very complex with bones, tendons, and nerves.

### LEGS

Our thighbone (femur) is our largest, longest, strongest bone. And second largest bone is our tibia (shinbone).

### FEET

A pair has 250,000 sweat glands that make about 1 cup (240 ml) of moisture a day.

# Glossary

### Abdomen

Includes all the digestive organs; small and large intestines, gallbladder, kidneys, liver, pancreas, spleen and stomach.

### Achilles Tendon

Largest tendon in the body that stretches from the heel bone to the calf muscle.

### Adenoids

Tissue at the back of the pharynx (throat) that work with tonsils to trap germs coming in through the mouth and nose.

### Adrenal Gland

Gland near the top of each kidney that make different hormones to help manage blood pressure, the immune system, metabolism, stress...

### Albino

Person or animal with no pigment (color) in skin and hair. Eyes may be pink.

### Alveoli

Tiny air sacs at the end of bronchioles in the lungs. Oxygen breathed in from the air passes through the alveoli and into the blood and then tissues of the body.

### Amygdala

Cells near the brain base.

### Amylase

Enzyme in saliva and pancreatic juice that break down starches and more into usable sugar.

### Anal Canal

End part of large intestine between the rectum and anus.

### Anemia

Lack of enough healthy red blood cells to carry plenty of oxygen to the body's tissues. Also called low hemoglobin, anemia can make one feel tired and weak.

### Antibodies

Proteins made by immune system to fight germs.

### Anus

The end of the gastrointestinal (GI) tract where poop come out.

### Anvil (incus)

Middle bone of a set of three small bones (auditory ossicles) in the middle ear. It gets vibrations from the hammer (malleus) and sends them to the stirrup (stapes).

### Aorta

Largest artery in the body. Carries blood full of oxygen from the left heart ventricle to other parts of the body.

### Aortic Valve

Keeps blood flowing in the right direction through the heart. Found between the left ventricle and aorta. One of four valves.

### Appendix

Tube-shaped sac attached to lower end of large intestine.

### Aqueous Humor

Clear fluid in the eye that flows between cornea and lens.

### Arteriole Artery

Small blood vessel that carries blood from an artery to capillary.

### Artery

Blood vessel that brings blood full of oxygen from the heart to the body tissues. Each artery has three layers.

### Atrium

Two of the four chambers of the heart. There are a left and right atrium. The left atrium gets blood full of oxygen from the lungs and empties the blood into the left ventricle. The right atrium gets blood low in oxygen from the body and then empties the blood into the right ventricle.

### Auditory Ossicles

Three bones in the middle ear; incus, malleus and stapes that send sounds from the air to the fluid-filled cochlea.

### Back Muscles

Skeletal muscles that support the vertebrae by tightening and relaxing, which create movement.

### Biceps Muscle

Large muscle on the front of the upper arm between the shoulder and the elbow. It pulls the forearm up and rotates it.

### Bile

Fluid made and released in the liver and stored in the gallbladder and helps with digestion by breaking down fats.

### Bladder

Hollow sac behind the pubic bone in the lower abdomen that holds urine (pee).

### Blood

Fluid that moves oxygen and nutrients to cells and carries away carbon dioxide and other waste products. Made up of red blood cells, white blood cells, platelets and plasma. Blood is necessary for life.

### Blood Cells

Contains many types; red blood cells, white blood cells and platelets.

### Blood Types

Decided by whether certain antigens are there or not in red blood cells. Eight major blood types; A+, A-, B+, B-, AB+, AB-, O+, O-.

### Bone Marrow

Spongy matter found inside bones. Makes red blood cells that carry oxygen, white blood cells that fight infections, and platelets that help blood clot.

### Brain

An organ that is the most complex part of the body. Controls functions of the body.

### Brain Freeze

Brief intense pain when eating or drinking something cold. Also known as Sphenopalatine Ganglioneuralgia.

### Brain Stem

Three parts; medulla oblongata, midbrain and pons. Connects the rest of the brain to the spinal cord and controls messages between the brain and to the rest of body. Controls heart rate, blood pressure, breathing, eating, sleeping and more. Beneath the cerebrum and in front of the cerebellum.

### Bronchi

Airways that lead from the trachea (windpipe) into the lungs, then branch off to reach the alveoli.

### Bronchioles

Branch of air tubes in the lungs that carries air to the alveoli.

### Buccinator Muscle

Flat, thin muscle in the cheek wall.

### Capillary Vessel

Smallest blood vessel in the body that carries blood between the arterioles and venules.

### Carbon Dioxide

Colorless, odorless gas formed during breathing, animal and plant matter decay or burning fossil fuels.

### Carpals

Eight small bones that make up the wrist in the hand.

### Cecum

Pouch that forms the first part of the large intestine. Connects the small intestine to the colon.

### Cerebellum

Controls balance, coordination and movement. Below cerebrum at the back of the brain.

### Cerebrum

The thinking part of the brain. Controls muscle functions, emotions, speech, thought, learning, reading, and writing. Largest part of the brain and has a right and left hemisphere.

### Chest Muscles

In charge of moving the arms up and down and across the body.

### Chromosome

Found inside the nucleus of a cell. Made up of protein and DNA and has a lot of genes which decides our traits: eye and hair color, height and more.

### Chyme

Thick semifluid mass of partly digested food and secretions. Formed in the stomach then sent out into the small intestine.

### Cilia

Very tiny (microscopic) hairlike vibrating strands on tissue cells which help move things along.

### Coccyx

Also known as the tailbone. Small triangular bone that joins with the sacrum and usually has four fused vertebrae (bones).

### Cochlea

Located in the inner ear. Changes sounds into nerve messages and sends them to our brain.

### Colon

Longest part of the large intestine from the cecum to the rectum. Rids body of waste.

### Conception

When a sperm cell from a fertile male joins an egg cell from a female that may lead to being pregnant for the female.

### Cones

Special cells in the retina of the eye that gives color vision and sharp central vision. There are about 6 million cones in each human eye.

### Cornea

Transparent layer over the front of the eye that lets light in. When light hits the cornea, it refracts (bends) the light onto the lens.

### Deoxygenated Blood

[dee-aak-suh-juh-nay-tuhd] Blood that is low in oxygen.

### DNA (Deoxyribonucleic Acid)

[dee-ahk-see-rye-bow-noo-clay-ik] Very complex molecule found inside each of our billions of cells. Contains hereditary info about how a living thing will look and function.

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**Deltoid Muscles**

Main muscle of the shoulder that help to raise the arm sideways.

**Dermis** [dur-muhs]

Second skin layer. Includes blood vessels, nerve endings, hair follicles, and sweat glands.

**Diaphragm** [di-uh-fram]

Large dome-shaped muscle for breathing. Found at the bottom of the chest and beginning of the stomach. When we breathe in it gets smaller and flattens and the chest cavity gets bigger.

**Divine Proportion**

Also known as Fibonacci Sequence. Unique order found in almost everything; animals, body, DNA, flowers, galaxies, plants, shells and more. A mathematical pattern where each number is equal to the sum of the two numbers before it (e.g.: 1, 1, 2, 3, 5, 8, 13, 21, 34, 55, 89, 144...).

**Duodenum** [duo-dee-nuhm]

First part of the small intestine right beyond the stomach. Leads to the jejunum.

**Eccrine Glands** [ek-rin]

Glands found in the skin that make us sweat to help control body temperature.

**Embryo** [em-bree-oh]

The beginning of life and early stages of growth for a baby. When cells, major organs and body parts are being formed.

**Endomysium** [en-doe-my-zee-uhm]

Connective tissue that covers each muscle fiber. It also has capillaries, nerves and vessels.

**Epidermis** [eh-puh-dur-muhs]

Outer skin layer. Tough and waterproof, protects the body from harmful things and gives skin its color mainly by melanin.

**Epiglottis** [eh-puh-glaa-tuhs]

Leaf-shaped flap of cartilage behind the tongue, at the top of the larynx (voice box).

**Epimysium** [eh-puh-mee-see-uhm]

Connective tissue that goes around the entire muscle tissue.

**Esophagus** [eh-saa-fuh-guhs]

Tube that carries food from the pharynx (throat) to the stomach.

**Exocrine Gland** [ek-suh-krin]

Gland that releases matter through a duct. Includes earwax, tears, milk, spit, oil and sweat.

**Extensors**

A muscle that extends or straightens a body part.

**Fascicle Muscle** [fa-suh-kl]

Bundle of skeletal muscle fibers encircled by perimysium, a connective tissue.

**Femur (thighbone)** [fee-mr]

Upper bone of the leg and longest bone in the human body.

**Fetus** [fee-tuhs]

A developing baby inside the female of a species.

**Fibula** [fib-yuh-luh]

Outer of the two bones of the lower leg or hind limb.

**Foramen Magnum** [fr-ay-muhn]

Large hole at the skull base through which the spinal cord enters to link to the brain. Allows blood vessels, connective tissue, fluid, nerves,

**Gallbladder**

Small pouch under the liver that stores bile made by the liver. The bile is then let go into the duodenum of the small intestine.

**Gastric Acid**

Also known as stomach acid. Watery, colorless fluid made by the stomach lining and helps break down food for easier digestion. Made up of hydrochloric acid, potassium chloride and sodium chloride.

**Gastrocnemius Muscle**

Calf muscle that flexes the foot and the knee.

**Genes** [jeeenz]

Made up of DNA. They carry information that gives us our physical traits passed on to us by our parents; eye color, curly or straight hair, hair color and more.

**Glia Cells** [glee-uhl]

Found in the nervous system. They surround neurons to keep them apart.

**Gluteal Muscles** [gloo-tee-uhl]

Large, fleshy muscles of the buttocks. Found from the back of the pelvic girdle (hipbone) to the top of the femur (thighbone).

**Groin Muscles**

Muscles between the abdomen and the thigh on either side of the public bone.

**Hammer (malleus)**

Outermost bone of a set of three small bones (auditory ossicles) in the middle ear.

**Hamstring Muscles**

Muscles at the back of the leg between the hip and the knee.

**Heart**

Muscular organ that works day and night and pumps blood through the blood vessels of the circulatory system.

**Hemoglobin** [hee-muh-glow-bn]

Protein inside red blood cells. Gives blood its red color. Carries oxygen and carbon dioxide through the blood.

**Hepatic Artery** [huh-pa-tuhk]

Artery that supplies blood full of oxygen to the liver, gallbladder, pancreas, stomach and duodenum.

**Hepatic Vein**

Vein that drains blood low in oxygen from the liver back to the inferior vena cava to the heart.

**Hippocampus** [hih-puh-kam-pus]

Complex brain structure set in the temporal lobe below the cerebral cortex. Part of brain linked mostly with short-term and long-term memory.

**Homeostasis** [ho-mee-o-stay-suhs]

Ideal balance of the body; blood pH, blood sugar, body temperature and more.

**Hormones** [hor-mownz]

Chemical messengers in the body that use the bloodstream to move to organs and tissues to do certain things. There are 50+.

**Humerus** [hue-mr-uhs]

Largest and only bone found in the upper arm that goes from the shoulder to the elbow. Allows for arm movements like lowering and raising the arms, moving the arm front and back, bending the elbow, shoulder joint rotation and more.

**Hyoid** [hi-oyd]

U-shaped floating bone found between the tongue base and voice box (larynx). Helps for breathing and swallowing and it is in the ideal spot in the human body for humans to speak.

**Hypodermis** [hi-po-dur-muhs]

Third skin layer. It's made of fat and connective tissue.

**Hypothalamus** [hi-puh-tha-luh-muhs]

Inside the brain and it keeps up the body's internal balance. Makes hormones that control blood pressure, body temp, heart rate, hunger, thirst & more.

**Ileum** [ill-ee-uhm]

Third part of the small intestine and joins to the colon.

**Inferior Vena Cava**

Large vein that moves blood low in oxygen from the lower body and stomach back to the right atrium of the heart.

**Insulin** [in-suh-lin]

Hormone made by cells in the pancreas that help control the body's blood sugar (glucose) levels after eating.

**Iris**

Muscle that is the colored part of the eye and helps control the pupil size to let more light into the eye in dim light or less light into the eye in bright light.

**Jejunum** [juh-joo-nuhm]

Second part of the small intestine and helps to better digest food.

**Kidneys**

Pair of organs on either side of the spine, just below the rib cage in the back. It filters waste materials out of the blood and passes them out of the body as urine (pee).

**Large Intestine** [in-tes-tin]

Last part of the digestive system that has the cecum, colon, rectum and anal canal.

**Larynx (voice box)** [lair-inks]

Inside the throat and has the vocal cords. Used for breathing, swallowing and talking.

**Latissimus Dorsi**

[luh-ti-suh-muhs dor-see] Largest muscle in the upper body. A back muscle that gives a wide range of movement.

**Lens**

Behind the iris and pupil in the eye. Focuses light rays through the vitreous humor (clear gel) to the retina at the back of the eye.

**Liver**

Found beneath the diaphragm. Filters blood coming from the digestive tract before passing it through the body and does hundreds of other needed tasks.

**Lungs**

Pair of spongy, air-filled organs found on either side of the chest. They bring oxygen into the body and remove carbon dioxide and other waste gases out of the body.

**Lymph Nodes** [limf knowdz]

Bean-shaped bumps that are a part of the body's immune system. They work as filters to remove germs that could harm the body.

**Masseter Muscle** [mass-uh-tr]

Muscle found in the cheek and jaw to help with biting and chewing food.

**Melanin** [meh-luh-nuhn]

The pigment that gives skin, eyes and hair their color. If your cells make more, then skin, eyes and hair color will be darker.

**Menstruation** [men-stray-shn]

Also known as a period. Normal bleeding that happens to a girl or woman monthly from shedding of the uterus lining. Menstrual blood and tissue flows from the uterus through the cervix and out the vagina.

**Metacarpals**

Bones in the hand between the finger bones (phalanges) and the wrist bones (carpals) that help the fingertips touch the thumb.

**Metatarsals**

Bones in the foot between the toe bones (phalanges) and the ankle bones (tarsals) and helps with the foot arch.

**Mitral Valve**

Flap in the heart that stops blood flowing the wrong way. Separates the two chambers (atrium and ventricle) of the left side of the heart. One of four heart valves.

**Molecules**

Made of atoms held together by chemical bonds. One example would be water, H2O; two hydrogen atoms and one oxygen atom. Another would be DNA.

**Muscle Fiber**

Single cell of a muscle. Together they can move the arms and legs and tissues.

**Neck Muscles**

Support and keep our head, neck and the upper part of the spine stable. There are 26 neck muscles.

**Nephrons** [neh-fraanz]

Complex microscopic cells found in the kidneys. They clean the blood, get rid of waste and balance minerals if they get low.

**Nerves**

Carries messages to and from the body, so the brain can simplify them and respond. There are 31 pairs of nerves in the body.

**Neurons** [nur-aanz]

Also called nerve cells. Unique cells designed to send electrical impulses to other nerve cells, gland cells or muscle. They come in many shapes and sizes.

**Neurotransmitters**

[nur-o-tranz-mit-trz] The body's chemical messengers in the nervous system. They send information between neurons by crossing a small gap (synapse). They affect heart rate, blood pressure, mood and more.

**Nucleotides** [noo-klee-oh-tidez]

Group of molecules that are the building blocks of DNA & RNA.

**Optic Nerve**

Joins the eye to the brain. Along with the lens and the retina, it turns light and electrical signals into images that we can see.

**Oxygenated Blood**

[aak-suh-juh-nay-tuhd] Blood that is full of oxygen.

**Pancreas** [pang-kree-uhs]

Long, flat gland that makes enzymes that are released into the small intestine to help with digestion and it helps balance blood sugar. Found in the abdomen behind the stomach.

**Parathyroid Glands**

[peh-ruh-thai-royd] Keeps the right levels of calcium and phosphorus in the body. These four small glands are next to two thyroid glands in the neck.

**Patella (knee cap)** [puh-teh-luh]

Bone in front of the knee joint that joins with the thighbone (femur) to protect the knee joint as it bends and straightens.

**Pectoralis Muscles** [pek-tr-a-luhs]

Large muscles that join the front chest walls with the upper arm and shoulder bones to help move the shoulders.

**Pericardial Cavity**

[pair-eh-car-dee-aal] Fluid-filled space between the two layers of the pericardium which helps heart movement.

**Pericardium**

[pair-eh-car-dee-um] Double-walled sac that surrounds the heart to protect it and to keep it moist. Keeps the heart in place within the chest.

**Perimysium** [peh-ree-my-see-uhm]

Covering of connective tissue that groups muscle fibers into bundles (fascicles).

**Period (menstruation)**

Normal bleeding that happens to a girl or woman monthly from shedding of the uterus lining. Menstrual blood and tissue flows from the uterus through the cervix and out the vagina.

**Periosteum** [peh-ree-oh-stee-uhm]

Membrane tissue that helps repair and grow bones. It covers every bone in the body.

**Peristalsis** [peh-ruh-staal-suhs]

Wave-like motion of muscles that move food through the digestive tract by tightening and relaxing.

**Peyer's Patch**

Tissue found in the small intestine and make up an important part of the immune system. There are about 100 found in the human body.

**Phalanges** [fuh-lan-jeez]

Finger bones and toe bones. There are fourteen bones on each hand and foot.

**Pharynx (throat)** [fair-inks]

Hollow tube that starts from the back of the nose, goes down the neck and ends at the top of the trachea (windpipe) and esophagus. Used for air, food and liquid.

**Pineal Gland** [pi-nee-uhl]

Gland that is the origin of melatonin, a hormone found naturally in the body and helps with the sleep-wake cycles.

**Pituitary Gland** [puh-too-uh-ter-ee]

Gland at the base of the brain that makes and releases hormones into the bloodstream. It tells other glands to stop making and releasing hormones.

**Placenta** [pluh-sen-tuh]

Female organ that develops in the uterus during pregnancy. The placenta is attached to the uterus wall and a baby's umbilical cord grows from the baby's stomach to the placenta. The umbilical cord brings oxygen, nutrients and life-giving blood to a growing baby and removes waste from the baby's blood.

**Plantar Fascia** [plan-taar fey-shuh]

Flat band of tissue that joins the heel bone to the toes. Helps in walking and supports the foot arch.

**Plasma**

The fluid part of blood and made of 90% water and contains nutrients, protein, hormones, and waste.

**Platelets**

Tiny cells that help blood clot to stop the bleeding and to help wounds heal.

**Poop**

Also called feces. The solid waste left over from eating food. Poop comes out the anus.

**Pregnancy**

When a fertilized egg has stuck (implanted) in the uterus (womb) wall. When a baby is developing in the female body.

**Pulmonary Artery**

[puhl-muh-neh-ree] Artery that carries blood that is low in oxygen to the lungs.

**Pulmonary Circuit**

Moves blood low in oxygen from the heart to the lungs where it picks up blood full of oxygen and then goes back to the heart.

**Pulmonary Valve**

One of the four valves in the heart. Moves blood low in oxygen toward the lungs. Found between the right ventricle and the pulmonary artery.

**Pulmonary Vein**

Carries blood full of oxygen from both lungs and drain into the left atrium. There are four veins.

**Pupil**

Black dot in the center of the eye that decides how much light is let into the eye. It opens in dim light and closes in bright light.

**Quadriceps** [kwaa-druh-seps]

Group of four muscles found on the front and sides of the thigh. They help to stand, walk, run, keep kneecap stable, straighten the knee and maintain posture.

**Radius** [ray-dee-uhs]

Main bone in the forearm (lower arm) found on the thumb side. It provides strength and works with the ulna to let the wrist and hand to rotate.

**Rectum** [rek-tum]

The end of the large intestine (6-8 in·15-20 cm) that stores solid waste (poop) until it leaves the body through the anus.

**Rectus Abdominis Muscle**

[rek-tuhs ab-daa-muh-nuhs] Also known as ab muscles. Pair of straight muscles that run up and down the front of the abdomen.

**Red Blood Cells**

Blood cells that carry oxygen. They start in the lungs and move to the heart, bringing oxygen to all parts of the body.

**Renal Artery** [ree-nuhl]

Blood vessel that carries blood full of oxygen from the heart to the kidneys.

**Renal Vein** [ree-nuhl]

Blood vessel that returns blood to the heart from the kidneys.

**Respiratory** [reh-spr-uh-tor-ee]

United design of organs: bronchial tubes, larynx (voice box), lungs, nose and trachea (windpipe) that take in and let out oxygen and carbon dioxide.

**Retina** [reh-tuh-nuh]

Found at the back of the eye. Changes the light coming into the eye into electrical signals which are sent to the brain where these signals are realized as images. Uses special cells called rods and cones to bring light into each eye to help see.

**Rib Cage**

Part of the chest area of the skeleton and is made up of curved bones called ribs. It protects the heart, lungs, liver and large vessels.

**RNA (Ribonucleic Acid)**

[rye-bow-noo-clay-ik] Complex molecule much like DNA. It carries the orders for making proteins for the body.

**Ribs**

Flat, long, curved bones which form the rib cage. There are 12 pairs (24) in humans. The rib is the only bone in the body that can regrow and repair itself if a part of it is damaged.

**Rods**

Special cells in the retina of the eye that help peripheral vision (seeing objects and movement off to the side) and to see in low light. There are about 120 million rods in each human eye.

**Rotator Cuff**

Group of muscles and tendons that go around the should joint. Keeps the top of the humerus bone in the shoulder socket.

**Sacrum** [say-kruhm]

Wedge-shaped bone found below the spine. Joined with the coccyx and has five fused vertebrae (bones) by age 30.

**Saliva (spit)** [suh-lie-vuh]

Clear liquid made by salivary glands in the mouth. It helps with chewing and swallowing and is made 24 hours a day, every day.

**Salivary Glands** [sa-luh-very]

Tissues in the mouth that makes and gives off saliva (spit).

**Sarcolemma** [saar-ko-leh-muh]

Clear tubular covering that is around our muscle fibers.

**Sarcoplasmic Reticulum**

[saar-ko-plaz-mick ruh-ti-kyuh-luhm] Complex system of skeletal muscle cells that are special tubes (endoplasmic reticulum) which make, package, and move proteins and fats.

**Scanning Electron Microscope**

Also called SEM. A microscope that uses a beam of electrons instead of light, and gives a detailed image of an object.

**Sclera** [sklur-uh]

The white part of the eye. It keeps the shape of the eyeball.

**Serratus Muscles** [sir-aa-tuhs]

Fan-shaped muscles below the arm pits on either side of the body. Helps move the scapula (shoulder blade) forward and up.

**Shin Muscles**

Found in the front part of the shin bone of the lower leg; from below the knee and all the way down to the top of the foot.

**Small Intestine**

Tube-like organ that carries food from the stomach to the large intestine. It has three parts; duodenum, ileum and jejunum.

**Spleen**

Found on the left side of the abdomen near the stomach. Filters blood, stores red and white blood cells and platelets. Makes white blood cells to fight off bacteria, germs and viruses.

**Stapedius Muscle**

[stay-puh-dee-uhs] Muscle in the middle ear and the smallest muscle in the human body. It keeps the stapes (stirrup) steady.

**Sternocleidomastoid Muscle**

[stur-nuh-klay-duh-maa-stoyd] Helps to rotate the head and bend and stretch the neck.

**Sternum (breastbone)**

Long flat bone in the upper middle of the chest. Along with the ribs it protects the heart, lungs, liver and large vessels.

**Stirrup (stapes)** [stur-uhp]

Innermost bone of a set of three small bones (auditory ossicles) in the middle ear. Smallest and lightest bone in the human body. Relays sound vibrations from the incus (anvil) to the inner ear.

**Stomach**

Muscular organ found on the left side of the upper abdomen. It gets food from the esophagus.

**Superior Vena Cava**

Large vein that moves blood low in oxygen from the head and lower body back to the right atrium of the heart.

**Synapse**

A small gap between two neurons that share info with each other to keep the nervous system working well.

**Systemic Circuit**

Moves blood full of oxygen from the left heart ventricle to all the body's cells.

**Tarsals** [taar-slz]

Seven small bones that make up the ankle in the foot.

**Tears**

Clear liquid sent forth from the tear glands. A tear film covers the cornea every time the eyes blink. This tear film keeps the eye wet, helps to focus clearly and keeps the eyes safe from dirt, dust and infections.

**Tendon**

Tissue that joins a muscle to other body parts, mainly bones, sometimes muscles. it helps us to move the bones or other parts of the body.

**Tensor Tympani Muscle**

[ten-sr tim-puh-nee] Muscle in the middle ear and joins to the hammer (malleus) bone. It reduces loud noises like chewing, shouting or thunder.

**Thymus** [thai-muhs]

Organ found behind the sternum (breastbone) in the upper chest and also in front of the lower neck. Grows T-cells that help fight infections.

**Thyroid** [thai-royd]

A butterfly-shaped gland found below the Adam's apple and in front of the trachea (windpipe). Takes iodine from food and changes it to hormones that are needed for all cells to work normally. Affects metabolism, growth and development and body temperature.

**Tibia (shinbone)** [ti-bee-uh]

Larger and strong bone in the lower leg. Joins the knee with the ankle bone. Weight bearing bone.

**Tibialis Anterior Muscle**

[ti-bee-ay-luhs an-tier-ee-ur] Found on the upper part of the tibia and helps us bend the foot in many directions.

**Tongue** [tuhng]

Muscular organ in the mouth which helps us chew and swallow food. Covered with moist, pink mucosa tissue. Tiny bumps (papillae) on the tongue have thousands of taste buds that lets us enjoy different flavors: bitter, salty, savory, sour and sweet.

**Tonsils** [taan-slz]

Pair of soft tissue masses at the back of the pharynx (throat) that work with adenoids to trap germs coming in through the mouth and nose.

**Trachea (windpipe)** [tray-kee-uh]

Tube just under the larynx and goes down behind the sternum. The trachea closes when food or liquid goes down the throat.

**Transversus Abdominis Muscle**

[tranz-vur-suhs ab-daa-muh-nuhs] Found in the front of the abdominal wall. Protects internal organs and holds them in place.

**Trapezius Muscle**

[truh-pee-zee-uhs] Starts at the neck base, then across the shoulders and to the middle of the back. Helps with posture, side bending, and turning the head.

**Tricep Muscle** [traï-seps]

Large muscle on the back of the upper arm between the shoulder and the elbow. Helps straighten the forearm.

**Tricuspid Valve** [traï-kuhs-puhd]

One of the four valves in the heart. Heart valve found between the atria (upper heart chambers) and the ventricles (lower heart chambers).

**Ulna** [uhl-nuh]

Bone in the forearm (lower arm) found on the pinkie finger side. It provides strength and works with the radius to let the wrist and hand to rotate.

**Urea** [yur-ee-uh]

Made in the liver and is waste from broken down proteins.

**Ureter** [yur-uh-tr]

Narrow tube that moves urine from the kidneys to the bladder. Humans have two ureters.

**Urethra** [yur-ee-thruh]

Tube that carries urine (pee) from the bladder to outside the body.

**Urine (pee)** [yur-uhn]

Liquid made by our kidneys, then passes through the ureters, is stored in the bladder and exits through the urethra.

**Uterus (womb)** [yoo-tr-uhs]

Organ inside a woman's body where a baby grows.

**Vein**

Large blood vessel that carries blood low in oxygen from the body back to the heart.

**Ventricle** [ven-trih-kl]

Two of the four chambers of the heart. There are a left and right ventricle. The left ventricle pumps blood full of oxygen out to the body. The right ventricle pumps blood low in oxygen to the lungs.

**Venule Vein** [ven-yool]

Small blood vessel that drains blood low in oxygen from the capillaries to the veins.

**Vertebrae** [vur-tuh-bray]

Thirty-three single bones that join with each other to form the spinal column: cervical, thoracic, lumbar, sacrum (sacral) and coccyx.

**Vessel**

Tube that moves blood through the body. Arteries are blood vessels that take blood away from the heart. Veins are blood vessels that give blood back to the heart. Capillaries are tiny blood vessels that connect the arteries and veins and they also give blood to tissues.

**Villi** [vil-lai]

Finger-like bumps in the inner wall of the small intestine. Help absorb nutrients from food. They are microscopic (very teeny) and there are millions of them.

**Vitreous Humor** [vi-tree-uhs]

Clear gel that gives us the round shape of the eyeball.

**Vocal Cords**

Two small bands of muscle within the larynx (voice box) that always move to make the voice.

**Water**

Molecule that has three atoms: two hydrogen and one oxygen (H2O). Water is necessary for life.

**White Blood Cells**

Blood cells that fight infections.

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**A**

abdominal (stomach) muscles, 4

oblique muscle, 5

rectus abdominus muscle, 5

achilles tendon, foot, 5

adenoids, immune system, 16

adrenal glands, kidneys function, 11 location, 10

albino, albinism, 25

alveoli, air sac, lungs, 14-15

amygdala, location, 12

amylase, enzyme function and pronunciation, 9

anal canal, large intestine, function, 9

anemia, 25

antibodies, immune system, 17

anvil (incus), ear, 2

anus function, 9 location, 8

aorta artery, heart blood speed, 7 description, 6

aortic heart valve, 6

appendix, large intestine function and location, 9 immune system, 16

aqueous humor, eye, 13

arm bones, 2-3 fact, 28 muscles, 4-5

arteriole artery, 7

artery, 6

atrium, 6

auditory ossicles incus (anvil), malleus (hammer), stapes (stirrup), 2

**B**

baby fetus, drawing (1510), 21 how they are made, 21, 23 info, 20

balance food and water, 9 stress, 10

ball and socket joint, shoulders, hips, 3

basophil, white blood cell, 16

Bible verses 1 Corinthians 6:19-20, 23 1 Corinthians 12:12, 18 Ephesians 1:7, 6 Galatians 3:28, 25 Genesis 1:27, 10 Genesis 1:31, 17 Genesis 2:7, 15 Jeremiah 1:5, 28 Job 10:11, 4 Philippians 4:6-7, 10 Proverbs 15:17, 8 Proverbs 17:22, 2 Psalm 139:13-14, 21 Psalm 139:16, 27 Romans 12:12, 12

biceps muscle, upper arm, 4-5

bile, 9

bile salts, 9

bladder size, 19 urinary system, 18

blood amount, 7 kidneys, 19 longevity, 7 pressure, 19 vessels, 4, 7, 24-25

blood cells amount, 6 design, 6 parts of, 6 production, 6 red and white, 3

blood types, 6

bone marrow, tissue teeth, 2 creation, 3 immune system, 16 kidneys, 19 production, 7

bones, 2-3

brain cerebrum (cortex), parts, 13 fact, 28 hippocampus, location, 12 neurons and weight, 12 stem, medulla oblongata, midbrain, pons, 13

bras, how to fit, 21

breastbone (sternum), chest, 6

breasts, 20-21

breathing deep, 10, 14, 15 exhalation / inhalation, 14-15

bronchioles, lungs, 14-15

bronchus / bronchi, lungs, 14-15

buccinator muscle, head, 5

**C**

calf, lower leg, 5

capillary vessel length, 7 size, 6-7

carbon dioxide, breathing, 14-15

cardiac muscle, heart, 4

carpals, wrists, 2

cecum, large intestine, function and location, 9

cells amount in body, 16, 25 blood, 3, 6-7 eye, 13

cerebellum, brain, 13

cerebrum, 13

cervical vertebrae, neck, 2-3

chemical balance, 19

chest muscles, 4 thoracic, 2-3

chromosomes, 27

chyme, small intestine function and pronunciation, 9

cilia, 15

circulatory system (cardiovascular) fascinating facts, 7 muscles, 4 system, 6

clavicle (collarbone), 2

cochlea, inner ear, 2

colon, large intestine ascending, 9 descending, 9 function, 9 sigmoid, 9 transverse, 9

condyloid joint, wrist, 3

coccyx vertebrae (tailbone), 2-3

compact bone, 3

cones, eye, 13

1 Corinthians 6:19-20, 23

1 Corinthians 12:12, 18

cornea, eye, 13

cranial bones, skull ethmoid, frontal, occipital, parietal, sphenoid, temporal, 2

cranium, skull, 2

creation, 2-28

cuticle, hair, 24

**D**

dehydration, 28

deltoid muscles, upper arm, 4-5

deoxygenated blood (oxygen-poor), 7

dermis, second skin layer, 25

diaphragm, muscle function, 5, 15 location, 6, 14-15

digestive system, food into fuel fascinating facts, 8 function, 8 muscles, 4

digestive tract description, 8 length, 8

dilator muscle, eye, 5

DNA (Deoxyribonucleic Acid) function, 26 in hair, 24

duodenum, small intestine function, 9 location, 9 pronunciation, 9 size, 8

**E**

ear fact, 28 small bones, middle ear, 2

eardrum, 2

eating (ingestion), 8

eccrine duct and gland, 24

enamel, tooth, 2

endocrine system, glands digestive, 11 function, 10-11 glands, 10-11 hormones, 10-11

Ephesians 1:7, 6

eosinophil, white blood cell, 16

epidermis, top skin layer, 24-25

epiglottis function and pronunciation, 9 location, 15

esophagus, tube to stomach function, 9 location, 8, 9 size, 8

ethmoid, skull bone, 2

excretory muscles, 4

exercise, 10, 15, 17, 19

exocrine glands ceruminous (earwax), lacrimal (tears), mammary (milk), mucus, salivary (spit), sebaceous (oil), sweat, 24

extrinsic muscle, arm, 5

eye close-up, 13 fact, 28 function and parts, 13 melanin, 25

eye muscles dilator, iris sphincter, 5 ciliary, eyelid, extra-ocular, iris, 13

**F**

face muscles, 4

facial bones irregular, lacrimal, mandible, maxillae, nasal, nasal conchae, palatine, vomer, zygomatic, 2

feet muscles, 4-5

femur, upper leg, 2-3

fetus (baby), drawing (1510), 21

Fibonacci sequence, 28

fibula, lower leg, 2

filaments, 4

fingerprints, 24

fingers, tendons / ligaments, 4-5

flat bones, ribs, scapula, sternum, 2

flexor muscles, lower arm, 4

floating bone, hyoid 2

food, healthy balance in, 9 immune system, 17 kidneys, 19

foot bones, 2-3 fact, 28 muscles, 4-5

foramen magnum, skull opening, 2

frontal skull bone, 2 lobe, brain, 13

**G**

Galatians 3:28, 25

gallbladder function and pronunciation, 9 location and size, 8

gastric acid (juices) function and pronunciation, 9

gastrocnemius muscle, calf, 5

Genesis 1:27, 10

Genesis 1:31, 17

Genesis 2:7, 15

genes, genome, 26-27  
giraffe, neck bones, 3  
glands  
  function, 11  
  location, 10, 24  
glial cells, 12  
gliding (plane) joint, foot, 3  
gluteal muscles (buttock), 5  
grateful, 10  
groin muscle, 4  
growth and development, 10

**H**  
hair,  
  about, 24  
  DNA, 24  
  fact, 28  
hammer (malleus), ear, 2  
hamstrings muscle, upper leg, 5  
hand  
  bones, 2-3  
  fact, 28  
  muscles, 4-5  
head  
  bones, 2-3  
  muscles, 4-5  
hearing, 2  
heart  
  beat, 4  
  blood speed, 7  
  chambers, 6  
  design, 6  
  diagram, 7  
  fascinating facts, 7  
  hormone, 11  
  kidneys, 19  
  muscles, 4  
  valves 4, 6  
hemoglobin, red blood cell  
  protein, 6  
  skin color, 25  
hepatic artery and vein, 7  
hinge joint, elbows and knees, 3  
hippocampus, location, brain, 12  
homeostasis, balance of body, 10  
hormones  
  function, 10-11  
  glands, 11  
human body  
  bones, 2-3  
  fascinating facts, 28  
  fact, 28  
  muscles, 4-5  
  pencil drawing (1490), 28  
  proportion of, 28  
  temperature, 4  
humerus, upper arm, 2  
hyoid bone, below jaw, 2  
hypodermis, third skin layer, 25  
hypothalamus  
  function, 11  
  location, 10, 12

**I**  
ileum, small intestine  
  function and pronunciation, 9  
  location and size, 8  
  vitamin B-12, absorption, 9  
immune system, fights germs  
  appendix, 16  
  bone marrow, 16  
  dendritic cells, 17  
  liver, 16

immune system, cont.  
  lymph nodes, 16  
  Peyer's patch, 16  
  spleen, 16  
  thymus, 16  
  tonsils and adenoids, 16  
incus (anvil), ear, 2  
inferior vena cava vein, 6  
inner ear, cochlea, 2  
insulin, pancreas hormone, 8  
integumentary system  
  glands, hair, nails, nerves,  
  skin, 24  
intestines  
  blood flow, 7  
  large, function, 8-9, 13  
  large, location and size, 8  
  large, water absorption, 9  
  muscles, 4  
  small, function, 8-9, 13, 17  
  small, location and size, 8  
  small, villi lining, 8  
intrinsic muscle, hand, 5  
iris, eye, 13  
iris sphincter muscle, eye, 5  
irregular bones, facial bones,  
  vertebrae, 2

**J**  
jejunum, small intestine  
  function and pronunciation, 9  
  location and size, 8  
Jeremiah 1:5, 28  
Job 10:11, 4  
joints  
  ball and socket, condyloid,  
  gliding (plane), hinge, pivot,  
  saddle, 3

**K**  
kidneys  
  blood flow, 7  
  design, 19  
  fascinating facts, 19  
  hormone, 11  
  size and weight, 19  
  urinary system, 18  
kneecap (patella), 2-3

**L**  
lacrimal, facial bone, 2  
larynx (voice box), 14-15  
latissimus dorsi muscle, arm, 5  
laughter, 6, 10  
left brain, cerebrum (cortex), 13  
leg  
  blood flow, 7  
  bones, 2-3  
  fact, 28  
  muscles, 4-5  
lens, eye, 13  
life, miracle of, 27  
ligaments, bone to bone  
  connective tissue, 4-5  
liver  
  blood flow, 7  
  function, 8-9  
  immune system, 16  
  location, 8  
long bones, femur, fibula,  
  phalanges, radius,  
  tibia, ulna, 2  
lower body, blood flow, 7

lumbar vertebrae  
  lower back, 2-3  
lungs (respiratory),  
  location, 6, 15  
  function, 14-15  
  pencil drawings (1840), 14  
  pulmonary circuit, 7  
  respiratory (breathing), 14-15  
  systemic circuit, 7  
lymphatic system, immune system  
  arteriole, 17  
  B-cells / T-cells, 17  
  capillaries, 17  
  lymph / lymphocytes, 17  
  lymph node, 17  
  venule vein, 17  
  vessels, afferent / efferent, 17  
lymph nodes, immune / lymphatic  
  system, 16-17  
lymphocytes, white blood cell, 16

**M**  
macrophage, white blood cell, 16  
malleus (hammer), ear, 2  
mandible, facial bone, 2  
manubrium, sternum, 2  
marrow, 2-3  
masseter muscle, head, 5  
maxilla, facial bone, 2  
melanin  
  hair, 24  
  skin, 25  
menopause, 21, 23  
menstruation (period), 20  
metabolism, 10  
metacarpals, hand, 2  
metatarsals, foot, 2  
microbes, amount, 24  
middle ear, small bones of  
  incus (anvil), malleus (hammer),  
  stapes (stirrup), 2  
minerals, 3  
mitral heart valve, 6  
monocyte, white blood cell, 16  
mood, 10  
mouth  
  fact, 28  
  function, 9  
  location, 8  
moving (exercise), 10, 15  
muscles  
  abdominal, biceps, cardiac,  
  chest, deltoid, face, flexors,  
  groin, neck, quadriceps,  
  shin, 4  
  achilles tendon, back, calf,  
  extensors, gluteals,  
  hamstrings, stapedius,  
  tensor tympani, trapezius,  
  triceps, 5  
  breathing and intercostal, 14  
  contraction, 4  
  fibers, 4-5  
  function and pronunciation, 5  
  smooth, 5  
muscular system, muscles, 4

**N**  
nasal cavity, 14  
nasal, facial bone, 2  
nasal conchae, facial bone, 2  
neck  
  cervical, 2-3  
  muscles, 4

nephrons, filters, 18-19  
nerve fibers, 13  
nerves, urine (pee), 19  
nervous system, cells / nerves  
  autonomic and somatic, 12-13  
  axon fibers, 12  
  central, 12-13  
  dendrites, 12  
  eye muscles, 13  
  fascinating facts, 13  
  function, 12-13  
  glial cells, 12  
  limbic, 12  
  motor neuron cell body, 12  
  nerves and neurons, 12  
  neurotransmitters, 12  
  parasympathetic and  
  sympathetic, 12-13  
  peripheral, 12-13  
  synapse, 12  
neutrophil, white blood cell, 16  
nose, fact, 28  
nucleotides, adenine, cytosine,  
  guanine, thymine, uracil, 26

**O**  
occipital  
  skull bone, 2  
  lobe, brain, 13  
ovary gland, female  
  function, 11, 20-21  
  location, 10, 20-21  
oxygen, breathing, 14-15  
oxygenated blood  
  (oxygen-rich), 7

**P**  
palatine, facial bone, 2  
pancreas, gland  
  function, 8-9, 11  
  location, 8, 10  
  pronunciation, 9  
  size, 8  
parathyroid glands  
  function, 11  
  location, 10  
parietal  
  skull bone, 2  
  lobe, brain, 13  
patella (knee cap), 2-3  
pectoralis muscle, arm, 5  
pee (urine), 18-19  
pelvic girdle, 2  
people, 25  
pericardial cavity, heart, 6  
period (menstruation), 20  
periosteum, membrane, 3  
peristalsis, function, 8-9, 18  
Peyer's patch, tissue, 16  
phalanges  
  finger and toe bones, 2  
pharynx (throat)  
  function, 9, 14  
  location, 8-9, 14-15  
  pronunciation, 9  
Philippians 4:6-7, 10  
pineal gland, brain  
  function, 11  
  location, 10  
pituitary gland, brain  
  function, 11  
  location, 10  
pivot joint, neck, 3

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placenta, female organ  
  hormone, 11  
plantar fascia ligament, foot, 5  
plasma, blood cell design, 6  
platelets, cells in blood  
  blood cell design, 6  
  bone marrow, 3  
poop, 9  
procreation (reproduction), 10, 23  
protein fibers, 3  
proteins  
  molecule, 26-27  
Proverbs 15:17, 8  
Proverbs 17:22, 2  
Psalm 139:13-14, 21  
Psalm 139:16, 27  
pulmonary  
  artery, 6  
  heart valve, 6  
  vein, 7, 15  
  pupil, 13

**Q**  
quadriceps, lower leg, 4

**R**  
radius, lower arm, 2  
rectum, large intestine  
  function and pronunciation, 9  
  location, 8  
rectus abdominis muscle, torso, 5  
red blood cells  
  amount, 6  
  blood cell design, 6  
  bone marrow, 3  
  longevity, 7  
  production, 6  
renal artery and vein, 7  
reproduction (procreation), 10, 23  
reproductive system  
  muscles, 4  
reproductive system, female,  
  fascinating facts, 21  
  function, 20-21  
reproductive system, male,  
  function, 22-23  
respiratory system, breathing  
  fascinating facts, 15  
  function and parts, 14-15  
retina, eye, 13  
ribcage, 2, 6  
ribs, 2-3, 14-15  
right brain, cerebrum (cortex), 13  
RNA (ribonucleic acid), 26  
rods, eye, 13  
Romans 12:2, 12  
rotator cuff muscle, shoulder, 5

**S**  
sacrum, vertebrae, pelvis, 2-3  
saddle joint, thumb, 3  
saliva (spit), mouth  
  function and pronunciation, 9  
salivary glands, face, 8, 24  
sarcolemma, muscle fiber, 4  
sarcolemmal reticulum, 4  
scanning electron microscope  
  images (SEM)  
  red blood cells, 7  
  hair shaft, 24  
scapula (shoulder blade), 2  
sclera, eye, 13  
serratus muscle, aids ribs, 5

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sesamoid bones, patella  
  (kneecap), 2  
shin muscles, lower leg, 4  
short bones, ankles and wrists, 2  
shoulder blade (scapula), 2  
skeletal muscles, 4  
skeletal system, bones  
  fascinating facts, 2  
  function and parts, 2  
skeletal muscle  
  blood vessel, bone,  
  endomysium, epimysium,  
  fascicle, muscle fiber,  
  perimysium, tendon, 4  
skeleton  
  joints, 3  
  protects, 2  
skin  
  colors, 25  
  fact, 28  
  hormone, 11  
  layers, 24-25  
skull, 2-3  
smooth muscles, 4  
Sophie the Seahorse  
  3-4, 7, 9-10, 13-14, 16, 19-20,  
  23-24, 26, 28,  
sound waves, 2  
sphenoid, skull bone, 2  
spinal cord  
  function, 12  
  parts, 13  
spine, 3  
spit (see saliva)  
spleen, immune system, 16  
spongy bone, 3  
stapedius muscle, ear, 5  
stapes (stirrup), ear, 2  
sternocleidomastoid muscle,  
  neck, 5  
sternum (breastbone), chest, 2  
stirrup (stapes), ear, 2  
stomach  
  acid (gastric juices), 9  
  blood flow, 7  
  function, 8-9  
  location, 8, 14  
  muscles, 4, 8  
  size, 8  
stress, 10, 17  
superior vena cava vein, 6  
sweat  
  fact, 28  
  glands, 24-25  
systemic circuit, 7

**T**  
tarsals, foot, 2  
teeth, 2, 14  
temporal  
  skull bone, 2  
  lobe, brain, 13  
tendons, muscle to bone  
  connective tissue, 4  
tensor tympani muscle, ear, 5  
testicle gland, male  
  function, 11, 22-23  
  location, 10, 22-23  
thoracic, vertebrae, chest, 2-3  
throat (pharynx)  
  function, 9  
  location, 8-9  
thymus, immune system, 16-17

thyroid glands  
  function, 11  
  location, 10  
tibia, lower leg, 2  
tibialis anterior muscle, foot, 5  
toenails, 24  
tongue muscles, 5  
tonsils, throat, immune, 16  
trachea  
  function, 2, 9, 14-15  
  location, 14-15  
  pronunciation, 9  
transversus abdominis muscle,  
  torso, 5  
trapezius muscle, shoulder, 5  
triceps muscle, arm, shoulder, 5  
tricuspid heart valve, 6

**U**  
ulna, lower arm, 2  
urea, urinary system, 18  
ureters  
  size, 19  
  urinary system, 18  
urethra  
  size, 19  
  urinary system, 18  
urinary system  
  bladder, kidneys, ureters,  
  urethra, 18  
  fascinating facts, kidneys, 19  
  function, 18  
  nephrons, 18-19  
urine (pee)  
  ammonia, blood cells,  
  creatinine, hormones,  
  minerals, salts, toxins, urea, uric  
  acid, urochrome, water, 18  
  kidneys, 19

**V**  
valves, heart, 6  
vein, 6-7  
ventricle, 6  
venule vein, 7  
vertebrae, 2  
vertebral column, 3  
villi  
  lining and size,  
  small intestine, 8-9  
  function and pronunciation, 9  
vitamin B-12, absorption, 9  
vitreous humor, eye, 13  
vocal cords, 15  
voice box (larynx), 14-15  
vomer, facial bone, 2

**W**  
water  
  absorption, 9  
  amount, 9, 19  
  immune system, 17  
  kidneys, 19  
  urinary system, 18  
weight, human head, 2  
white blood cells (leukocytes)  
  blood cell design, 6  
  bone marrow, 3, 15  
  types, 16  
windpipe (see trachea)

**Z**  
zygomatic, cheekbone, 2

## Author's Note

To **OPEN LINKS** in New Window > On Mac: Shift-Option-Command-Click. On iPad: Shift-Command.  
On iPhone: Select Link and Hold-Copy-Paste in New Window.

*This* book tugged at this grandma's heart and wouldn't let go. Wonderful World shows just a wee bit of what has been made in this incredible world, with its beauty, complexity, design, order, and symmetry. I realize not everyone will agree with this and that's okay. Let's respect our difference of opinion and be kind to each other and leave it at that.

For me, the splendor of this world with its detail, variety, and sheer volume of subject matter displays the Glory of God from **Romans 1:20**. It's truly magnificent; humans, animals, birds, bugs, food, herbs, spices, flowers, plants, trees, planets, universe, stars (God knows them all by name, **Psalms 147:4**), and so much more. I'm amazed by the beauty of color, brilliance of sight, exquisiteness of hearing, and nummy fragrant smells...*think flowers come springtime or cinnamon rolls.*

Though this world is wonderful and creation may point us to God, it doesn't give us eternal life, which comes only through Jesus Christ. God loved us so much that He sent Jesus to die for our sins and through Christ's blood, God made a way for us to get to heaven for eternity. We don't have to work for anything, just simple belief in Jesus (**1 Corinthians 15:1-4**), who offers forgiveness of sins and gives us the gift of eternal life (**John 14:6**). We all have sinned (**Romans 3:23**) but there is not a sinner so vile that if they would come in simple faith believing, God's grace is enough to save. Through Jesus all things were made (**Colossians 1:15-16, John 1:1-3**). Heaven is going to be amazing, awesome, breathtaking (**1 Corinthians 2:9**)... and I don't want to miss it.

I would like to express my gratitude to my hubby, daughters', and family's support and to my precious father and mother-in-law and sister who has made this book endeavor possible (see you in heaven sis!). Thank you to the many folks who saw me through this book and who provided encouragement, feedback, and support; Reenie Campbell, Tracey Finck, Ardy Hollermann, Deborah Ann Kirkeeide (check out her artist page), Dennis L., Lynette Lindberg and Andrea Peterson. A HUGE Thank You to all of you sweet people who signed up for the Book Updates and were there for the long haul! There's too many to mention, but you know who you are. I thank you for the humor, help, and prayers. Thank you so much to Henry L. Richter, PhD. for your gracious foreword, I appreciate your kindness. And also, thank you Pamela Humphrey for proofreading this book and giving valuable feedback. Thanks Kelly Thomas, geneticist/teacher, for helping with the Reproductive Systems and DNA/Chromosomes pages; yikes, a difficult task indeed. I appreciate all your help Sharon G. with proper names, punctuation, and getting me through the A & P-Anatomy & Physiology.

I beg forgiveness of those whose names I have failed to mention. I apologize for any grammatical or spelling errors; any errors that remain are my sole responsibility (I'm only human, I make mistakes).

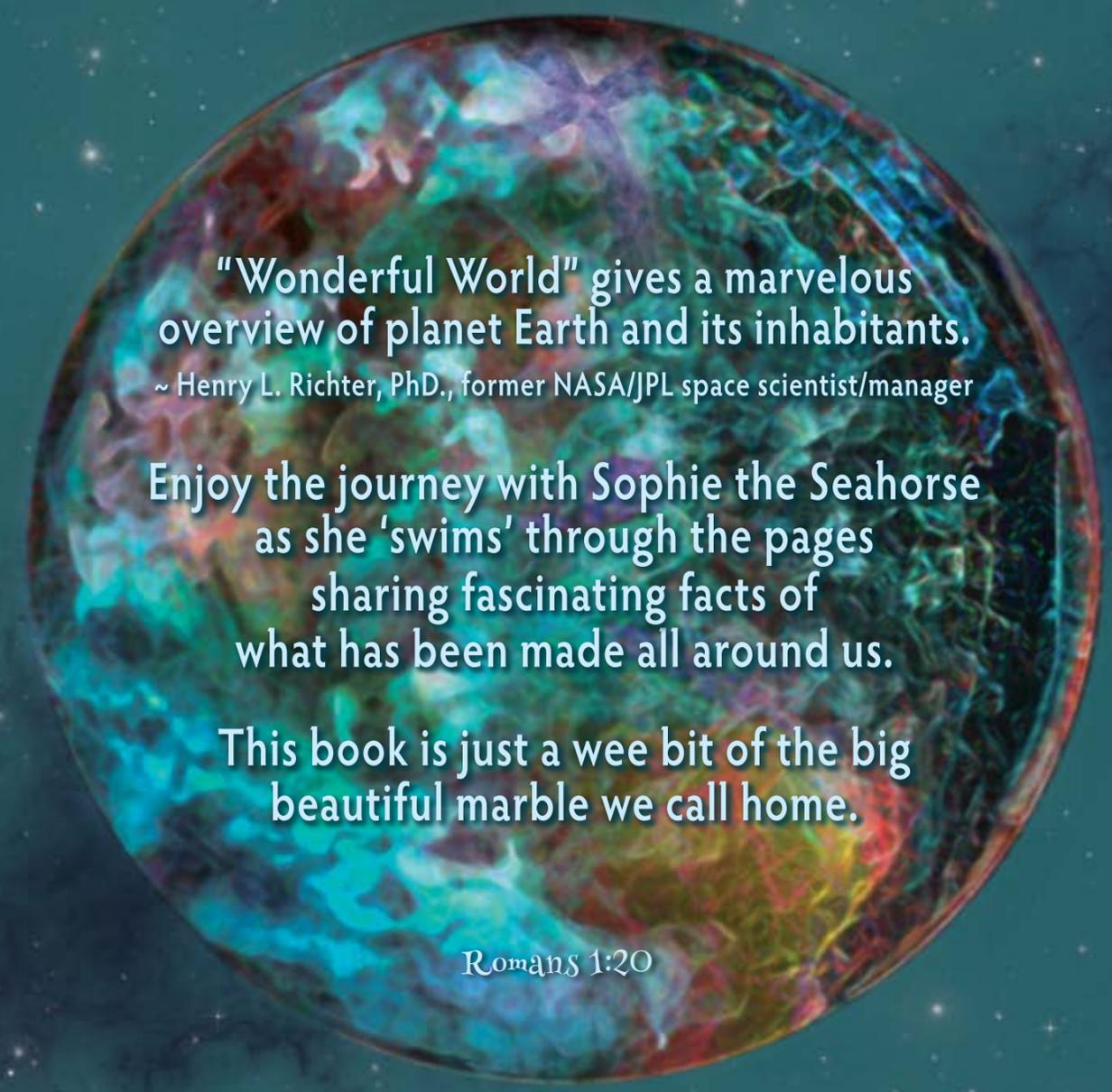
Love & blessings,  
Jacque [said like Jackee]

### METRIC CONVERSION CHART

to convert	to	multiply by	to convert	to	multiply by
Inches	Centimeters	2.54	Gallons	Liters	3.78541
Centimeters	Inches	0.393701	Liters	Gallons	0.264172
Centimeters	Feet	0.0328084	Miles/hr.	Kilometers/hr.	1.60934
Feet	Centimeters	30.48	Kilometers/hr.	Miles/hr.	0.621371
Feet	Meters	0.3048			
Ounces	Grams	28.3495			
Grams	Ounces	0.035274	<b>to convert</b>	<b>to</b>	<b>do this</b>
Pounds	Kilograms	0.453592	Fahrenheit	Celsius	-32 then +1.8
Kilograms	Pounds	2.20462	Celsius	Fahrenheit	x1.8 then +32

# Wonderful World

*A learning resource book exploring creation*



"Wonderful World" gives a marvelous overview of planet Earth and its inhabitants.

~ Henry L. Richter, PhD., former NASA/JPL space scientist/manager

Enjoy the journey with Sophie the Seahorse as she 'swims' through the pages sharing fascinating facts of what has been made all around us.

This book is just a wee bit of the big beautiful marble we call home.

Romans 1:20

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