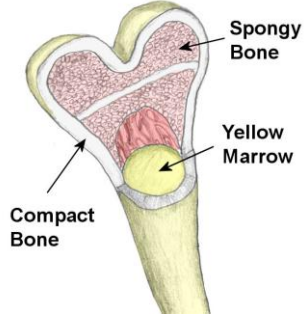


# 5.2 Bones Study Guide by Hisrich

1. How does the skeletal system assist with protection in the body?

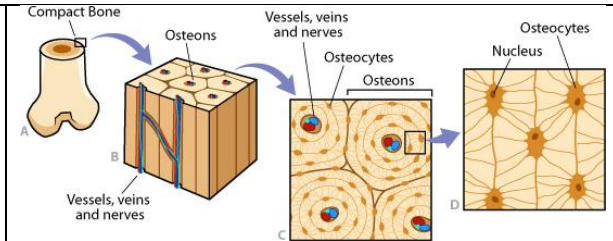
The **bone marrow** produces blood, including the white blood cells that are part of the immune system. Bones also protect internal organs (heart, lungs, brain) from damage.

2. How does the structure of **compact bone** differ from the structure of **spongy bone**?

<p><b>Compact Bone</b></p> <p>Forms the outside of bones and most of the <b>diaphysis</b> (“<i>nature of being across</i>” shaft), osteons are close together</p>	 <p>The diagram shows a cross-section of a long bone. The outer layer is labeled 'Compact Bone'. The inner ends are labeled 'Spongy Bone'. The central cavity is filled with 'Yellow Marrow'.</p>	<p><b>Spongy (cancellus) Bone</b></p> <p>Found inside short, flat &amp; irregular bones and in the <b>epiphyses</b> (“<i>nature of being on top</i>” ends) of long bones.</p>
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3. How does the overall structure of bone provide great strength and flexibility, but keep bone from being too bulky and heavy? <http://science.howstuffworks.com/life/6830-human-body-bone-strength-video.htm>

Bone is stronger than concrete (pound for pound) and stronger than any other natural material. Cells are hollow and have paper-thin walls, giving bone its light-weight structure. Calcium and phosphorus give bone its rigid strength, but ~ 1/2 of bone mass is soft and alive, allowing bones flexibility to bend. Every bone cell is replaced every 7 seven years, keeping bone strong.



4. What is an X-ray?

An x-ray is an invisible type of high energy radiation. Soft tissues are made of smaller atoms and don't absorb x-ray photons well. The calcium atoms in bone are larger and absorb x-rays better. That causes a picture of the bones to show up.

5. What are the different types of bone **fractures** and how are they identified on X-rays?

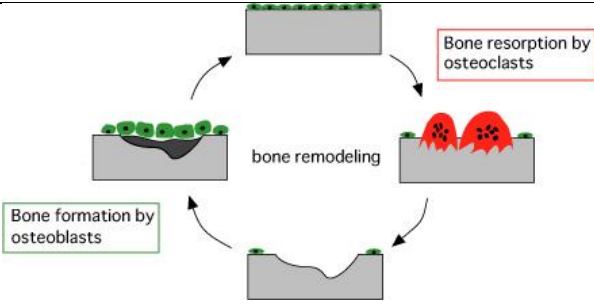
Comminuted	Depression	Compression
Break in several pieces, splintered/crushed	Fragment is pushed down, typically due to a blow to the skull	Collapse of vertebra, often due to osteoporosis (“holes in bones”) or tumors or to being ejected from an ejection seat
Transverse	Oblique	Spiral
Complete break at right angle to bone axis, often from direct blow	Break has curved/sloped pattern, often caused by slanted blow	Caused by twisting force on bone, such as rotation to leg during skiing
Greenstick	Open	Closed
Incomplete, bone is bent & partially broken, most common form in kids	Bone breaks through skin—greater risk of infection	Bone breaks, but doesn't puncture skin

6. How can damage to a bone affect other human body systems?

Fat tissue from the bone marrow can leak into the blood, causing fat embolism syndrome, which can cause lung problems and seizures. If the skin breaks (open fracture), pathogens can enter the body and cause an infection.

7. What is **bone remodeling**? 8. How do **osteoblasts** and **osteoclasts** assist with **bone remodeling** and overall bone homeostasis?

**Bone remodeling** happens throughout life and is also called “bone metabolism.” It’s the process by which bone tissue is removed and new tissue forms (ossification). It increases after a **fracture** and is the method by which the bone heals. **Remodeling** is rapid early in life (100% replacement during first year of life) and then slows (10% yearly for adult). An imbalance in the process can lead to bone diseases like osteoporosis.

<p><b>Osteoblasts</b>  (“bone sprouts”)</p>	 <p>The diagram illustrates the bone remodeling cycle. It shows a cross-section of bone with a central gap labeled 'bone remodeling'. On the left side of the gap, green cells labeled 'Osteoblasts' are shown forming new bone tissue, with a box labeled 'Bone formation by osteoblasts'. On the right side, red cells labeled 'Osteoclasts' are shown breaking down bone tissue, with a box labeled 'Bone resorption by osteoclasts'. Arrows indicate the continuous nature of the process.</p>	<p><b>Osteoclasts</b>  (“bone breakers”)</p>
<p><b>Osteoblasts</b> form new bone tissue, to replace those reabsorbed by <b>osteoclasts</b>—produce the organic part of bone (osteoid), made mostly of <b>collagen</b> protein, that inorganic minerals crystalize around—many of them turn into mature <b>osteocytes</b></p>		<p><b>Osteoclasts</b> break down and reabsorb bone tissue—come from monocytes in <b>bone marrow</b>, release minerals (calcium phosphate) and other stored materials (like growth factors)</p>

9. What is the relationship between bone remodeling and blood calcium levels? 10. How do hormones assist in the maintenance of healthy bone and the release of calcium to be used in other body processes?

Low blood calcium	High blood calcium
Glands in the parathyroid release <b>parathyroid hormone</b> (PTH), causing <b>osteoclasts</b> to break down bone matrix and release calcium ions into blood.	C cells in the thyroid release <b>calcitonin</b> & that stimulates storage of calcium in bones

11. What are the four main stages of healing that occur after a bone fracture?

Inflammation	Soft <b>Callus</b> Formation	Hard <b>Callus</b> Formation	<b>Remodeling</b>
3-5 days	4 days-3 weeks	2 weeks-6-12 weeks	6-12 weeks +
There’s bleeding in the tissue and the trauma doctor must return bone fragments to place to stem blood flow. A mesh of blood clots between the fragments.	Fibroblast cells start to form <b>cartilage</b> to fill the gap—but it’s fragile, fracture must be kept immobile (sling or cast)—new blood vessels start to form	<b>Cartilage</b> begins to transform into woven bone. It takes longer for lower limbs than upper limbs. It’s controlled by release of calcium and phosphorus minerals into the cartilage, forming a hard <b>callus</b> over the fracture site. The end of this is called “fracture union.” Gentle weight bearing encourages this process, so removable cast walkers are suggested.	The body lays more hard <b>callus</b> than necessary during bone healing, enlarging the bone. After uniting, bone <b>remodeling</b> occurs and the bone shape becomes normal. The <b>osteoclasts</b> remove unneeded bone and <b>osteoblasts</b> lay bone where needed. Full weight-bearing exercise increases bone strength. Loosely organized woven bone gets replaced by highly organized Lamellar bone.

12. What lifestyle choices relate to the overall strength and protective properties of bone?

Good Diet	Physical Activity	Healthy BMI	Not Smoking	No Alcohol	Avoid glucocorticoids
Eat plenty of foods with calcium and vitamin D	Regular exercise strengthens bone	Healthy body weight (not too thin) reduces risk of osteoporosis	Smoking prevents the body from using calcium well & brings menopause earlier	Alcohol raises risk of osteoporosis	Avoid medicines (such as these) that cause bone loss