

Collagen

A complete primer.

Why it's important.

How it works.

How it can help you.



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Thanks again, and please enjoy the read!

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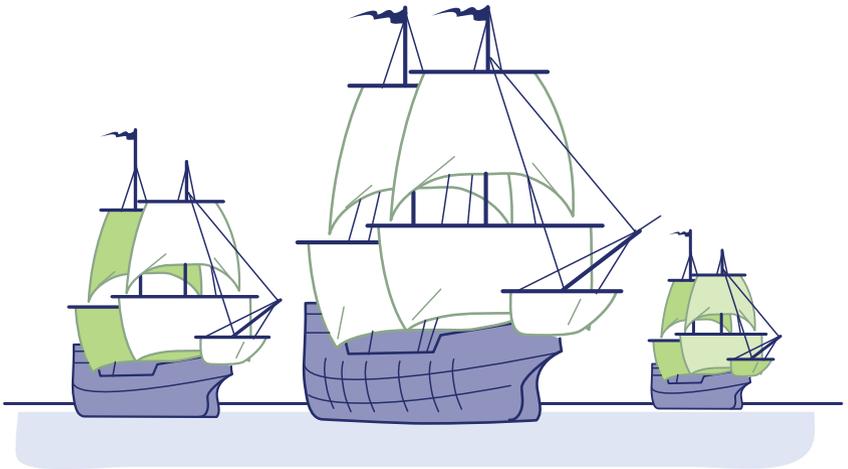
How it can help you.

What's inside

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Elixir of youth?

In 1513, Juan Ponce de León sailed with a fleet of three ships to what is now the coast of Florida. As legend goes, he was looking for the mythical fountain of youth. The Spanish explorer never found it.



But the rest of us have never stopped looking. With the global market for anti-aging products now worth well over C\$65 billion a year, we're committed to slowing down and even reversing the effects of time.

It's understandable. We're all getting older, and depending on our stage of the aging process, we may have begun to feel some of its effects. Dry, sagging skin. Deepening wrinkles. Creaking knees. Muscles that can't lift as much as they used to. Cuts that don't heal as quickly as they should. These effects, while normal, do put a damper on our intention to age gracefully. It's hard to stay physically active when physical activity actually hurts. And maintaining a healthy glow isn't easy when your skin seems determined to look dull.

One of the latest "elixir of youth" candidates you may have heard of is collagen. Its marketing promises are breathless: Erase fine lines from the inside out! Heal arthritis and joint

pain! Get longer, thicker hair! Improve gut health! And lose weight while you're at it!

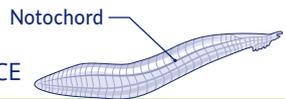


Naturally, you may be curious about these claims—as well as skeptical. How many of these marketing promises should we believe? How do we separate the science from the hype? And what is collagen, anyway?



A timeline of collagen

505 million BCE



Chordates begin to appear in the fossil record. Chordates are animals marked by the presence of a notochord at some point in their development—that is, a primitive backbone made of collagen.

What is collagen?

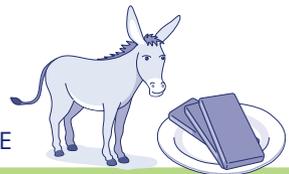
Collagen is the most abundant protein in the human body (and in all animals, actually). It's found throughout your body, from your teeth to your toenail bed, and pretty much everywhere in between: skin, muscle, cartilage, tendons, bones, organs, arteries, even your cornea. Three quarters of your skin's dry weight is collagen—and your skin is your largest organ. Of all the protein in your body, collagen makes up one third. It's safe to say that collagen is pretty important!

c. 6000 BCE



The oldest known glue in the world was made of collagen, and used by clever Neolithic people in ancient Israel. The collagen glue was discovered in 1998, in a cave near the Dead Sea.

c. 500 BCE



Ejjiao—or gelatin derived from the collagen in donkey hides—appears as an ingredient in traditional Chinese medicine, used to treat health concerns from anemia to aging skin.

A cultural history of collagen

Collagen does a lot for us. Over the years, we've learned that we can do a lot with it, too. Below are a few ways that collagen has been put to use by different cultures at different times.

A primitive adhesive

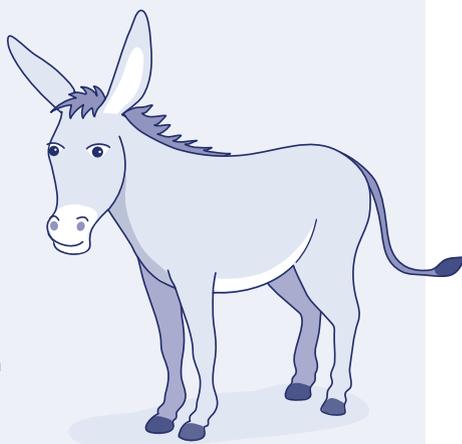
Collagen was used as glue by many cultures who would boil the skin, hides, bones, and tendons of animals to extract it. Egyptians 4,000 years ago used collagen as a binder in paint and possibly as furniture glue. About 1,500 years ago, Indigenous Americans used it to glue together horn, wood, and sinew to make bows. The oldest known glue in the world is made of collagen, and was discovered in Nahal Hemar Cave, near the Dead Sea in Israel. The glue was dated back to the Neolithic period, more than 8,000 years ago.

From ancient Chinese remedy to hot-ticket commodity

Chinese traditional medicine has used *ejiao*—collagen derived from donkey hides—for at least 2,500 years. It's said to improve blood circulation, treat anemia, boost blood cell counts, and maintain youthful skin. While it was once only accessible by the elite, today the *ejiao* business is booming, so much so that China's donkey population is dropping sharply.

Connective-tissue consommé, anyone?

Collagen has long been consumed by our ancestors, who would simmer animal bones and connective tissues into nourishing stocks. The traditional dishes of many cultures include collagen, from Inuit *muktuk* (made of whale skin and blubber) to European head cheese (boiled pig's-head meat, set in jelly). Waste not, want not!



1400s

Gelatin, which is derived from collagen and turns quivery when dissolved and cooled, begins to make an appearance in food dishes in the Middle East, then Europe, then America. This eventually leads to regrettable food fads (salads encased in gelatin in the 1950s) and enduring favourites (Jell-O, anyone?).

So collagen is a protein. But... what is protein?



You already know that cottage cheese, chickpeas, and sirloin steak are good sources of protein, but have you ever paused to think about what protein is?

Protein isn't just something you eat. It's also something you make. Your body breaks down the proteins in your food and uses these raw materials to build new proteins, including collagen. And you build a lot of it.

About 20% of your body is protein, and it's fundamental to life. Protein is

directly involved in all of the chemical processes going on in your body, in building and replacing your cells and tissues.

Without protein, you couldn't grow even a single cell in your body. It's no wonder that pregnant women are told to increase their protein intake to a minimum of 60 grams a day. Not getting enough protein during pregnancy can lead to major problems for the child down the road, from organ dysfunction in infancy to high blood pressure in adulthood.

Mid-1930s



Scientists discover that collagen has a regular structure at the molecular level. This understanding paves the way for future discoveries about collagen's properties and functions.

1955



G.N. Ramachandran, a physicist from Chennai, in the south of India, finds that collagen's structure is a triple helix—a braid of three polypeptide chains—which holds the key to collagen's incredible strength.

What do proteins do?

Our bodies contain many, many different proteins—somewhere between the tens of thousands and the billions, according to current estimates. Why so many? Humans are incredibly complex multicellular organisms, and there are many jobs to do within our bodies. Proteins happily take these on.

Some types of protein and their jobs

There are several different types of protein, some of which we'll touch on here. Which type of protein do you think collagen is?



Hormones

Hormones act as messengers from one cell to another. Take insulin for example: its job is to signal to cells when they can use glucose as energy, and when they should store it for use later.

Antibodies

Antibodies, or immunoglobulins, are another type of protein. Their job is to destroy harmful viruses and bacteria in our bodies.

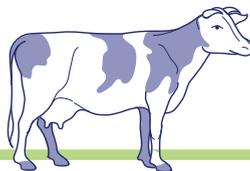


1970s



Hydrolyzed collagen (collagen broken down into amino acids that dissolve more readily) first appears in topical skin creams. Collagen's effectiveness as a skin cream is later debunked.

1980s



Bovine collagen (collagen derived from cows) is the first substance approved by the US Food and Drug Administration (FDA) for cosmetic injection.

Transport proteins

Transporters, like hemoglobin, carry the oxygen in red blood cells to all parts of the body, and ship carbon dioxide to the lungs to be exhaled when you breathe out.



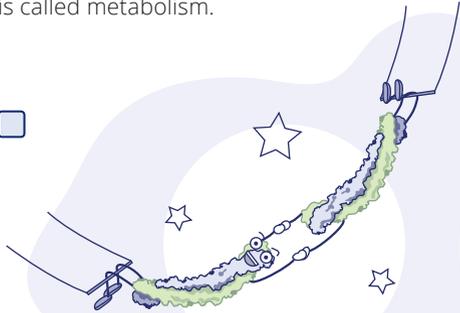
Enzymes

Think of enzymes as spark plugs. Enzymes catalyze, or speed up, the trillions of chemical reactions that occur in our bodies every second, from digesting food to creating new tissue to making new strands of DNA. These chemical reactions keep us alive, and the collection of these processes is called metabolism.



Structural proteins

Think of these as shaping proteins. They anchor our cells and give our tissues and organs their shape.



So which type is collagen?
If you guessed structural, you got it right!

You may be wondering: If there are so many different types of proteins with different jobs to do, what makes each of them a protein? The answer is really quite tiny.

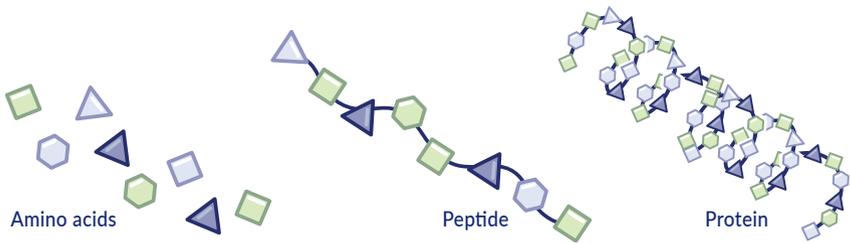
2000s



Hydrolyzed collagen, also known as collagen peptides, begins to be marketed as an antidote to aging skin, joint pain, bone loss, and more. Now, the peptides are ingested and absorbed whole, rather than applied to the skin.

The building blocks of protein

While there are many, many types of protein in our bodies, they are all made from the same ingredients: amino acids.



We mentioned that we eat protein and make protein in our bodies. When we eat a hamburger, tofu, or any other source of protein, we digest it into chunks of amino acids. Our cells then take these amino acids and combine them into amino acid sequences that our bodies can use. These amino acid sequences are called peptides. As they form bonds with other peptides, they get

larger and fold into more complex structures, which we call proteins.

All plant, animal, and human life is supported by just 20 amino acids. It's like the alphabet: with just 26 letters, we make all the words in the English language (and many other languages too). These words may be short or long, simple or complex.

Terms to know

As you read this guide, you'll come across terms you may not be familiar with, or haven't seen since high-school biology. We'll explain them as we go, but here are a few key ones to remember:

Collagen: The most abundant protein in the human body. It does everything from supporting cells to providing structure and tensile strength to tissues.

Tissue: Groups of cells that perform specific functions. The four types of tissue are muscle tissue, nervous tissue (brain, spinal cords, nerves), epithelial tissue (lining around organs and blood vessels), and connective tissue. Connective tissue's job is to

connect, separate, and support all other types of tissue. This type includes bone, ligaments, tendons, cartilage, and skin.

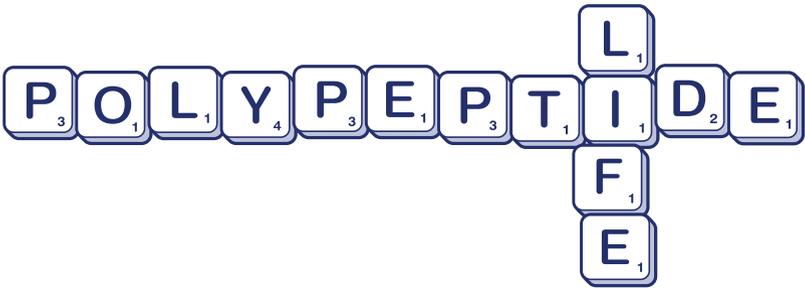
Protein: A family of large molecules (or macromolecules) involved in every chemical process essential to life. Every cell in the human body contains protein, and its basic structure is a chain of amino acids. We eat protein in our food, as well as make it in our cells.

Just like every word is a different combination of letters, every protein is a different sequence of amino acids, which are themselves collections of specific atoms. The protein's structure is based on how its amino acids interact with, or bond to, one another. The structure of collagen, for example, is a long triple helix: three polypeptide chains coiled around one another.

Because they're made up of so many different combinations of amino acids,

proteins come in many shapes and sizes. Some are globular, or rounded, like enzymes and antibodies. Others are fibrous, elongated proteins that play a protective and structural role in our bodies.

Collagen is a fibrous protein. As we'll learn, everything collagen does—keeping your skin firm to keeping your joints moving—depends on this structure.



Amino acid: A building block of proteins (kind of like beads on a necklace). All proteins are composed of amino acids, some of which our body makes, and some of which we get from food.

Peptide: A chain of amino acids that's shorter than a protein chain. Peptides contain between two and 50 amino acids, while proteins contain more than 50. A single collagen polypeptide chain contains 1,050 amino acids! Breaking down collagen into peptides allows your body to absorb it more easily.

Fibroblast: A specialized cell that produces, or synthesizes, collagen

and other proteins. Fibroblast-like cells in different tissues have different names—like chondrocytes, which synthesize collagen in our cartilage, and osteoblasts, which synthesize collagen in our bones.

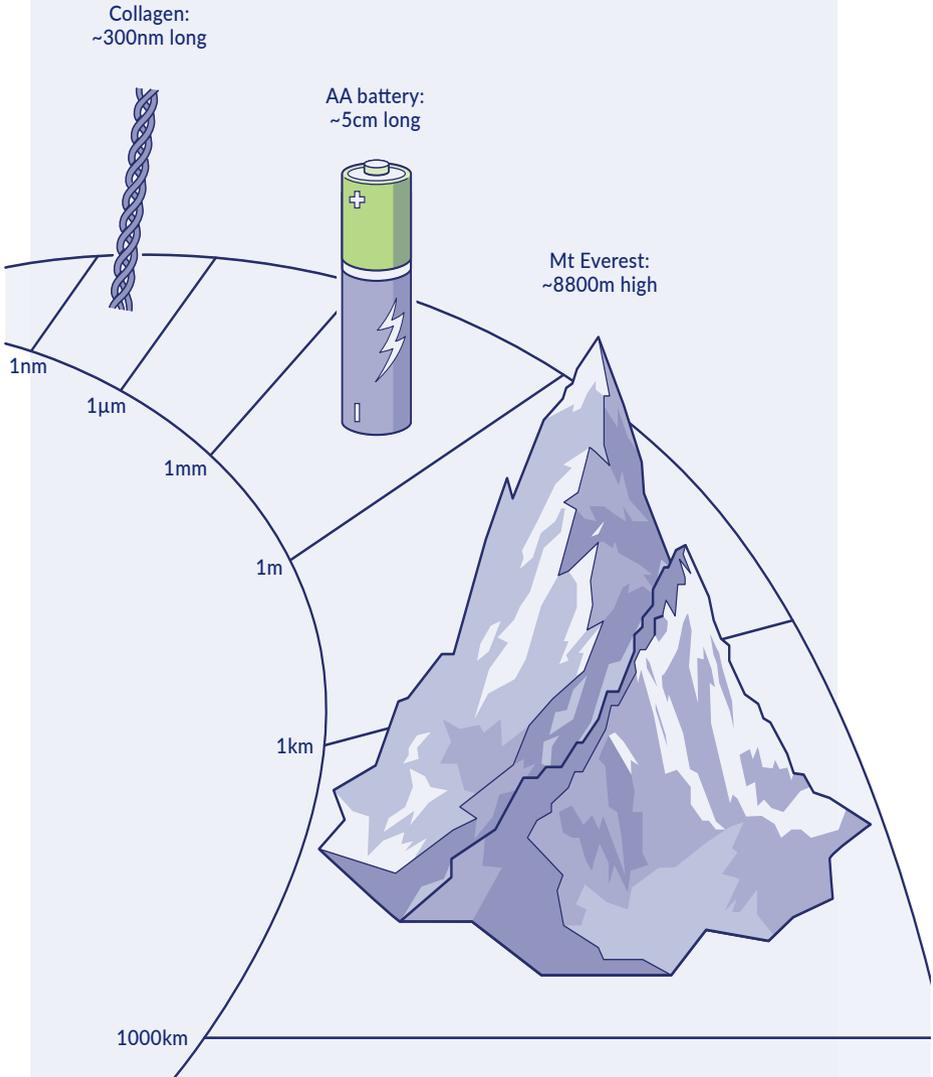
Enzyme: A type of protein that catalyzes, or speeds up the rate of, chemical reactions in our bodies. Enzymes are involved in everything from digestion to collagen synthesis and breakdown.

Procollagen: An early form of collagen in the synthesis process.

How small are proteins?

Since one cell can contain thousands of proteins, you might be wondering just how small proteins are. Proteins come in many shapes and sizes, but none of them are visible under a light microscope.

Take collagen: one collagen molecule is about 300 nanometres long. To get a sense of how small that is, think of a standard AA battery compared to the height of Mount Everest. A collagen molecule compared to the AA battery is the same size scale: 170,000 times smaller!



Form and function: What collagen looks like and what it does

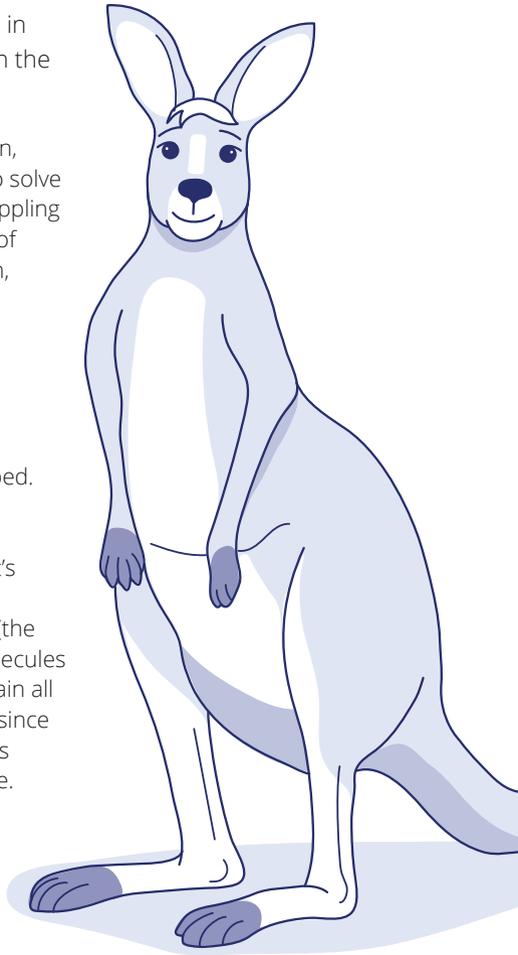
What do kangaroos and x-rays have in common? They both played a part in the discovery of collagen's structure.

In the early 1950s, G.N. Ramachandran, a physicist in Chennai, India, set out to solve a mystery many researchers were grappling with: What is the molecular structure of collagen? Everyone knew that collagen, found in the connective tissue of all animals—bone, cartilage, ligaments, dermis—was incredibly strong. They just didn't know why.



The puzzle had researchers stumped. Collagen can't be studied under a light microscope: it's far too small. And molecular biology (the study of macromolecules like proteins and nucleic acids to explain all life processes) had only been around since the 1930s. So to understand collagen's structure, scientists had to get creative.

Here's where the kangaroos come in.



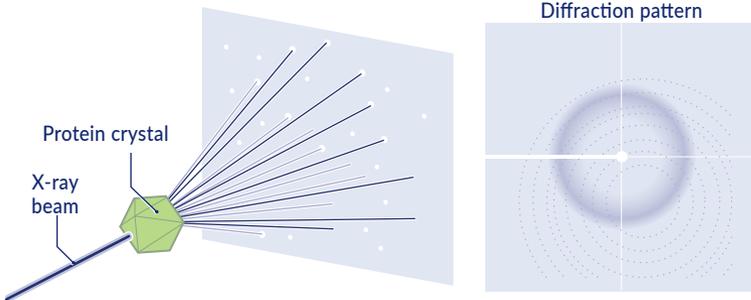
Ramachandran got his hands on some purified kangaroo-tail collagen from Australia, which he felt would provide the best images in his x-ray crystallography lab. X-ray crystallography (or x-ray diffraction) is a method used to determine the structures of proteins and other molecules. Crystallizing something—in this case, collagen—causes its atoms to organize into a repetitive lattice pattern.

X-rays are then beamed through the crystal from all sides. The rays bounce off the electron clouds of the atoms and are registered onto

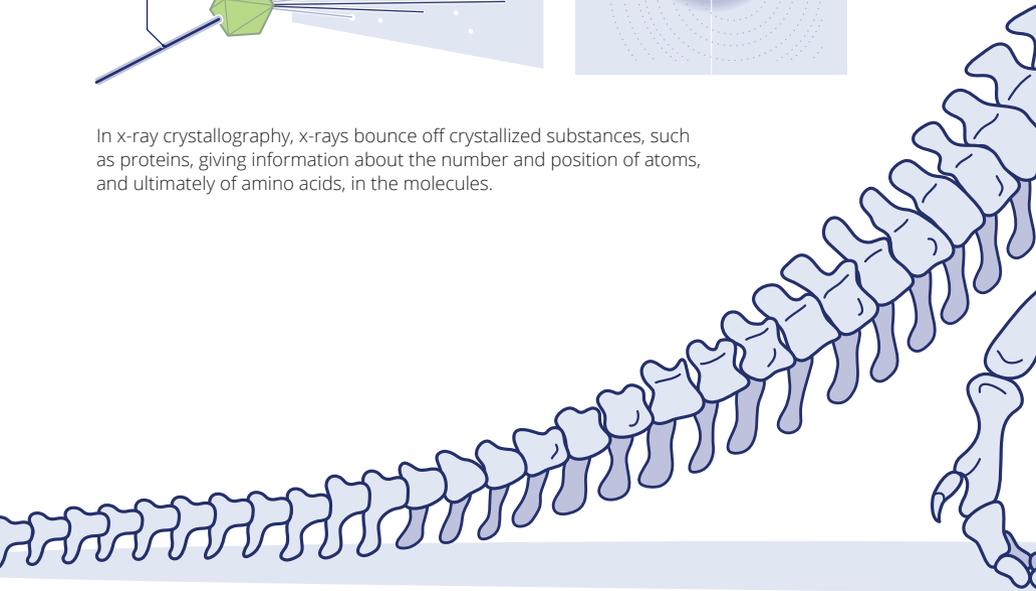
photographic film, giving clues about their density and location, and also the density and location of the amino acids inside the molecule.

When something is crystallized, its atoms organize into a repetitive lattice structure.

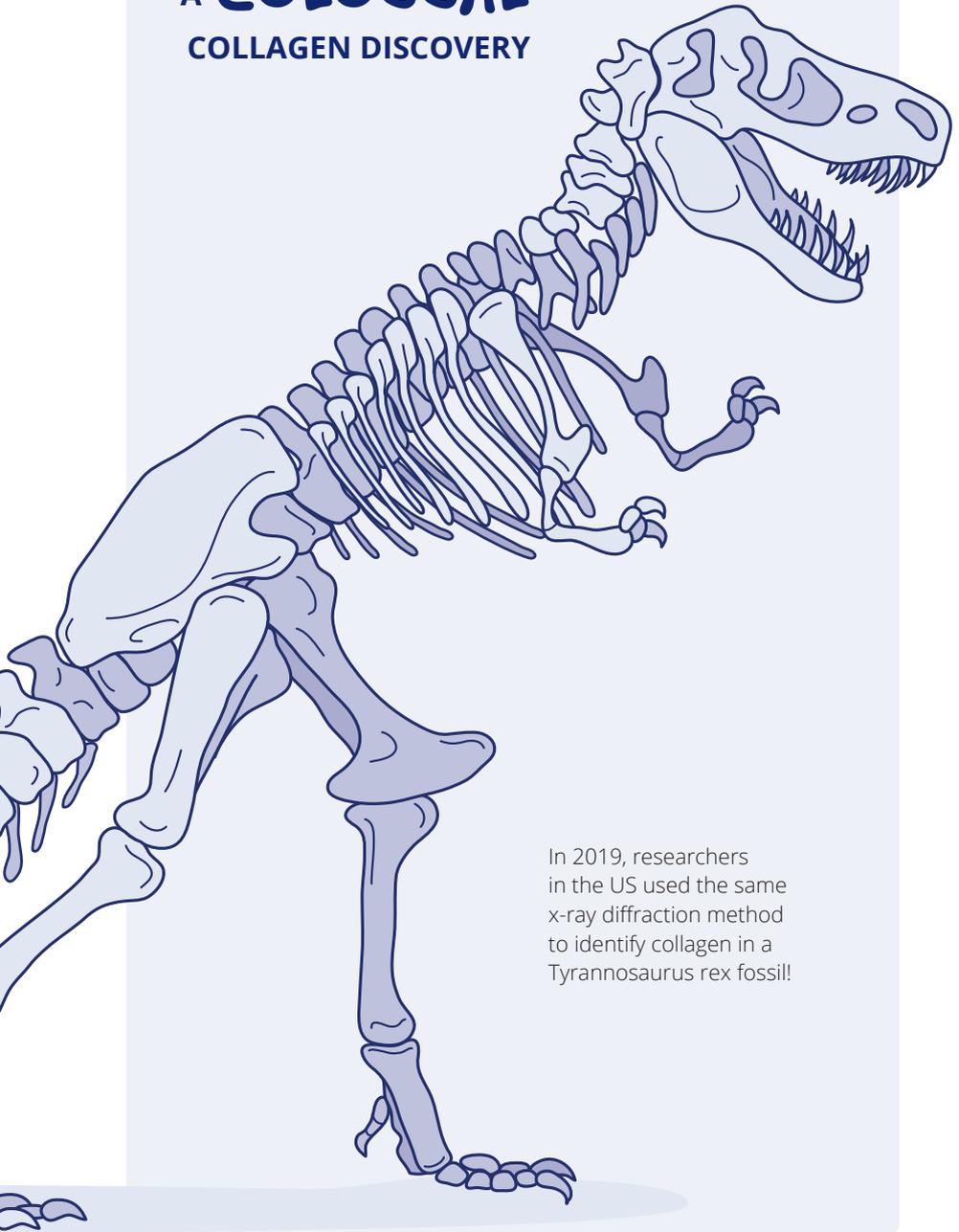
Based on the x-ray diffraction pattern and many other observations, Ramachandran famously reasoned that collagen's structure was a "coiled-coil" or a triple helix: three polypeptide chains curled around one another, like a braid. That model has survived to this day.



In x-ray crystallography, x-rays bounce off crystallized substances, such as proteins, giving information about the number and position of atoms, and ultimately of amino acids, in the molecules.



A COLOSSAL COLLAGEN DISCOVERY

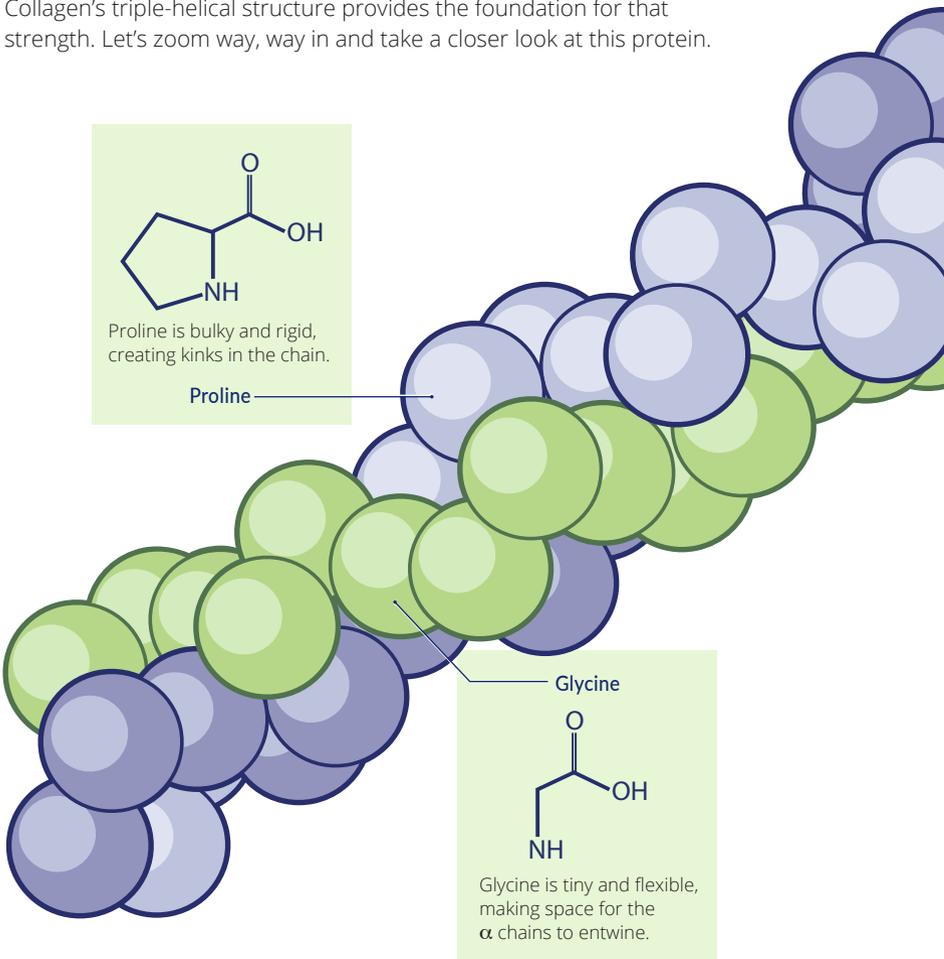


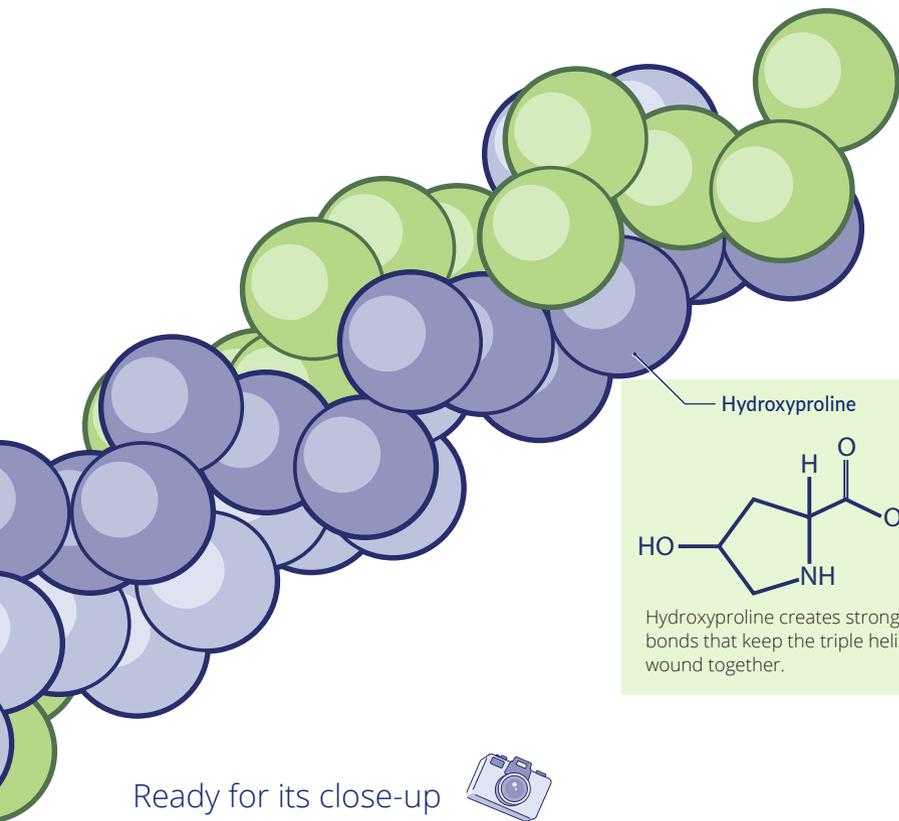
In 2019, researchers in the US used the same x-ray diffraction method to identify collagen in a Tyrannosaurus rex fossil!

What's so important about collagen's structure?

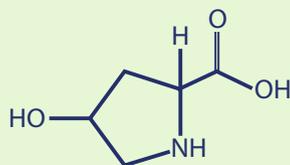
Collagen is found throughout our connective tissue. Connective tissue is fibrous material that connects, supports, binds, or separates other tissues or organs. This includes the dermis (the layer of skin under the thin outer epidermis), the cartilage that separates bones in joints, the tendons that connect muscles to bone, and the bones that make up your skeleton. Unless you don't mind your skin dripping off your body, your bones snapping when you fall, and your muscles tearing when you throw a baseball or swing a bat, you want that connective tissue to be pretty strong.

Collagen's triple-helical structure provides the foundation for that strength. Let's zoom way, way in and take a closer look at this protein.





Hydroxyproline



Hydroxyproline creates strong bonds that keep the triple helix wound together.

Ready for its close-up



Isn't it a thing of beauty? Collagen is like a triple-stranded necklace, each strand strung with 1,050 pearls, and each pearl representing an amino acid. Each strand in the necklace is called an α (alpha) chain, containing its own sequence of amino acids. Wound tightly together, the triple helix gives collagen incredible strength and resistance to breakage. The saying "A cord of three strands is not easily broken" definitely applies here.

What's in a name?



Collagen's name gives us a clue about what it does. The word stems from the Greek word *kolla*, which translates to "glue." In Greek, the second part of the word, *gen*, means "producing." Think

of collagen as the glue that binds your body together and gives your tissues their structure. Without it, you'd be a puddle!

Some amino acids in collagen

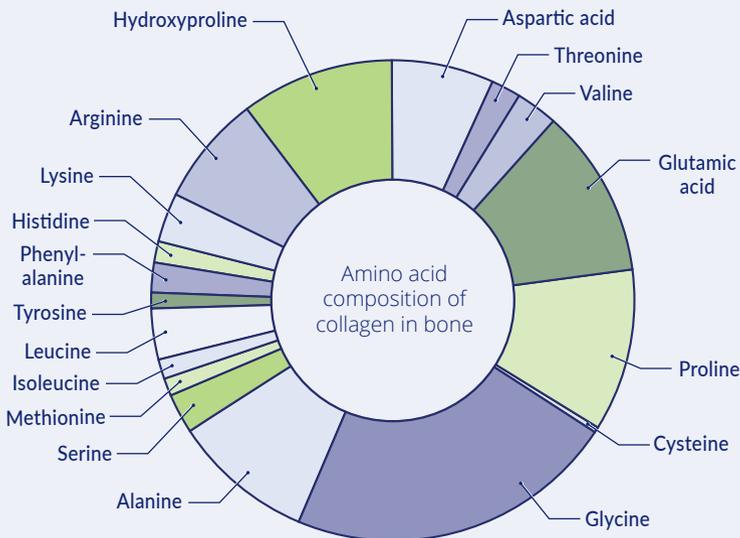
Remember our friend G.N. Ramachandran? Part of how he came up with his triple helix model was by identifying the amino acids in collagen's α chains. He found that every third one was glycine, which is important for two reasons. First, glycine is flexible, making each α chain itself flexible enough to wind around the others. And second, glycine is tiny compared to other amino acids, creating space for the α chains to entwine and form a super compact triple helix around the center.

After glycine, the most abundant amino acid in collagen is proline. While glycine is tiny and flexible, proline's bulkier and rigid structure creates kinks in the chain—think of how a

chunky necklace behaves when you try to twist it.

Yet another amino acid that helps hold collagen together is hydroxyproline: proline that's been hydroxylated during the synthesis process. Hydroxylation is a process that introduces a hydroxyl group (oxygen bonded to hydrogen, or -OH) into an organic compound, in this case, proline. Basically, hydroxyproline creates strong hydrogen bonds within the triple helix, keeping it wound tightly together.

Other amino acids can make an appearance in an α chain, too. In fact, the only amino acid never found in collagen is tryptophan.



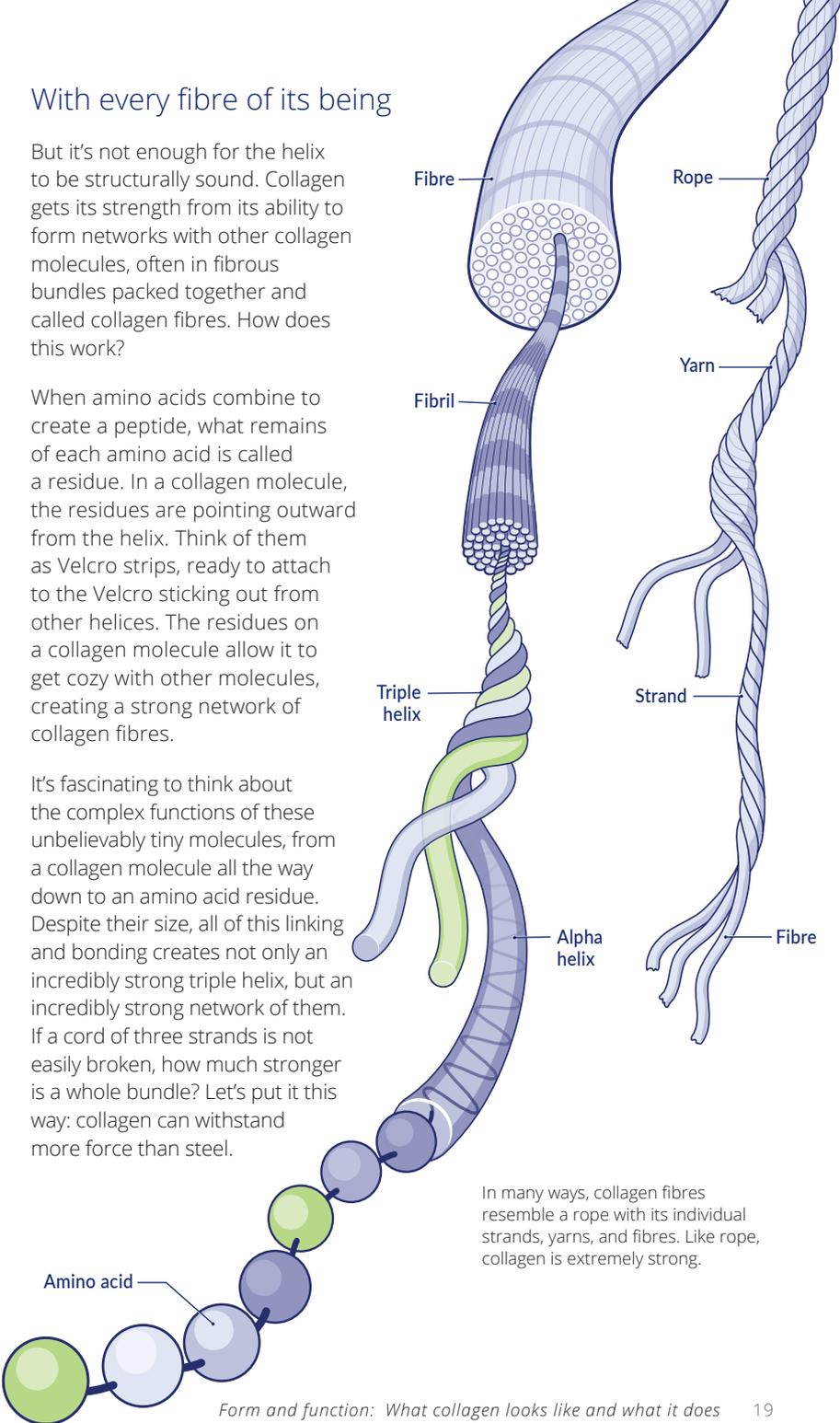
The amino acid composition of bone

With every fibre of its being

But it's not enough for the helix to be structurally sound. Collagen gets its strength from its ability to form networks with other collagen molecules, often in fibrous bundles packed together and called collagen fibres. How does this work?

When amino acids combine to create a peptide, what remains of each amino acid is called a residue. In a collagen molecule, the residues are pointing outward from the helix. Think of them as Velcro strips, ready to attach to the Velcro sticking out from other helices. The residues on a collagen molecule allow it to get cozy with other molecules, creating a strong network of collagen fibres.

It's fascinating to think about the complex functions of these unbelievably tiny molecules, from a collagen molecule all the way down to an amino acid residue. Despite their size, all of this linking and bonding creates not only an incredibly strong triple helix, but an incredibly strong network of them. If a cord of three strands is not easily broken, how much stronger is a whole bundle? Let's put it this way: collagen can withstand more force than steel.



In many ways, collagen fibres resemble a rope with its individual strands, yarns, and fibres. Like rope, collagen is extremely strong.

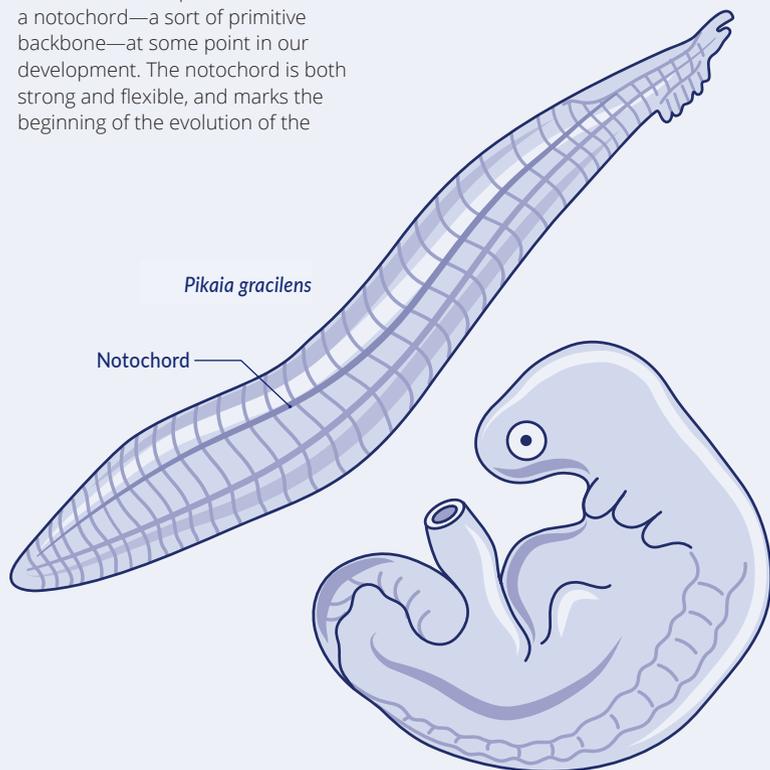
Collagen in human evolution

If you trace your family tree (way) back, you may be surprised that one of your earliest known ancestors is a five-centimetre-long marine creature that looks like a cross between a slug and an eel. Fossils of *Pikaia gracilens* found in Yoho National Park in British Columbia, Canada, are thought to be 505 million years old, making them the oldest known chordate fossils on record. Some of your greatest-grandparents were Canadian!

Chordates include all birds, reptiles, amphibians, fish, and mammals, including humans. What we all have in common is the presence of a notochord—a sort of primitive backbone—at some point in our development. The notochord is both strong and flexible, and marks the beginning of the evolution of the

endoskeleton (the internal skeleton, as opposed to the exoskeleton found on bugs, spiders, and crustaceans). Can you guess what this strong and flexible notochord is made of? Collagen!

Our sophisticated spinal cord may lead us to believe we've moved on from the lowly notochord, but this evolutionary souvenir shows up in a key stage of our development: when we're embryos, growing in the womb. All remnants of our embryonic notochords disappear completely when we're children, but don't worry—we've still got plenty of collagen in our bodies.



Human embryo, 26–27 days

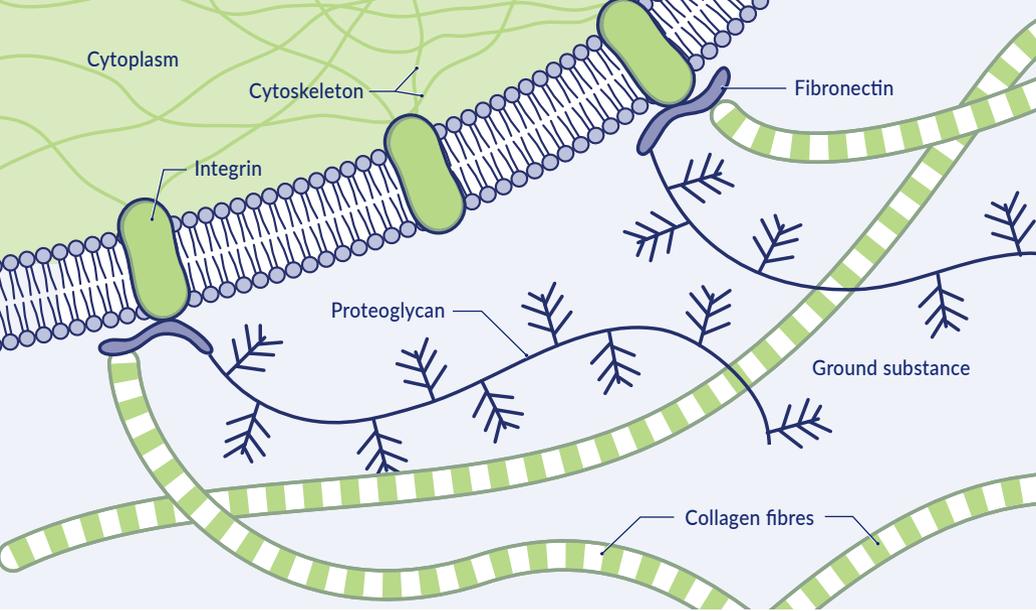
Where exactly does collagen live?

We know that collagen is found in our connective tissues and in other parts of our body. But **where** in those places does collagen actually live? In our cells? Somewhere else?

All living things are made of cells. But our cells don't always stand shoulder to shoulder. In most of our tissues and organs, the spaces between our cells are called the

extracellular matrix. The extracellular matrix may sound like the not-too-promising name of an action movie sequel, but it's the place collagen calls home.





The extracellular environment

The makeup of ECM varies across tissues, but in connective tissue, it is generally a gel-like goo called ground substance, plus a network of proteins and proteoglycans (which are molecules that trap water, hydrating the matrix and allowing it to be compressed). Basically, the ECM gives cells a solid place to stand.

You should also meet collagen's trusty sidekick in the ECM, a protein

called elastin. While collagen allows tissues like muscles, tendons, ligaments, skin, and bone to withstand strain without breaking, elastin gives these tissues their elasticity, allowing them to contract when stretched. We can thank collagen for the firmness and stretchiness of our skin, and elastin for our skin's ability to snap back after it's pinched. Collagen and elastin are truly a dynamic duo.

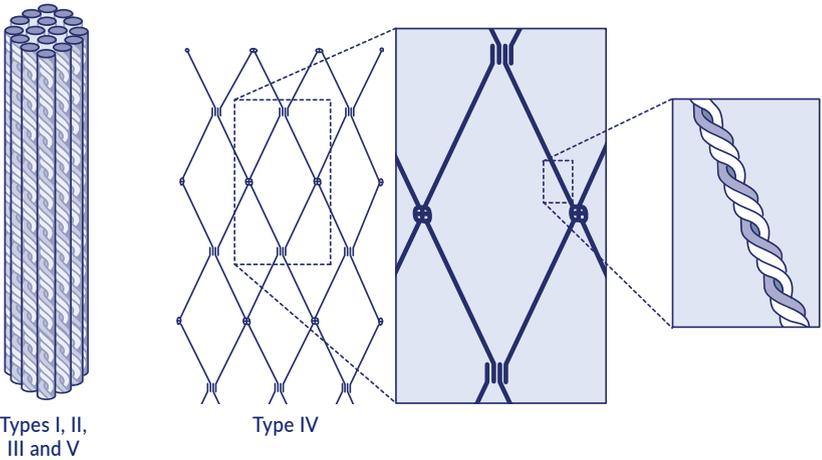
The collagen family

A quick recap: A collagen molecule's structure is a triple helix. That structure gives it strength, which then gives our tissues strength. And collagen lives in the extracellular matrix.

So far, so good. But let's shake things up a bit. Did you know that

there are at least 28 different types of collagen?

Since collagen's triple helix was discovered in 1955, scientists have been searching for new types of collagen in our bodies, and finding them everywhere from our brains to our blood vessels. The vast majority



of collagen in our bodies—around 90%—is type I collagen. That’s the type that makes up three quarters of our skin’s dry weight. But there are many more, some of which we’re still learning about.

Different types of collagen have slightly different triple-helical structures, and may vary in how they are organized. For example, types I, II, III, and V take on a fibrillar pattern: collagen molecules joined into long

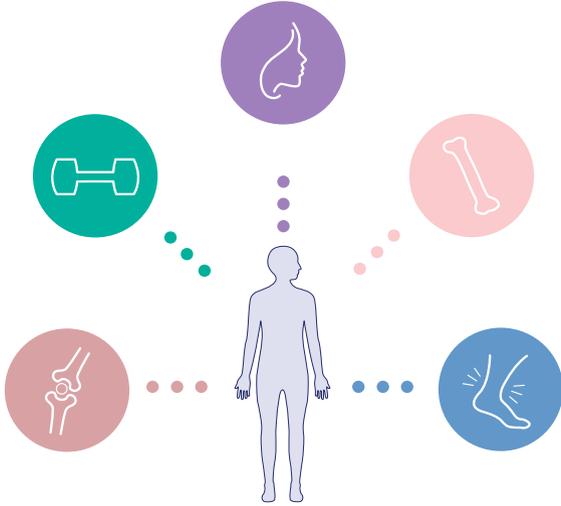
strands or fibrils, packed tightly together into large collagen fibres. Type II, found in cartilage, has more loosely packed fibres than the other fibrillar types, allowing cartilage to absorb shock in our joints. On the other hand, type IV, found in our basement membranes (see page 31), is arranged in sheets in a mesh-like pattern. Wherever it’s found, the type of collagen is perfectly suited to its function.

Five main types of collagen

Type of collagen	Structure	Where it’s found
Type I	Fibrillar	Dermis, bone, tendon, ligament
Type II	Fibrillar	Cartilage, vitreous (gel between lens and retina in eye)
Type III	Fibrillar	Muscle, fascia, blood vessels, intestine
Type IV	Network	Basement membranes
Type V	Fibrillar	Bone, dermis, cornea, placenta

Collagen and you

If collagen were on a football team, it could play any position. This versatile protein has many different functions depending on where it's found in the body. Let's look at some ways collagen helps the parts of your body do the things they do.



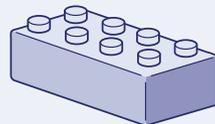
Type I, type II, type III—does it matter what type of collagen is listed on the label?

Walking through a health food store, you spot a shelf of collagen peptides. One bottle says it contains type I collagen. Another contains type I and III collagen. Another, type II collagen. Does the type on the label have anything to do with the product's effectiveness?

Not really. When protein is broken down into amino acid sequences in your gastrointestinal tract, your body doesn't recognize which type of protein it once was—it simply absorbs the peptides into the bloodstream and uses them to make its own collagen. Similarly, the collagen peptides you buy are already broken down, so your body can't recognize the type. What's important is that your cells recognize

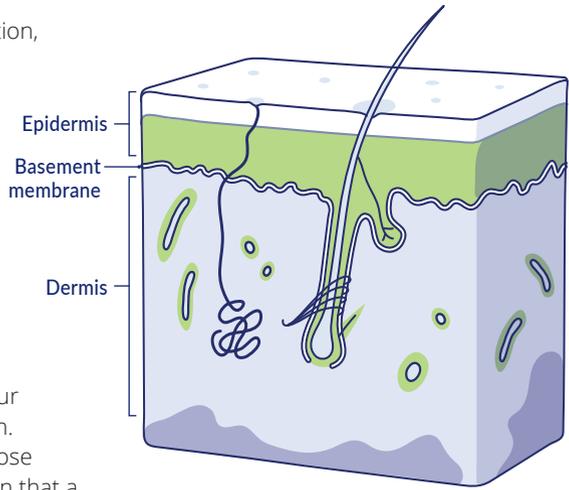
that collagen fragments are present and respond accordingly (more on that later), using the peptides to build brand-new collagen.

Remember playing with LEGO as a kid? Sometimes you'd have to take apart your creations to get enough bricks to build new ones. You'd break down a red house to build a red airplane, and the fact that they weren't "airplane bricks" didn't bother you. They were red bricks, they were the right size, and they were exactly what you needed.



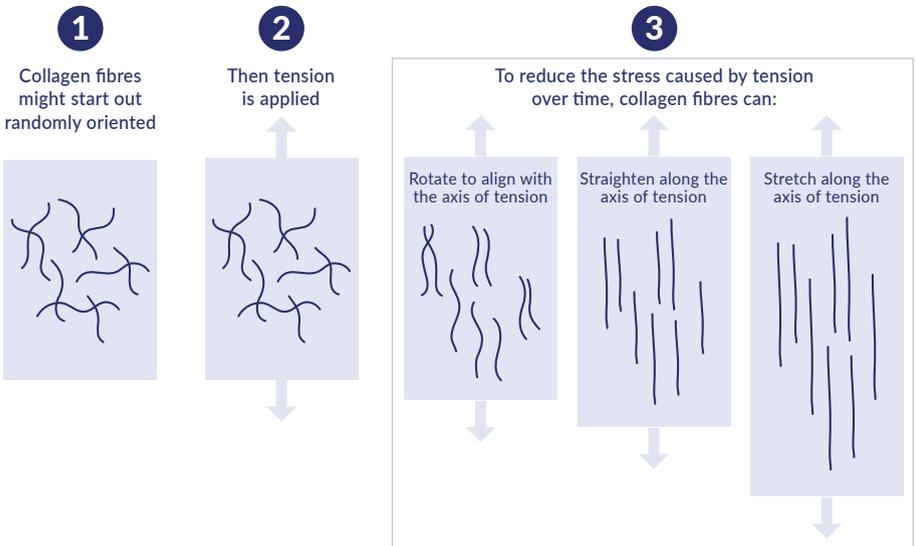
Collagen and your skin

Skin density, skin hydration, skin texture, skin elasticity—collagen is key to so many of our skin's characteristics. Type I collagen is everywhere in our dermis, the layer of skin beneath the thin outer epidermis. When we're young, collagen acts like the coils in a new mattress, leaving our skin bouncy and smooth. (Mattresses eventually lose their spring, but more on that a little later.)



We often think of skin as a fragile tissue, but it's surprisingly tough. The collagen in dermis is incredibly resistant to tearing. When scientists examined the micro-scale behaviour of collagen fibrils under pressure,

they discovered that they're quite acrobatic: fibrils and fibres rotate, straighten out, stretch, and slide, reorienting themselves toward the application of force to reduce the stress placed on them.



But collagen isn't just structurally interesting. It also plays a role in some of your body's key functions, like wound healing.

The extracellular matrix (ECM) shares a complex communication system with the cells it surrounds. A cell picks up signals from the extracellular world via proteins called integrins. Integrins live in the cell's plasma membrane, and they're anchored to the ECM via proteins called fibronectins. Changes in the ECM send signals to the cells to repair, reproduce, or even make more collagen.

Say you cut yourself while slicing an avocado. While your epidermis (outer layer of skin) is able to regenerate, the dermis layer beneath cannot. A major component of the dermis is collagen. So an enzyme called collagenase breaks down the collagen at the wound site, releasing fragments of collagen called peptides. These peptides pass on a signal that the integrin picks up: **Send collagen!** That triggers the production of collagen-producing cells (called fibroblasts) and ultimately more collagen, which is layered onto the wound site like paper-mâché.

The end result? A really cool scar, made of collagen!

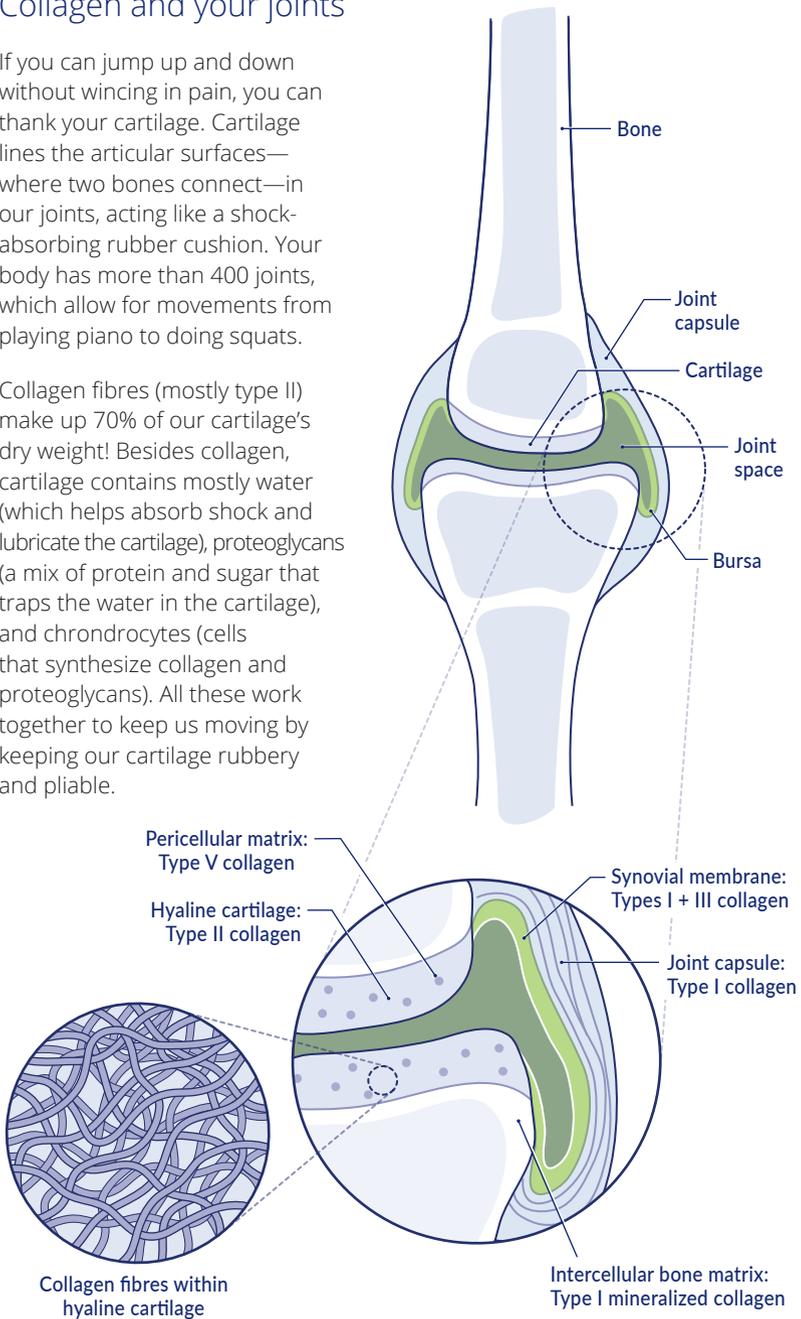


Like a walkie-talkie, integrin in the cell's plasma membrane picks up signals from the extracellular matrix and transmits it into the cell to make more collagen

Collagen and your joints

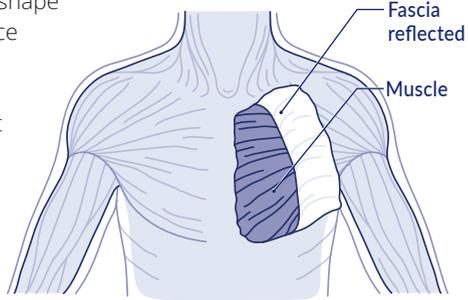
If you can jump up and down without wincing in pain, you can thank your cartilage. Cartilage lines the articular surfaces—where two bones connect—in our joints, acting like a shock-absorbing rubber cushion. Your body has more than 400 joints, which allow for movements from playing piano to doing squats.

Collagen fibres (mostly type II) make up 70% of our cartilage's dry weight! Besides collagen, cartilage contains mostly water (which helps absorb shock and lubricate the cartilage), proteoglycans (a mix of protein and sugar that traps the water in the cartilage), and chondrocytes (cells that synthesize collagen and proteoglycans). All these work together to keep us moving by keeping our cartilage rubbery and pliable.



Collagen and your muscles

Only about 6% of our muscle mass is made of collagen, but that doesn't mean it's not important. Type III collagen is plentiful in fascia, the thin connective tissue that surrounds bundles of muscle fibres, like a sticky wrapper. Fascia gives shape to our muscles, and transmits force during muscle contractions. It's involved in every movement we make. There is even evidence that fascia itself may be able to contract! It's also high in elastin, which makes it stretchy and resilient.

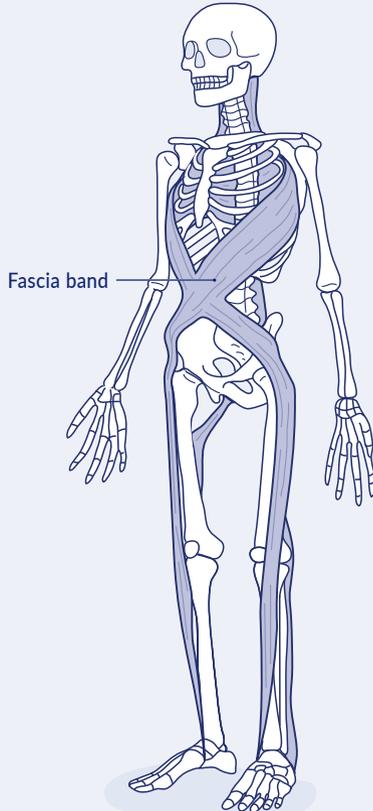


Pushing back the frontiers of fascia knowledge

Fascia is a subject of increasing scientific interest, and is apparently not as passive as we once thought.

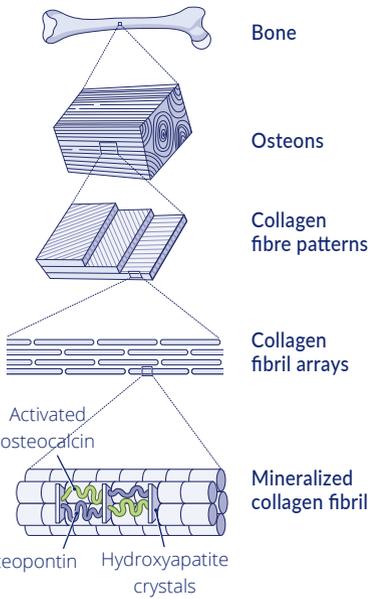
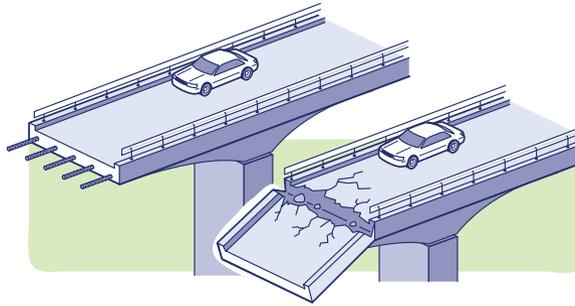
A concept called myofascial continuity indicates that a small number of continuous fascia bands wrap around and connect muscles in different parts of our body. This may explain the phenomenon of referred pain: when you feel pain in one area, like your foot, following injury to another, like your calf. The concept has interesting implications for pain and injury, and could lead to a less localized, more holistic approach to treatment.

And that's not all. We think fascia bands are also involved in proprioception—our body's sense of its place in space (think of how you can touch your toes even with your eyes closed).



Collagen and your bones

We tend to think of bones as hard, inflexible things. But bone is a mix of brittle minerals and soft organic matter. 90% of this organic matter is type I collagen, giving bones both strength and flexibility. When bone mass declines, as it does in osteoporosis, bones become much more prone to fracture.



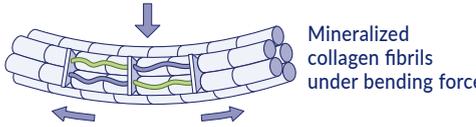
Bone

Osteons

Collagen fibre patterns

Collagen fibril arrays

Mineralized collagen fibrils



Mineralized collagen fibrils under bending force

Together, carboxylated osteocalcin (gcOC) and osteopontin (OP), form elastic collagen fibrils that act as “shock absorbers” in bone. In the event of applied force, these dilatational bands formed by gcOC and OP dissipate the energy and protect the bone from further damage.

Think of the collagen in bones as rebar, the reinforcing steel rods within concrete structures like bridges and buildings. Reinforced concrete can support greater loads than concrete that’s not reinforced.

As we continue to learn more about the collagen in our bones, it gets more and more interesting. A recent discovery suggests that collagen works with two proteins, osteocalcin and osteopontin, to prevent the cracks in bone fractures from growing. Together, these proteins form elastic fibrils, which act as shock absorbers or springs, making bones a bit more flexible.

When a bone is subjected to bending force, tiny holes appear in the bone matrix. The fibrils stretch to form bands within these gaps, dissipating the energy and preventing greater damage. When the stress subsides, the bands can close and the tiny holes can be repaired.

Collagen and your tendons and ligaments

Tendons are extremely strong connective tissues that attach a muscle to a bone, which makes healthy tendons very important for mobility and joint stability. Their strength and stretch allows them to transmit force and withstand tension during muscle contractions. As any athlete who's suffered an Achilles rupture can tell you, you'd miss them if they were gone! Tendons are a whopping 85% type I collagen.

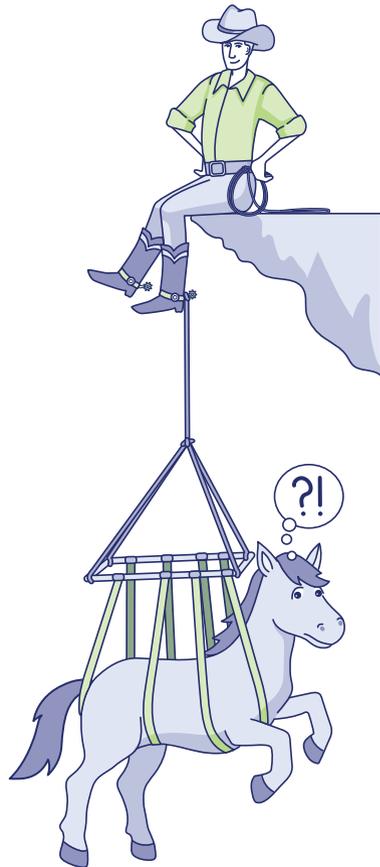
Ligaments act as joint stabilizers: tough, criss-crossing bands of fibrous tissue that attach bones together. They limit the motion of joints to prevent injury, like how a car's shock absorbers keep it from bouncing uncomfortably on a rough road. For example, four major ligaments keep the knee from moving too far forward, backward, left, or right. (You've likely heard of one of these, the anterior cruciate ligament or ACL, more than the others, due to its endangered status among professional athletes.) Collagen makes up about 80% of ligaments' dry weight.

It's well known that you can strengthen your tendons and ligaments through resistance training and other exercises. But one study indicates that collagen fibrils themselves can become stronger—as much as 70% stronger—when they are repeatedly stretched and relaxed. To perform this study, the researchers had to design a testing device smaller than a millimetre in size!

DID YOU KNOW ?

A TERRIFIC TENDON

The Achilles tendon, the largest tendon in our body, can withstand 1,000 pounds of longitudinal or lengthwise force (the weight of a horse). Don't test this; just take our word for it!

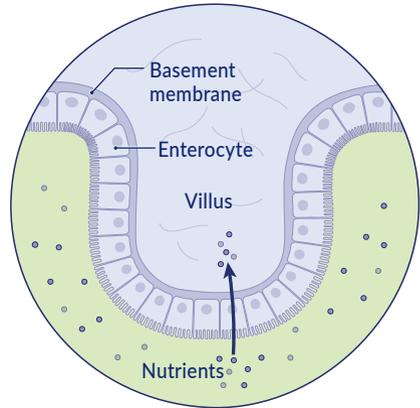


Collagen and your basement membranes

A basement membrane is a very thin layer between epithelial tissue and the tissue beneath it. What's epithelial tissue? It's protective tissue that lines the organs, blood vessels, and cavities in our bodies. It lines your esophagus (the tube connecting your throat and stomach), protecting it from abrasive foods like nuts and toast. It lines your intestines, absorbing nutrients from the food you eat. It lines your bladder, allowing it to expand and stretch whenever you can't find a bathroom.

We already saw a kind of epithelial tissue earlier in this section—your epidermis, or the outermost layer of your skin. In this case, the basement membrane connects and anchors the epidermis to the dermis below it.

The main type of collagen found in the basement membrane is type IV. Type IV collagen is organized in mesh-like sheets rather than in fibrous networks. These sheets act as structural support—like a floor—for the tissue above. They also filter nutrition from below up to the epithelial tissue, which has no blood vessels of its own.



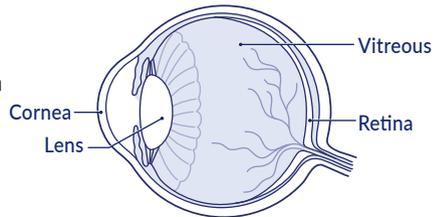
The basement membrane lining your intestine absorbs nutrition from food and filters it through

Collagen and... everything else

Collagen is truly almost everywhere in the body. Let's look at some of the unexpected places it turns up, both in our bodies and in scientific discovery.

Up to your eyeballs in it

Your cornea, the transparent front cover of your eye, is made of collagen and cells. The collagen keeps the cornea in place—an important job, since even a slight distortion in the cornea's shape can disrupt your vision. It's also in your vitreous, the clear jelly-like liquid between your lens and the retina at the back of your eye. As you age, stringy bits of



collagen can clump together and cast a shadow on your retina, which you see as “floaters” in your vision.

Gut feeling

Type I, III and V collagen is everywhere in your gastrointestinal tract. Some health practitioners believe that collagen peptides can provide relief from digestive disorders like irritable bowel syndrome by helping to rebuild the lining of the intestine, but more research is needed.

Hair today, gone tomorrow



There isn't much collagen in hair itself, which is made mostly of the protein keratin, but researchers have discovered that the breakdown of one type of collagen in hair follicles contributes to hair thinning and

hair loss. Healthy collagen in our dermis, where the follicles live, is also associated with healthy-looking hair.

Probing prolapse

One study linked low collagen levels, or low collagen strength, to incontinence and pelvic organ prolapse in women (when a pelvic organ, like the bladder, drops and presses into the vaginal walls). This same study found prolapse connected with other collagen-linked disorders, including varicose veins, in which veins are deficient in type III collagen.

Against Alzheimer's

Another study found that type VI collagen in the brain is actually produced by neurons, and may protect them against the proteins that cause Alzheimer's disease.



Collagen is so important to our physical makeup and to our functioning that we expect many more discoveries to come.

And we're STILL learning about collagen!

There is still so much to discover about collagen, what it can do, and how it does it. Take the wound healing process in skin: How does an integrin know how to use the information it receives from the ECM? How does it send its signals within the cell? And how does collagen know what to do? We're still finding out.

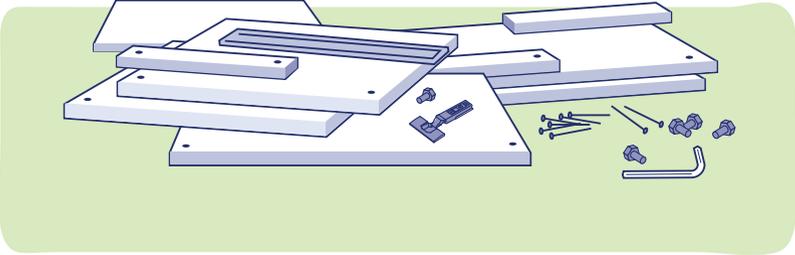
Collagen may have been around for hundreds of millions of years, but

we're really just beginning to learn about it. Collagen has had lots of time to evolve its many functions within the body, and to be used by clever people across cultures and generations. The trend continues today, with people becoming more interested in its health benefits, and scientific studies beginning to show how collagen peptides can help our bodies make more of this amazing protein.



Putting it together: How we make collagen

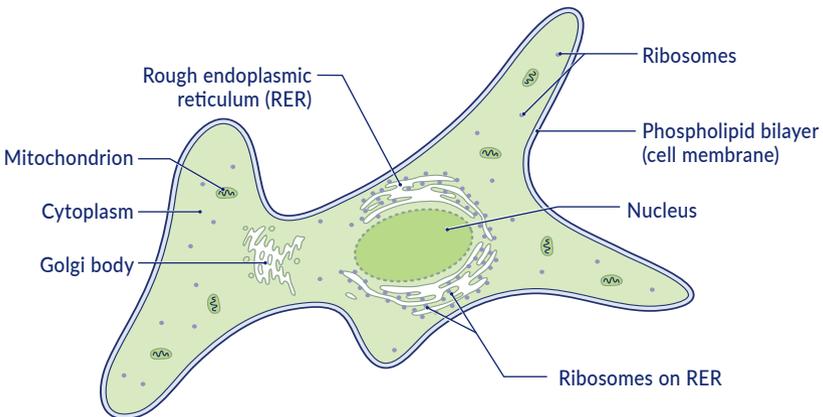
Before talking about how to help our bodies make more collagen, let's look at how they make it in the first place. For that, we'll take a trip through the extracellular matrix until we come to a fibroblast. Fibroblasts are specialized cells that synthesize collagen and other proteins in the ECM, like elastin.



If you've ever bought furniture from IKEA, you know that they give you all the parts, but it's up to you to assemble them. That's what fibroblasts do: they take a number of components—amino acids—and combine them into something your body can use. (Unlike most of us, they manage to do it without grunting or complaining.)

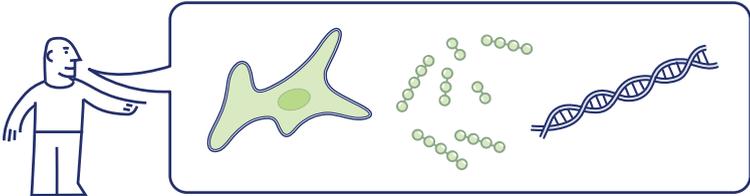
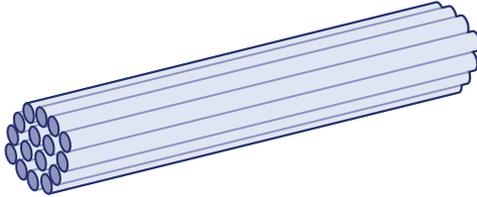
And while fibroblast-like cells may go by different names depending on where they're found—osteoblasts in our bones, chondrocytes in our cartilage—they all follow the same assembly instructions.

Ready to put some collagen together? Let's go!



Assembling collagen, step by step

COLLAGEN

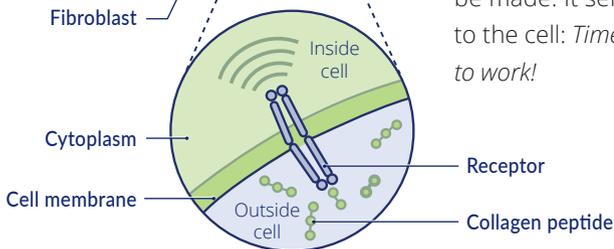


1



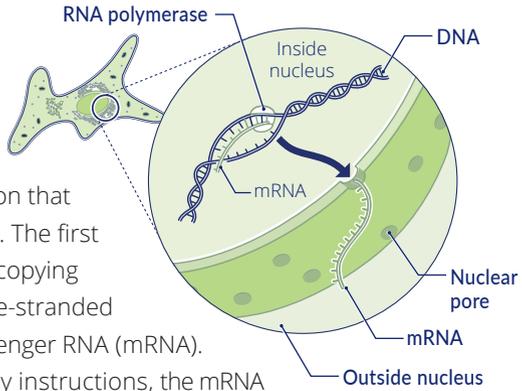
Collagen

A receptor in the cell membrane, connected to the ECM, “notices” that too much collagen has broken down and more needs to be made. It sends a signal to the cell: *Time to get to work!*



2

The signal is picked up by the nucleus, where the DNA holds the genetic information that codes for our protein. The first step is transcription: copying the code onto a single-stranded molecule called messenger RNA (mRNA). Carrying the assembly instructions, the mRNA heads for the exit, which is a gateway in the nucleus called the nuclear pore.



The fibroblast family

Fibroblasts are largely responsible for synthesizing collagen and other proteins in our skin and connective tissue. Some collagen-producing cells

are called different things depending on where they're found, but they're all closely related.

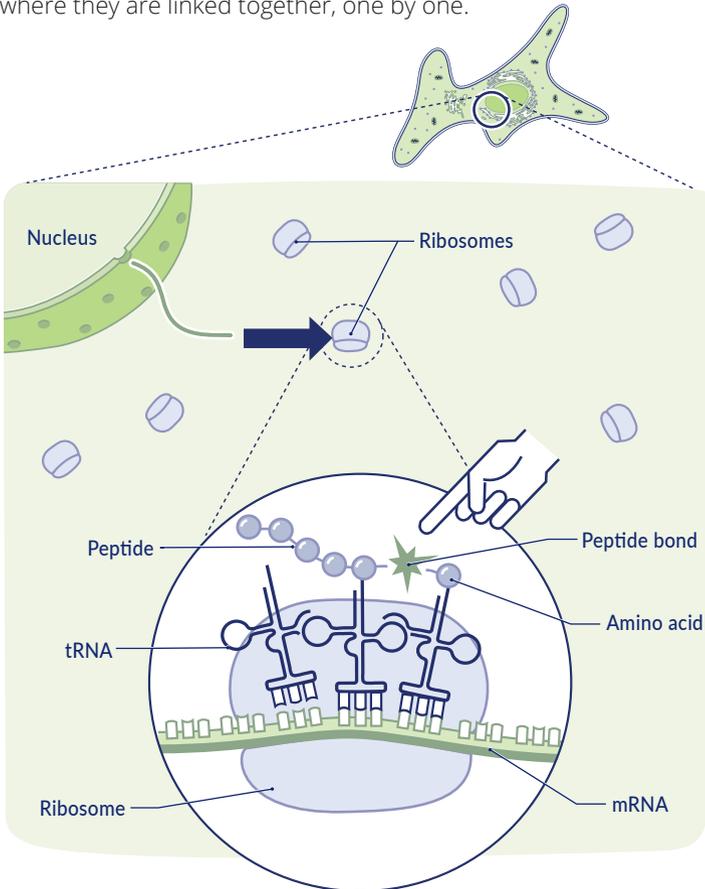
The diagram shows five types of fibroblasts, each with an icon above and a cell illustration below. The background is a gradient from teal to orange.

				
				
Tendocytes live in our tendons	Ligamentocytes live in our ligaments	Fibroblasts live in our skin	Chondrocytes live in our cartilage	Osteoblasts live in our bones

Assembling collagen, step by step

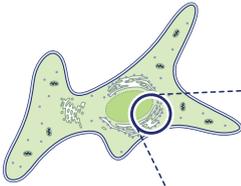
3 Once the mRNA molecule has left the nucleus, it's not long before it comes into contact with free ribosomes. In our furniture assembly analogy, you can think of ribosomes as Allen keys that help fasten components together.

Once the mRNA molecule interacts with a ribosome, we begin the process of translation. In an incredible display of manufacturing efficiency, the ribosome “reads” the sequence provided by the mRNA. Molecules called transfer RNA (tRNA) gather up the appropriate amino acids and bring them into the ribosome, where they are linked together, one by one.



Assembling collagen, step by step

4



Rough endoplasmic reticulum

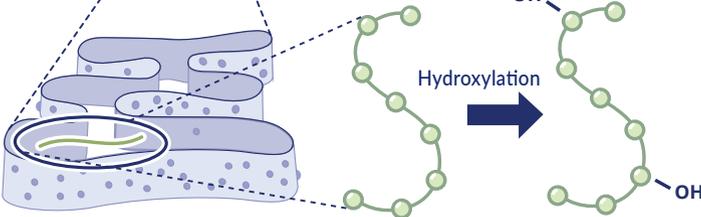
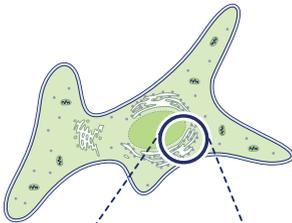
Pro α chain

The molecule that emerges from the ribosome is then sent to the next part of the assembly process: the maze-like rough endoplasmic reticulum (RER).

The RER is the site of something called post-translational modification, in which many molecules, or chains, are being formed at the same time inside the RER.

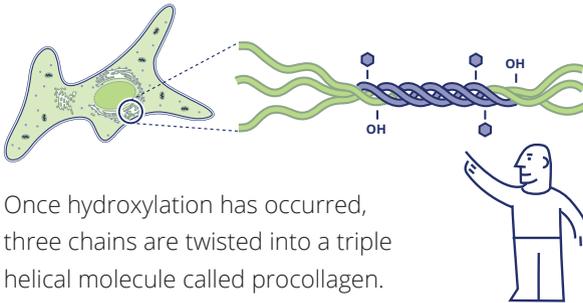
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Hydroxylation also occurs inside the RER. In hydroxylation, hydroxyl groups (pairs of one hydrogen atom and one oxygen atom) are added to the proline and lysine amino acids in the chains, creating hydroxyproline and hydroxylysine. Hydroxylation is like a dab of glue that allows collagen molecules to stick together down the road.



Assembling collagen, step by step

6

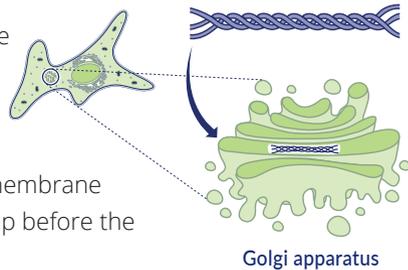


Once hydroxylation has occurred, three chains are twisted into a triple helical molecule called procollagen.

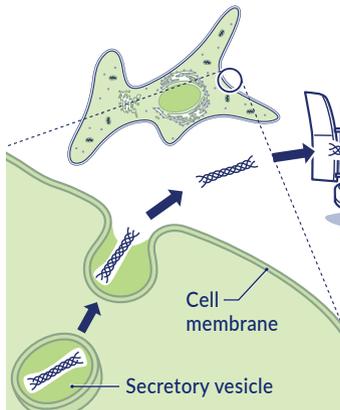
On either end of the procollagen molecule, there are regions called propeptides. Unlike the rest of the molecule, these regions aren't in a helical shape. But they help hold the procollagen together with something called disulfide bonds. Think of them as temporary fasteners that will later be removed.

7

The procollagen molecule heads into the Golgi apparatus. Here, the molecules are packaged into vesicles—a sort of membrane parcel. This is the last step before the molecule exits the cell.



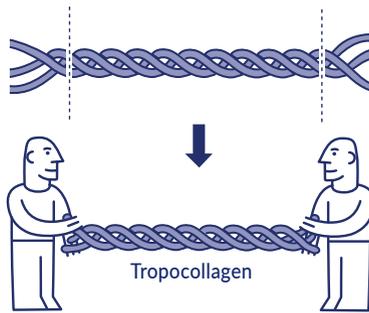
8



The vesicle is shipped out of the cell and into the extracellular matrix. This process is called exocytosis.

Assembling collagen, step by step

9 Once it's in the extracellular matrix, enzymes called peptidases snip off the propeptides on each end of the molecule. What's left is called tropocollagen, or a single collagen monomer: a molecule that can combine with other molecules.

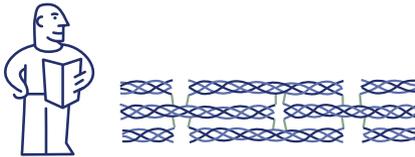


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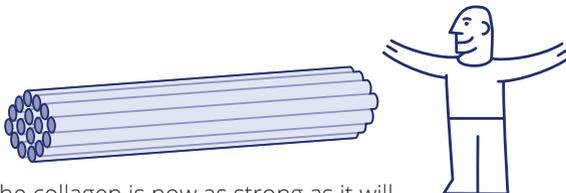
The monomers organize themselves into stacking units. The groups of overlapping tropocollagen are called fibrils.

11



To stabilize the fibrils and build a strong collagen structure, we finally need to tighten the screws. An enzyme called lysyl oxidase, together with copper, acts upon the fibrils to create strong cross-linkages between them.

12



The collagen is now as strong as it will ever be. Assembly is complete!

Some “tools” to keep on hand

Furniture assembly often needs a few tools that aren't included in the package, like a screwdriver. Similarly, collagen synthesis needs the help of a few supporting ingredients in our bodies.

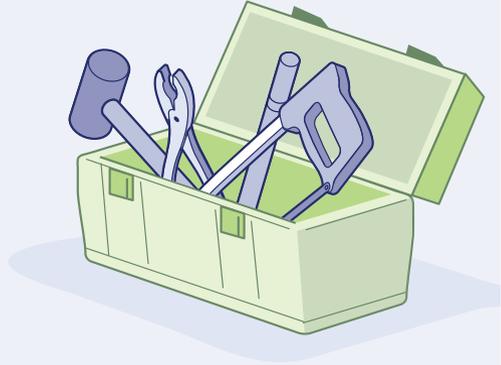
Silicon

It's not just found in the semiconductors that gave Silicon Valley its name. Silicon is actually one of the most abundant trace elements in our bodies, and it helps to activate the hydroxylation enzymes that are essential to building strong collagen networks. In skin, silicon is associated with the synthesis of ECM glycosaminoglycans like hyaluronic acid, which traps water and combats skin dryness, and has even been shown to increase the number of collagen-making fibroblasts. Dietary sources of silicon include whole grains, beer, and certain vegetables, such as green beans.

Vitamin C

You've probably heard of scurvy, which plagued 18th-century sailors who didn't get enough vitamin C on long sea voyages. Their gums bled, their teeth fell out, their wounds didn't heal, and many died.

Their lack of vitamin C made it impossible for them to produce healthy collagen. Vitamin C (or ascorbic acid) helps the hydroxylation of the proline and lysine amino acids in collagen, which lets collagen fibrils form stable connections in the extracellular matrix. We get vitamin C



from citrus fruits and vegetables like broccoli and red peppers.

Copper

Copper helps lysyl oxidase connect collagen fibrils to create a strong collagen network. We simply can't build stable collagen without copper. But we don't need very much: only about 1.4 to 2.1 grams of copper per kilogram of weight. In a healthy person weighing 65 kilograms for example, that's the same as the mass of two drops of water! Our diets usually supply all the copper we need, particularly from foods like shellfish, nuts and seeds, leafy greens, and (great news!) dark chocolate.

Vitamin K2

Vitamin K2 is a workhorse vitamin that also plays a role in collagen formation. It activates osteocalcin, a protein that helps form collagen fibril bands in the bone. These bands absorb tension and stress on the bone, and improve fracture resistance. Vitamin K2 is difficult to find in our diets (unless you're keen on natto, a sticky Japanese dish of fermented soybeans), but you can always take supplements.

What happens if we can't synthesize collagen correctly?

Serious disorders can happen when our bodies don't synthesize collagen properly. Here are a few of them:

Ehlers-Danlos syndrome

Ehlers-Danlos syndrome is a group of inherited disorders caused by mutations in certain genes that code for collagen. These mutations affect the ability of enzymes to snip off the propeptide regions in the ECM, which prevents fibrils from connecting. Unstable collagen causes joint pain or loose joints, stretchy skin, easy bruising, and many more symptoms, which range from mild to life-threatening.

Menkes disease

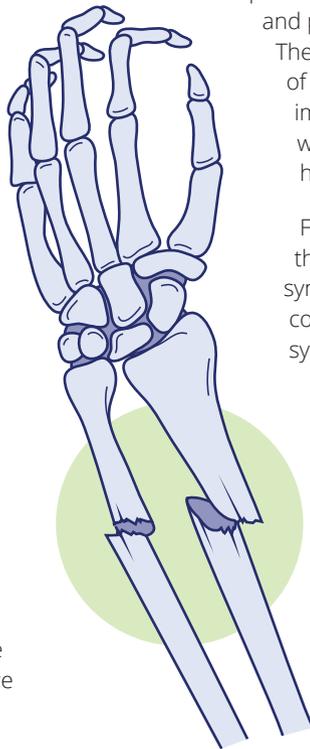
In this rare and fatal disorder, the body doesn't release copper into the bloodstream. Symptoms include sagging skin, muscle floppiness, and poor growth. Menkes disease is caused by mutations (either inherited or appearing randomly) in a gene responsible for a protein that regulates copper in the body. As we've discussed, we need copper to build stable collagen.

Osteogenesis imperfecta

Also known as "brittle bone disease," osteogenesis imperfecta is a result of gene mutations that affect the formation of procollagen in the cell. Glycine, the smallest amino acid, is substituted for bigger ones, which change collagen's triple helix structure. This leaves patients' bones weak and prone to fracture.

There are eight types of osteogenesis imperfecta, and you wouldn't want to have any of them.

For most people, the problem isn't synthesizing collagen correctly, but synthesizing enough of it. If you want to learn more, our discussion on collagen's decline begins on page 46.



Taking collagen apart

As you can see, collagen synthesis happens in many stages both inside and outside the cell. But collagen doesn't "live" forever. The extracellular matrix in tissues is always being remodelled. Remodelling is particularly important when we're growing, when we're injured, and when we're aging.

A group of enzymes called metalloproteinases (MMPs), and particularly the enzyme collagenase,

break down collagen by severing the bonds of the triple helix. When these bonds are broken, there is evidence that the remaining peptide fragments signal the cell to produce more collagen.

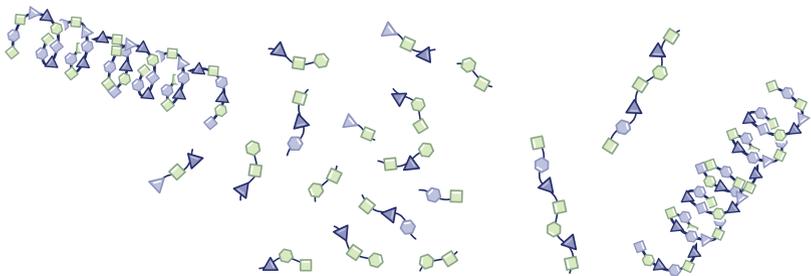
This process is why you might take collagen peptides. The short peptide chains, absorbed into your bloodstream, send a message to fibroblasts that too much collagen has been broken down, and that they need to make more.

So if collagen is so important... ...why does my body break it down?

Our bodies are making and breaking down collagen all the time. We make it, we break it down. We break it down, we make it. This is true for all proteins, as well as all other macromolecules (lipids, carbohydrates, and nucleic acids). Every day, in young and healthy bodies, around 400 grams of broken down proteins are replaced by newly

synthesized proteins. That equals the weight of nearly two cups of peanut butter!

The process of building larger things out of smaller things is called anabolism, while the breakdown process is called catabolism. The combination of both processes



A protein being broken down (catabolism) into peptides, which are then reformed (anabolism) into a protein.

is called metabolism. Metabolic activity is a good sign! Our cells stop metabolizing only when we die.

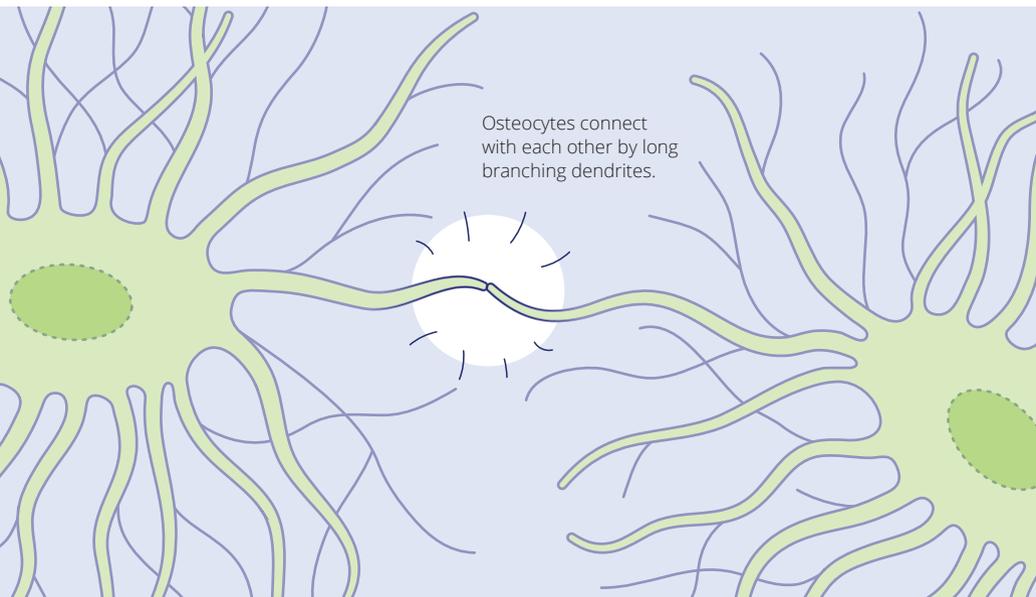
Within our bodies, anabolism and catabolism are dependent on one another. We've already seen how, when we eat protein in our food, our bodies break it down into amino acids: catabolism. Our bodies then use these amino acids to create their own proteins like collagen: anabolism. Catabolism is a necessary step toward anabolism. It provides the ingredients to synthesize the proteins that our bodies need.

Another neat example of this is bone remodelling. New bone continuously replaces old bone, particularly as we grow. Cells called osteoclasts resorb (dissolve) brittle or damaged bone matrix, and osteoblasts fill in the spaces left behind with new bone

matrix, mostly collagen. Some of the osteoblasts get trapped in the new matrix, and become cells called osteocytes, which are connected to each other by long branching dendrites.

These well-connected osteocytes can detect pressure or cracks in the bone, and kickstart the process that sends the osteoclasts to those areas to begin resorbing the bone. Anabolism and catabolism, in perfect equilibrium! Bone remodelling keeps your skeleton strong and healthy—at least until the age of 30, at which point osteoclast activity begins to exceed that of osteoblasts. In other words, more bone is removed than replaced.

So you might be asking: Why does catabolism outpace anabolism as we age?





If we make it, why take it?

You've just woken up. You sit up and stretch, then rub your stiff back. You swing your legs out of bed. **Okay, maybe not swing**—you're not up for that this early. You gently shift yourself to the side of the bed, where you manage to stand with some effort.

You pad down the hallway toward the bathroom, your knees throbbing dully. You blame the run you took yesterday. You often avoid running because your knees no longer seem to enjoy it as much as you do, but sometimes you just have to go for it.

You peer into the bathroom mirror. Nobody looks their best when they wake up, you tell yourself. But when did these new lines show up?

You smile ruefully at your reflection. Where's that elixir of youth when you need it?

Collagen's (partially) inevitable decline

Aging is a normal and inevitable process, and we all experience it. But what does that mean for our collagen?

We've learned about the amazing way your body makes collagen on its own, and we've looked at the way your body breaks it down. As you may have guessed, these two processes don't remain in balance forever.

When we're young and growing, our bodies are making more collagen than they're breaking down.

But sometime in our early to mid-twenties, our bodies break down collagen faster than we make it. After this, we produce about 1% less collagen every year. For women, this rate picks up at the beginning of menopause, before levelling off again. In the first five years of menopause, women can lose up to 30% of type I and type III collagen in their skin!

This is called intrinsic aging: the chronological, inevitable kind. But it's not the only factor that contributes to decreased collagen production.

What does menopause have to do with collagen loss?

You might know that estrogen is the hormone that regulates development and reproduction in the female body. But did you know estrogen also affects many tissues, from your brain to your bones? We don't yet understand how it all works, but we think estrogen is involved in the balance between collagen being synthesized and broken down in the skin and elsewhere. At around age 50, the female body stops producing estrogen hormones in the ovaries. At the same time, there is more of the collagenase enzyme that breaks down collagen.

The bottom line is that hypoestrogenism—low levels of estrogen, as in menopause—accelerates the skin's aging process. As goes estrogen, so goes collagen. The sort-of good news is that estrogen replacement therapy has been shown to increase dermal (skin) thickness by 30% in post-menopausal women. However,

this therapy is linked with a higher risk of breast and uterine cancer. Better news: A study has shown that after eight weeks of taking bioactive collagen peptides, women aged 45 to 65 had a significant reduction in eye wrinkle volume (20%), as well as significantly higher content of procollagen type I (65%) and elastin (17%) than the placebo group.



Other culprits in collagen loss

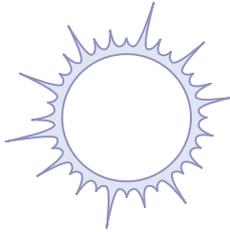
Let's look at some of the external factors affecting collagen production, over which we have more control. Remember, as your body's protective barrier, your skin takes the brunt of these factors. This helps explain why your skin is usually the first (but not only) place you notice signs of aging.

Sun damage

How many times have you heard how important it is to wear sunscreen?

We aren't here to scold. Instead, we'll just point

out that when your skin is exposed to UV rays, it increases the number of enzymes like collagenase, which breaks down collagen. That's why time and repeated exposure to UV rays leads to wrinkles, change in skin colour, and other visible signs of aging, all before you feel ready for them. It's called photoaging, but it doesn't leave you feeling very photogenic.



Smoking

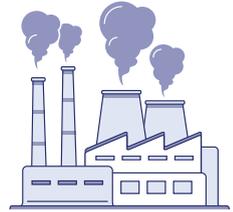
You know smoking is bad for you. But did you know it's bad for your skin? One study compared synthesis rates of collagen types I and III in a group of smokers and non-smokers (using suction blister fluid from a sun-



protected area of the body). The synthesis rates were lower by 18% and 22%, respectively, in the smokers compared with the non-smokers. Levels of MMP-8, a collagenase enzyme, were higher by 100% in the smokers.

Pollution

Ground-level ozone (O₃), the main ingredient in smog, harms more than your lungs. It leads to damage in the ECM, increasing amounts of MMP-9 (another collagenase enzyme), and a decrease in collagen types I and III.



Overexercise

The mechanical pressure on our joints when we exercise is a good thing: it lubricates and nourishes the cartilage, and even keeps collagen-busting enzymes at bay. However, overdoing it has the opposite effect. Too much stress on our joints wears down the cartilage, which has great difficulty regenerating itself in adulthood.

Also, high levels of stress—such as those experienced by a regular marathon runner—release the hormone cortisol, which appears to speed up the breakdown of collagen and elastin. In exercise as in most things, moderation is key.

How can I tell if I have enough collagen?

As we've seen, our bodies are very good at making their own collagen. As long as you're eating well and staying healthy, you're unlikely to ever be diagnosed with a "collagen deficiency." Even if you scrape your knee on your 100th birthday, your skin will still heal—it just may take longer.

But as you age, you may find that collagen loss hampers your activity and appearance in many ways. If that's the case, you may benefit from taking a collagen supplement. To help you determine if a supplement is right for you, here are some signs to watch out for.

Changes in your skin

As our protective barrier, skin is often where the earliest signs of aging appear.



The sagging mattress

Wrinkles are usually the first changes we notice in our skin. Fine lines tend to appear around our eyes in our thirties. As we get older and the collagen in our skin continues to diminish, these lines get deeper and deeper. Eventually shadows and then bags appear under our eyes, and nasolabial folds—the lines between our nose and the corners of our mouth—become more prominent. As years go by, our cheeks and chin start to droop, altering our entire facial structure.

Collagen loss is mainly what causes these unwanted changes in our appearance. Not only does collagen production slow down, but the remaining collagen is less organized, with fewer fibrous

bundles. Elastin becomes similarly disordered, and skin elasticity decreases. As the fibres in the dermis (the lower layer of your skin) become more fragmented, they're unable to support the epidermis above. If young collagen in the dermis is a bouncy new mattress, aging dermis is like a well-used mattress whose coils have begun to come loose.

To add insult to injury, there's also evidence that reduced mechanical tension—a loss of stretchiness in the skin—can itself make fibroblasts stop synthesizing as much collagen.



Easy bruising

Wrinkles and sagging skin aren't the only visible changes brought about by collagen loss. As our skin thins, our blood vessels lose some of their protection, so we bruise more easily. Blood vessels are themselves surrounded by collagen and become more fragile as we age, again leading to easy bruising.

Slow healing

Wounds taking their own sweet time to heal is also a sign of collagen loss. Fibroblasts become slower to deposit collagen at the site of a wound to create scar tissue. Wounds will still heal, but it takes longer.

More and more randomized, placebo-controlled studies show the benefits of collagen peptides on our skin's appearance, reducing wrinkles and roughness and increasing elasticity and density. Research tells

DID YOU KNOW?

BEAUTY BONUS

Lab studies of dermal fibroblasts indicate that collagen dipeptides (chains of two amino acids, in this case proline and hydroxyproline) not only helped fibroblasts increase in number, but also increased the production of hyaluronic acid, a substance in the ECM that binds very well to water and keeps skin moist.

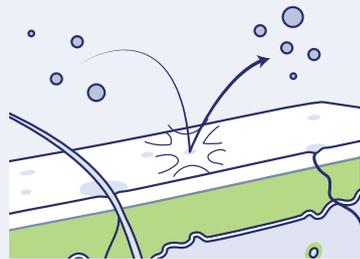
us that collagen peptides stimulate anabolic activity in skin tissue—that is, they help fibroblasts proliferate and increase their production of collagen, while reducing the MMP enzymes that break down collagen. Studies also support collagen peptides' ability to accelerate the wound healing process.

Should I use skin creams containing collagen?

Your friend swears by a skin cream that contains collagen. Should you buy it too?

While your friend may well have stumbled onto a great product, you can be sure it's not the collagen that makes it effective. Collagen molecules are simply too large to be absorbed by the dermis, and basically sit on top of your skin when applied. While they won't do any harm there, they also aren't doing anything useful. As for topical creams including smaller collagen peptides, there's still no solid evidence that they can penetrate the skin to encourage collagen production.

If you're hoping to plump up your skin and diminish wrinkles, you'll have far more success encouraging collagen synthesis from the inside out.



Collagen molecules are just too big to be absorbed by your skin

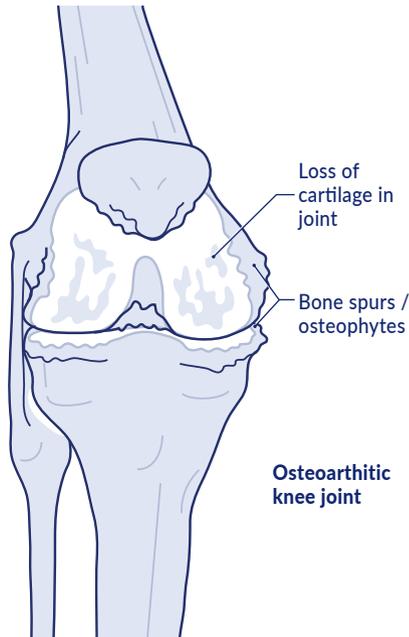
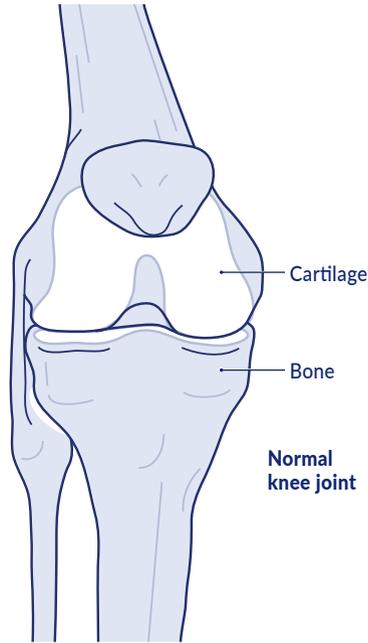
Joint pain

Do you have bad knees? Do you wake up with stiff hips? Decreased collagen may be the reason.

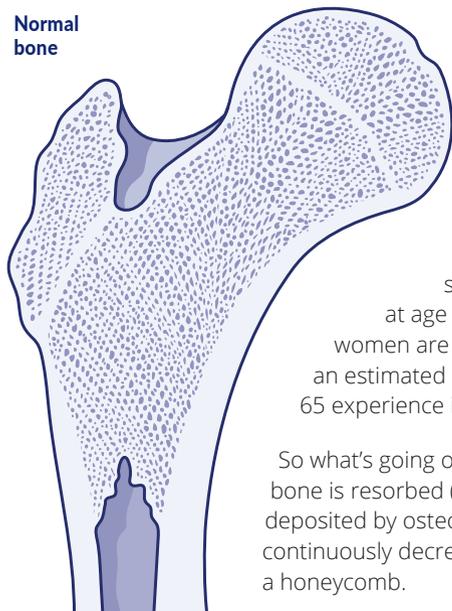
You've likely heard of osteoarthritis, also known as degenerative joint disease or "wear and tear" arthritis. In osteoarthritis, the cartilage in your joints breaks down, increasing friction between the connecting surfaces of your bones. You most often notice it in your hips, knees, spine, and fingers. You may feel stiffness in the mornings, and maybe even pain throughout the day.

Because it can change shape under pressure, cartilage normally acts as an excellent shock absorber in our joints. As the type II collagen in cartilage decreases, the cartilaginous tissue loses its integrity and its shock-absorbing ability, and begins to erode. In severe cases of osteoarthritis, the cartilage may wear away entirely. Ouch!

The trouble is, pain often makes us exercise less, and you need movement to trigger the fluid that lubricates and nourishes the cartilage. This causes a vicious cycle that can only lead to worsening cartilage. If you're avoiding exercise or certain positions because of joint pain, or feel that your joints are "creaky," you might consider a collagen supplement.



**Normal
bone**



Bone loss

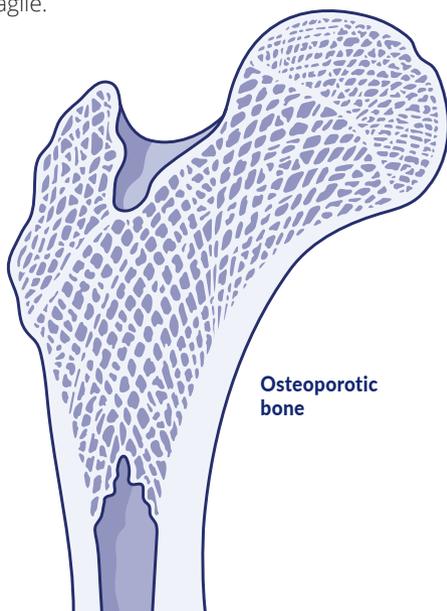
This one is tricky to watch out for, since you may not feel bone loss in the same way that you feel pain in your joints—until you sustain a fracture.

But it's important to keep in mind that osteopenia, the earliest stage of osteoporosis, can begin at age 35. Statistically, post-menopausal women are especially prone to osteoporosis: an estimated 25% to 35% of women over 65 experience it.

So what's going on in osteoporosis? Essentially, more bone is resorbed (dissolved) by osteoclasts than is deposited by osteoblasts. As a result, bone mass continuously decreases, and becomes porous, like a honeycomb.

While most of us know that calcium is necessary for strong bones, we may be missing an important part of the puzzle. Bones are a combination of hard minerals and soft matrix, 90% of which is type I collagen. Remember that earlier example of rebar in a bridge? Think of what happens when that rebar rusts. The entire structure becomes fragile.

If you have osteoporosis or want to head it off early, collagen supplements can help. One study found that taking collagen peptides daily over 12 months greatly increased bone mineral density of post-menopausal women, in the spine and femoral neck (where hip fractures most commonly occur). The study also showed increased bone formation and reduced bone degradation in these women, when compared to a placebo group. And stronger, denser bones means less risk of fractures.

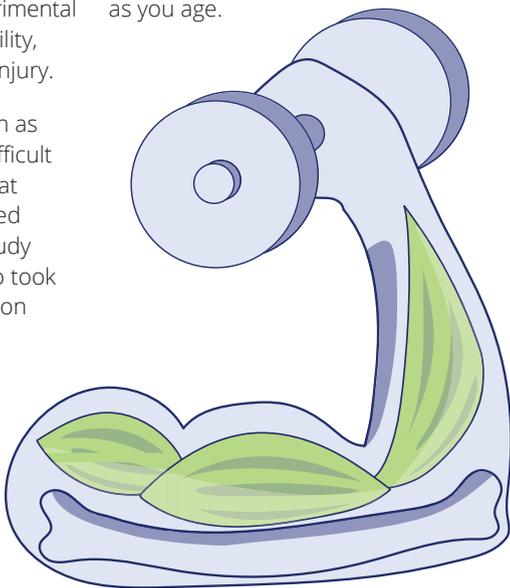


Weak muscles

Muscles: if we don't use them, we lose them. But even if we use them, they can still shrink as we age. Around 50% of all 80-year-olds have sarcopenia, age-related loss of muscle mass and strength. Sarcopenia has a detrimental effect on your health and mobility, leaving you frail and prone to injury.

If you find you can't lift as much as you used to, or stretching is difficult or painful, there is evidence that collagen supplements combined with exercise can help. One study indicated that elderly men who took collagen peptides in combination with resistance training three times a week experienced a significant increase in muscle mass and decrease in fat mass, compared with a control group that did the same training but took a placebo instead of collagen peptides.

Every bodybuilder knows that you need protein to build muscle. But proteins like collagen also simply help you maintain healthy muscle as you age.

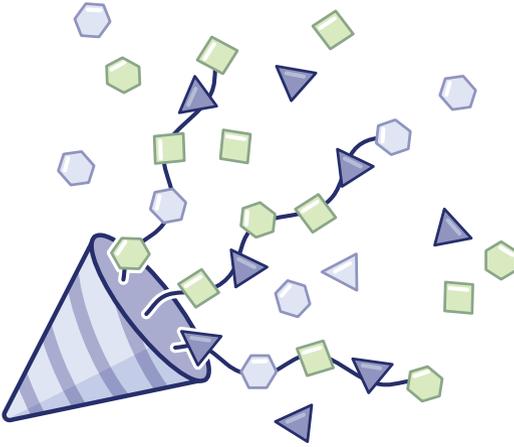


Can my diet make up for lost collagen?

Your mother may have told you to eat a balanced diet. If so, she was right! Your body gets many of the amino acids it uses to build healthy collagen, such as lysine, only from your food. And we already saw how vitamins like vitamin C are necessary to synthesize collagen, and need to be in your diet.

But eating healthy can only do so much to halt the gradual collagen loss as your body ages. That's because

when you digest proteins, they are broken up into amino acids and sent to wherever your body can use them. And since proteins are at work literally everywhere, there's no way to make sure the protein you eat will turn into the collagen you want. So while there's every reason to keep eating the "right" foods—we want to be healthy, after all—there is very little payoff in terms of increased collagen production.



Collagen peptides for the win!

People have long been interested in “getting more collagen.” From the *ejiao* of ancient China to collagen injections and topical creams, we have tried many ways to boost the collagen in our skin, joints, bones, and elsewhere. While some of these methods are proven more effective than others, one specific collagen supplement has been getting lots of attention lately, and it deserves yours too: collagen peptides.

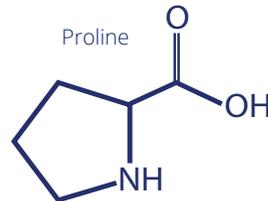
Remember how collagen is made of three long strands of amino acids (polypeptide chains)? Peptides are simply shorter amino acid chains.

What sets peptides apart from other sources of collagen? Their bioavailability.

DID YOU KNOW ?

PROLINE'S A PRO

The amino acid proline is remarkably resistant to digestive enzymes. Proline and hydroxyproline make up a quarter of the amino acids in collagen peptides, and this helps protect the peptides from being broken down further as they go through the gastrointestinal tract.



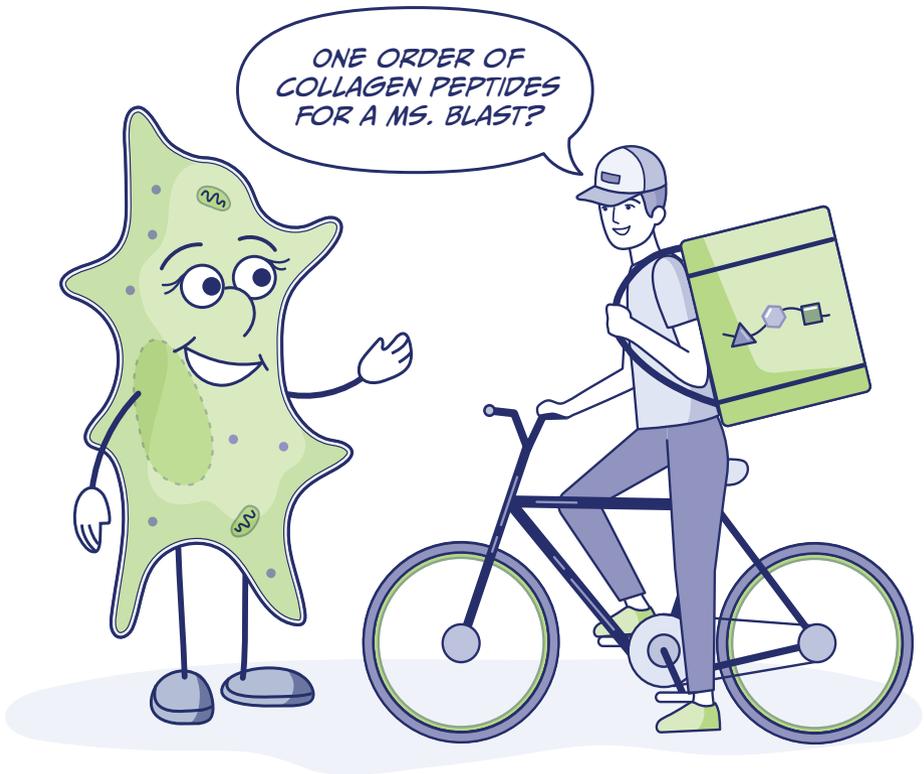
The journey of your lunch

Bioavailability is the amount of a substance, such as a drug or protein, that can cross our intestinal barrier, reach the bloodstream, and be available for metabolic processes in the body.

Let's briefly walk through how your cells get their nutrients: You take a bite of a turkey sandwich, for example. You chew and swallow it, and it heads down your esophagus and into your stomach. Here, acids and enzymes dissolve the sandwich and begin to break down the proteins. Then it's on to the small intestine, where enzymes

break down the fats into fatty acids, the carbohydrates into glucose, and the proteins into amino acids.

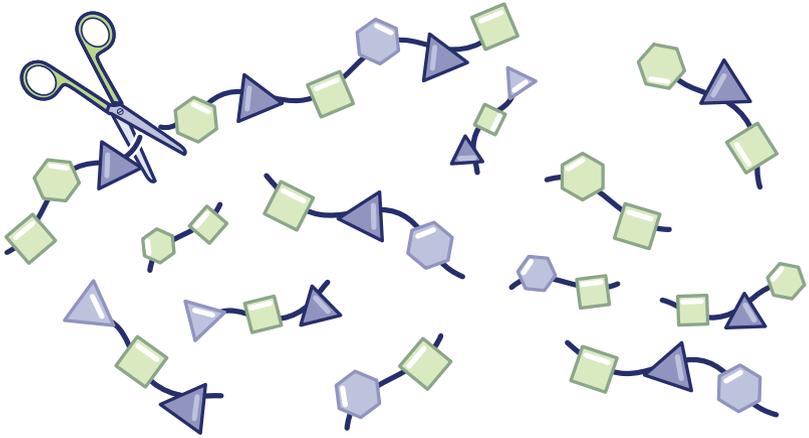
The small intestine absorbs these nutrients and transfers them into the bloodstream, which taxis them around the body to nourish our organs and tissues.



Your food must be broken down into incredibly small pieces to be absorbed into the bloodstream. Since collagen peptides are very tiny snippets of larger polypeptide chains—just two or three amino acids strung together—they come “pre-digested.” When you take them, they’re already raring to get to work! Peptides are small

enough to pass through the small intestine into the bloodstream, ready-to-go building blocks of collagen that are taken to the parts of your body that can use them.

In other words, they’re highly bioavailable.



Is bone broth as effective as collagen peptides?

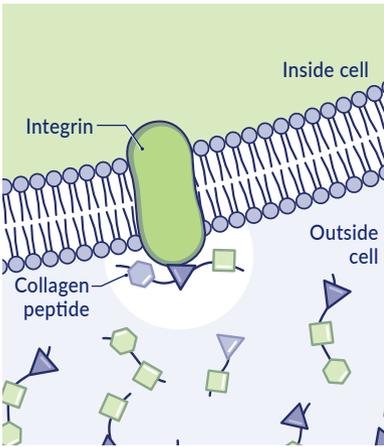
If you’ve read anything about collagen online, you’ve probably also read some of the hype around bone broth. But bone broth, made from simmering animal bones for many hours, isn’t anything new, as people have been eating collagen-rich food for centuries. The idea is that the long simmering process leaches the collagen out of the bones, leaving you with a protein-packed meal that should gel in the refrigerator. (When cooked for long enough, collagen turns to gelatin, which turns wobbly when it cools.)

Bone broth is certainly a great (and delicious) source of amino acids, and

may have other benefits as well, such as soothing cold symptoms. However, bone broth is not hydrolyzed: we still have to break down the proteins into amino acids that our body can use, which it uses at its own discretion—either to make collagen or any number of other proteins. This means that, even if we are committed to simmering bones for 24 to 48 hours and drinking the broth daily, bone broth cannot target specific collagen concerns the way that peptides can.



How do peptides help collagen production?



Collagen peptides help fibroblasts and other cells make collagen in two ways.

First, and most simply, peptides provide raw building blocks for collagen. No building blocks, no collagen.

The second way is a little more interesting. Collagen peptides bind to the integrin receptor proteins on the surface of fibroblasts, and this triggers the fibroblast to produce more collagen. The more peptides

How is collagen turned into peptides, anyway?

Maybe you're wondering: how do manufacturers snip collagen proteins into teeny-tiny peptides that can pass through your small intestine and into your bloodstream?

A process called enzymatic hydrolysis uses heat, water, and enzymes to create precise peptide sequences. First, animal tissues (bones, connective tissues, skin, scales) are heated in water, which breaks the bonds that hold the collagen molecules together and creates gelatin—just like when we simmer meat bones to make broth. But to isolate specific peptide sequences, gelatin must be broken down much further, which is done using enzymes. The process is similar

to human digestion, but much less random. Imagine the precision it takes to isolate a sequence of two or three specific amino acids!

At the end of the hydrolysis process, we're left with a soluble, odourless, practically tasteless powder that won't turn thick and wobbly like gelatin, even in hot liquids—good news if you'd like to take collagen with your coffee.

Does it matter where my collagen peptides come from?

Typically, collagen peptides are extracted from bovine (cow), porcine (pig), or marine (fish) sources. Unless you have an allergy to one of these or choose not to eat it for some reason, any of these sources is a great choice, since the peptide sequences from them are identical.

CanPrev's collagen peptides are mostly bovine-derived. Since we're as concerned as you are about what goes into your body, our sources are pasture-raised, grass-fed, and GMO-free.

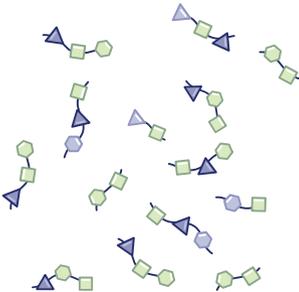
in the area, the more signals to produce collagen.

It's like a bricklayer seeing a pile of bricks, and knowing that it's his job to use them to build a wall. He picks up bricks from the pile and places them side by side, just as a cell sequences amino acids to synthesize collagen. The bricklayer works steadily at first, but slows down as his pile of bricks gets smaller.

But what if we dump a new pile of bricks beside him when he's not looking? When peptides bind with integrin, the cell recognizes the peptide fragments as broken down collagen, or a fresh pile of bricks. As this happens, the cell senses an imbalance. In response, it promptly produces more collagen. The bricklayer sees the new pile, and picks up the pace. The wall goes up quickly.

Scientists have conducted many in vitro studies on this subject over the years.

Pretty cool, right?

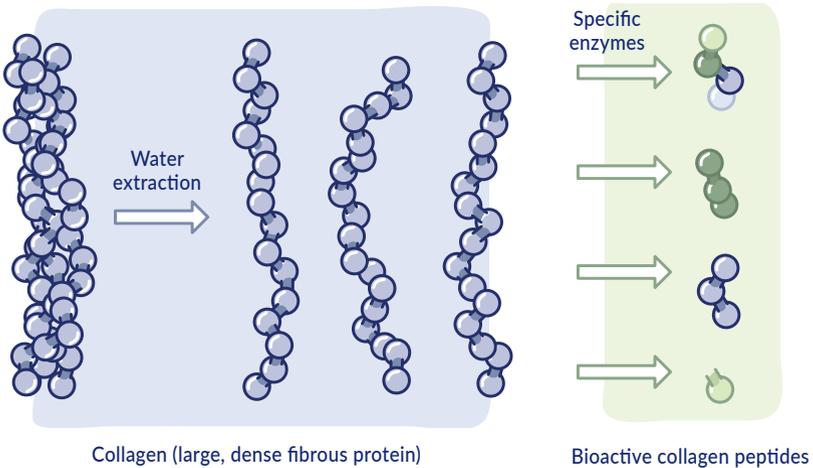


Can we control where collagen is produced in the body?

We've talked a lot about how amino acids from the protein we eat are distributed to wherever the body can use them, and we have little control over where they end up. So can we actually direct peptides to trigger collagen synthesis where we want it? We think we can.

Size matters

Collagen peptides can target a range of different health concerns—skin, joints, bones, and muscles—in molecular weights ranging from 2 to 5 kilodaltons (kDA). Since one kilodalton is equal to 0.000000000000000000166054 (1.66054e-21) grams, this range may seem too tiny to be important. But it means big things for different areas of your body.



By controlling the size and sequence of the peptides—that is, which amino acids are included—we're able to effectively address a range of health concerns.

While it's unlikely that peptides of a specific molecular weight trigger collagen synthesis in only one area, collagen peptides have been researched in a lab to determine where they do their very best work. This research looked at the

interactions of different sizes of peptides with different tissues, then calculated the percentage of activated fibroblasts or other cells. The studies confirmed the correlation between certain molecular weights and collagen-building in different tissues.

According to this research, dosage size also affects the performance of collagen, and this varies depending on the health target. For example, while 2.5 grams of 2 kDa is most effective at targeting collagen production in the

skin, 5 grams of 5 kDa is most effective at targeting bone formation.

Want to know which collagen peptide sizes are right for your specific health concerns? Flip to page 64 for more.

Studies show...

Test-tube experiments are one thing, but do collagen peptides really work in a living, breathing, aging human body?

A growing number of clinical trials confirm what the lab studies found. Here are some of those results for the different peptide formulas used in CanPrev's collagen.

Beauty

In an eight-week study, 114 women between ages 45 and 65 took 2.5 g of either 2 kDa collagen peptides or a placebo. The women who took the peptides experienced a 20% reduction in eye wrinkles, and their skin ECM showed 65% more procollagen type I and 18% more elastin than the placebo group. Recent studies have also confirmed that these peptides have a positive effect on hair thickness and the number of hair follicle cells.



Is there such a thing as vegan collagen?

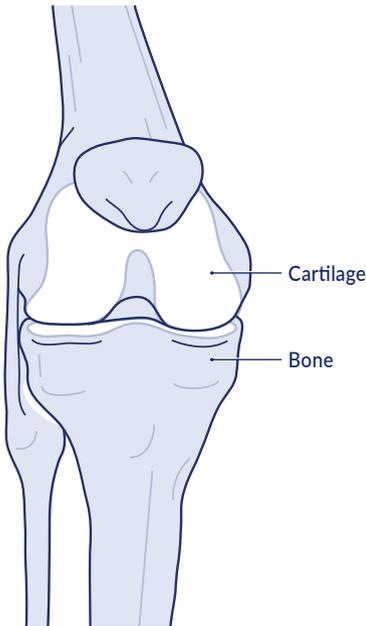
Unfortunately for vegans, all collagen is derived from animal sources. Efforts to produce synthetic collagen in a laboratory have yet to create a product that's readily available on the market. Vegans sometimes choose to take collagen boosters, which usually include plant-derived amino acids and vitamins that are necessary in the production of collagen. While these boosters may benefit users by providing some of the raw materials for collagen synthesis, they cannot trigger collagen production in the same way that intact collagen peptides can.

There's another option for vegans however, and that's silicon. Silicon is a chemical element that's found throughout the earth's crust and oceans, and as a trace element in our bodies. We saw earlier that silicon helps activate the hydroxylation enzymes that build strong collagen networks. It's particularly helpful for skin, hair, and nails: higher silicon content in hair seems to reduce hair loss, and higher silicon content helps to strengthen nails. In skin, silicon is associated with the synthesis of ECM glycosaminoglycans like hyaluronic acid, which is tied to skin moisture, and even increases the number of collagen-making fibroblasts. Bonus: It's completely vegan!

Joints

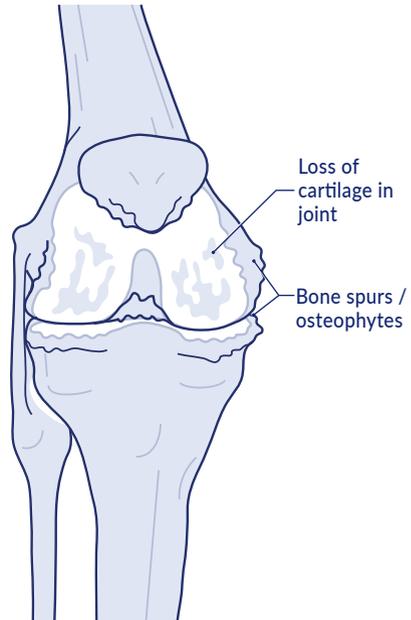
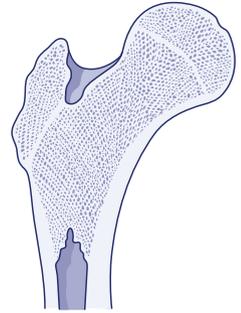
A study of people with early knee osteoarthritis found that those who took 3 kDa collagen peptides experienced cartilage tissue regeneration after 24 weeks, including a large increase in proteoglycan density, as compared to a placebo group. (Proteoglycans are responsible for trapping the water that cushions the joints and lubricates the cartilage.)

Another study indicated that collagen peptides at this molecular weight improved pain, stiffness, and joint function in young adults suffering from activity-related knee pain. In more than 40% of all patients, pain was reduced completely.



Bones

Over 12 months, 180 women with low bone mass (osteopenia or osteoporosis) took 5 grams of 5 kDa collagen peptides or a placebo every day. The women taking the collagen peptides showed a marked increase in bone mineral density in the spine and femoral neck (just below the ball-and-socket joint where your upper leg meets your pelvis, where hip fractures most often occur. Remember how the rate of catabolism (breaking down) in bone



overtakes the rate of anabolism (building up) as we age? This study indicates that collagen peptides can tip the scales back in favour of anabolism.

Muscles

Several studies have shown that collagen peptides at a molecular weight of 3.5 kDa, combined with resistance training, can have a powerful impact on both young and aging muscles.

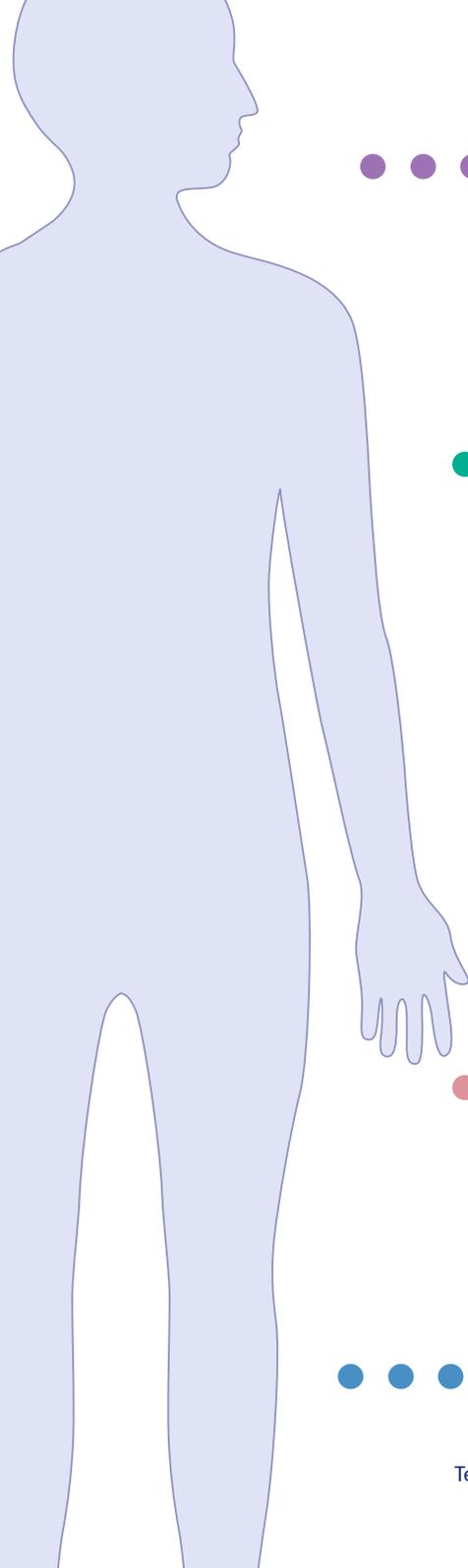
Just as peptides send a signal via fibroblast, osteoblast, and chondrocyte receptors to produce more collagen, peptides seem to regulate protein metabolism in muscles, keeping synthesis and breakdown in balance. Collagen peptides increase lean body mass and muscle strength.

In one study, over 100 inactive men aged 35 to 60 took either 15 grams of 15 kDa collagen peptides or a placebo, with resistance training. The researchers found that when men combined exercise with a post-workout collagen supplement, they built significantly more lean body mass (muscle mass, bone mass, connective tissue) within three months than those who exercised just as much, but took a placebo. The results were similar in a study of elderly men who already had sarcopenia.



The bottom line?

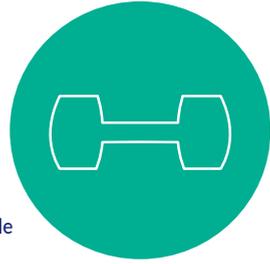
From our skin to our muscles, collagen is essential to our physical makeup, many of our bodily functions, and our appearance. People from different eras and cultures have long been “taking collagen” in different ways to combat its inevitable decline in their bodies. But our understanding of the science behind peptides has allowed us to take what people have always known—that collagen is good for us, in some way or another—and hone in on the best way to help our bodies keep producing this incredible protein.



Skin



Muscle



Bones



Joints



Tendons



CanPrev collagen: The power of choice

When we designed our collagen peptides, we wanted to achieve several important things.

First, we wanted to provide peptides that the body can absorb whole, so that they can get to work for you immediately.

We also wanted to design products that make sense for you right now. We know everyone experiences collagen loss in different ways and at different times.

We wanted our peptides to target your specific concerns—skin health, joint health, bone health, or muscle health—and to activate collagen synthesis right where you want it.

And of course, the peptides have to be easy to use. We tested the solubility of our powders, or how well it dissolves into your favourite drinks, both hot and cold, to make sure you look forward to taking collagen every day. Our liquid products can be easily mixed, or taste clean and pleasant on their own.

Your health is our top priority. We wanted our collagen products to be completely clean and safe: pasture-raised, grass-fed, gluten- and GMO-free, with absolutely no artificial additives.

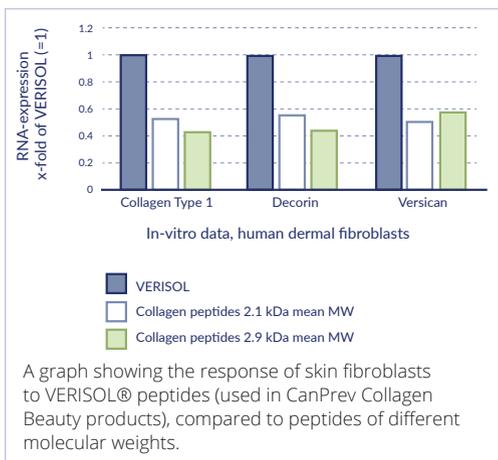
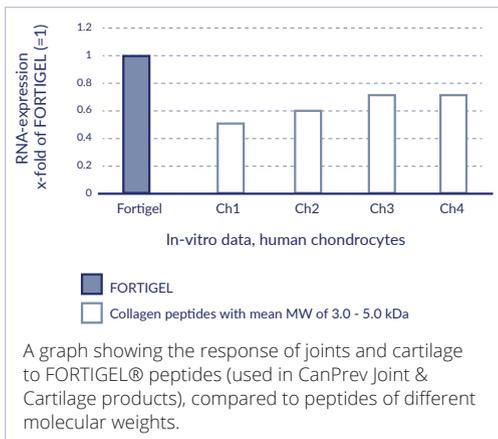
Good product design takes all of these factors—effectiveness, choice, ease, and safety—into account.

We think we've done that with our collagen.

Which collagen peptides are right for me?

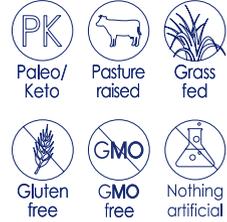
The short answer is, it depends what you want to achieve. CanPrev's collagen peptides are ideal for those suffering from age-related issues that affect skin, bones, joints, and mobility, as well as active individuals experiencing "wear and tear" on their joints. The peptides you choose will depend on your health goals and stage of life. Whether you are interested in building strong bones or combating osteoporosis, easing joint pain, improving your skin, or maintaining healthy muscle mass, we offer a product that's right for you.

All of CanPrev's collagen peptides are characterized not only by their small size and precise sequencing, but by their excellent solubility. They dissolve well in any cold or warm beverage, while remaining highly bioavailable and easily absorbed whole by your gut.



Here's a breakdown of CanPrev's collagen peptides, the areas they target, and their average molecular weights, as well as the recommended doses for optimal results.

Product	Health benefit	Average molecular weight	Effective dose
CanPrev Beauty	Skin, hair, and nails	2 kDa	2.5 g
CanPrev Joint & Cartilage	Joints	3 kDa	5 g
CanPrev Bone	Bones	5 kDa	5 g
CanPrev Muscle Tone	Body composition	3.5 kDa	15 g
CanPrev Full Spectrum	Whole body	2-5 kDa	5-10 g



Collagen Beauty

By supporting skin elasticity and healthy collagen production, Collagen Beauty helps improve the appearance of skin, reduces wrinkles, and diminishes fine lines. Designed to stimulate fibroblast cells in the skin, this unique liquid formula contains

bioactive epidermal collagen peptides that are clinically proven to help reduce eye wrinkles in as early as 28 days. It also reduces the appearance of cellulite and improves nail growth.

What's inside

Verisol™ Bioactive Collagen Peptides® 2kDa
(Type I and III hydrolyzed bovine collagen)

Available formats

Powder and Liquid

Ideal for



Aging



Women 30+



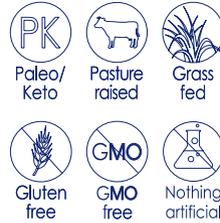
Fine lines
and wrinkles



Skin/
wound healing



Hair, skin
and nails



Collagen Joint & Cartilage

Collagen makes up approximately 70% of the body's cartilage. As we age, we may experience more joint conditions related to cartilage wear and tear. In order to keep our cartilage matrix healthy, proper

joint homeostasis and turnover of new chondrocyte cells is necessary. These peptides act as a continuous nutrient supply for more collagen production directly at the joints.

What's inside

Fortigel™ Bioactive Collagen Peptides® 3kDa
(Type I and III hydrolyzed bovine collagen)

Available formats

Powder

Ideal for



Joint repair



Osteoarthritis



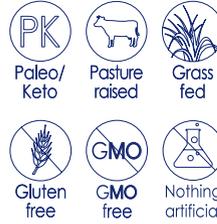
Inflammation



Active lifestyle



Endurance athletes



Collagen Bone

Collagen is a major component of bone tissue and is important for maintaining bone strength. The collagen peptides in this formula target connective tissue cells to stimulate extracellular bone matrix for enhanced collagen building at your

bones. And when you combine these clinically studied bioactive peptides with ultra gentle and highly absorbable forms of vitamin D3, soy-free K2, calcium and magnesium, you ensure the best support for your bones.

What's inside

Fortibone™ Bioactive Collagen Peptides®
(Type I and III hydrolyzed bovine collagen)

5kDa

Plus:

Vitamin D3 (cholecalciferol)

Vitamin K2 (menaquinone-7, K2VITAL)

Calcium

(TRAACS calcium bis-glycinate chelate)

Magnesium

(TRAACS magnesium bis-glycinate chelate)

Available formats

Powder

Ideal for



Bone & Teeth



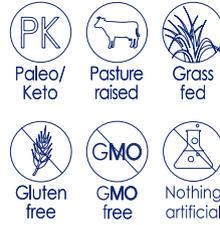
50 years
or older



General health



Osteoporosis



Collagen Muscle Tone

Highly specialized and clinically studied, these peptides are ideal for the active individual wanting to achieve optimal muscle strength and tone. When combined with resistance training (2–3 times per week), these peptides

are proven to enhance one's lean body mass. Studies also indicate these peptides are beneficial for reducing muscle atrophy, helping aging individuals who want to maintain muscle mass.

What's inside

BodyBalance™ Bioactive Collagen Peptides® (Type I and III hydrolyzed bovine collagen)

3.5kDa

Available formats

Powder

Ideal for



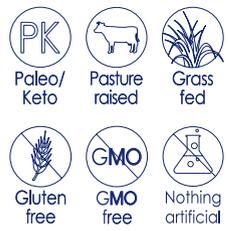
Those looking to improve body composition



Individuals wanting to maintain muscle mass



People aged 60–80 with age-related muscle loss



Collagen Full Spectrum Powder

CanPrev's Collagen Full Spectrum features hydrolyzed Peptiplus® Bioactive Collagen Peptides™, a premium source of peptides

designed to build up the body's collagen stores in your joints, hair, skin, bones, ligaments, and muscles.

What's inside

Bodybalance™ Bioactive Collagen Peptides® (Type I and III hydrolyzed bovine collagen)

2-5kDa

Available formats

Powder

Ideal for



Muscle tone



Speeds recovery



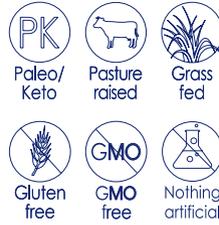
Bone strength



Beauty



Joint repair



Collagen Full Spectrum Blend Liquid

Factors like UV radiation, hormonal changes, nutrient deficiencies and dehydration contribute to decreased collagen production. This results in wrinkles, loose skin, muscle atrophy, and joint pain.

CanPrev's Collagen Full Spectrum ensures the body always has a supply of peptides for collagen production. This unique blend of type I and type III collagen helps support joints, bone, muscle, and skin health.

What's inside

Full Spectrum Blend
(Type I and III hydrolyzed marine and bovine collagen)

Available formats

Liquid

Ideal for



Muscle tone



Speeds recovery



Bone strength



Beauty



Joint repair

Frequently asked questions

What's the right amount of collagen to take? Is it possible to take too much?

It's difficult to overdose on collagen, but there's no need to take more than is necessary. The right amount to take depends on which product you're using and which health concern you're targeting. We recommend the following doses:

Product	Effective dose
CanPrev Beauty	2.5 g
CanPrev Joint & Cartilage	5 g
CanPrev Bone	5 g
CanPrev Muscle Tone	15 g
CanPrev Full Spectrum	5-10 g

Should I take collagen peptides every day?

Yes, collagen peptides should be taken daily for best results.

Can I add collagen peptides to coffee or other hot drinks?

Research indicates that our collagen remains effective (doesn't degrade) at a temperature of 180°C (356°F), which is considerably hotter than even an "extra hot" coffee from Starbucks (82°C, 180°F). So you can safely enjoy your collagen peptides in whatever beverage you choose.

Are there side effects to taking collagen peptides?

Collagen peptides are completely safe, and most people don't experience

any side effects. Some complain of gastrointestinal upset, but this is generally mild.

Can collagen peptides help me lose weight?

Collagen peptides are not intended as a meal replacement, but they can promote weight loss in several ways. They can make you feel full for some time, helping you cut down on snacks between meals. And if taken in combination with strength training, they can also help build muscle, which burns calories.

I'm vegan. Can I take collagen peptides?

If you're on a strictly plant-based diet, collagen isn't for you, as it's derived from animal sources. Another option is silicon, a trace element in our bodies that helps activate the hydroxylation enzymes that build strong collagen networks. It's particularly helpful for skin, hair, and nails.

Why don't you include tryptophan in your collagen peptides?

Collagen peptides contain all essential amino acids, with the exception of tryptophan. We are simply following our body's own formula: our cells cannot use tryptophan to build collagen, so adding it to our products is unnecessary. Collagen peptides are not a meal replacement, and we recommend eating a wide range of healthy foods to get all of your essential amino acids, including tryptophan.

Which is best: bovine, porcine, or marine collagen?

There is no appreciable difference in collagen quality from any of these sources, as the peptide sequences from all of them are identical. Of course, if you have an allergy to one of these or choose not to eat it for any reason, you may wish to choose one of the other sources. CanPrev's collagen peptides are mostly derived from bovine sources, which are pasture-raised, grass-fed, and GMO-free.

When will I begin to see results?

That depends on which product you are taking. Based on studies of our products, we have determined the following timelines for noticeable results (although results may also show up sooner):

- With CanPrev's Collagen Beauty, you will begin to see improvements in facial wrinkles within four weeks, stronger nails within two months, and increased hair thickness within four months.
- With our Collagen Joint & Cartilage, it will take three months to feel

a difference in your joints, due to the slower growth and repair of cartilage tissue.

- If you take CanPrev's Collagen Muscle in combination with resistance training, you will begin to see improvements in muscle tone within 12 weeks.
- You can expect increased bone mineral density within 12 months of taking CanPrev's Collagen Bone.

Once I'm happy with my results, do I need to keep taking collagen peptides?

While its benefits may linger for weeks after you stop taking collagen, your body will soon revert to its natural catabolic ways, and anabolic activity will decline. To maintain higher levels of collagen production, it's important to take collagen peptides continuously.

Question not answered? Let us know.

info@canprev.ca
t. 888 226 7733



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Good health is the gateway to a good life, whether it's feeling good enough to put in a productive day's work, taking in a spectacular view, keeping up with the pack on a run, playing hide and seek with the kids, or just feeling extraordinary, everyday.

CanPrev exists so that you can live the life you want, however you want, without limitations. We want to provide you the knowledge and tools to help you find your own road to good health, and the road to greater adventures.

Our reason for being

CanPrev grew out of a desire to make natural medicine safe, effective and accessible to everyone. Good health is at the heart of all good passions. It is behind every shout-worthy accomplishment, every mountain climbed, every hard-earned victory.

It involves understanding how your body works. A strong collaboration with practitioners. And supplements you can trust are reliable and powerful. These are the core values of a company started by a partnership between determined patients and natural health practitioners.

We are focused on making the best possible products that informed people and real practitioners can rely on. It demands really understanding root causes. It requires understanding the role of every ingredient before anything goes into a capsule. And it insists on the highest standards of purity and potency.

Staying true to our mission has helped to create a company that we are proud to work for. And for over a decade, our passion for good health has driven us as much as it has sustained us. We're working to put your health back into your hands.

A portrait of Tanya Salituro, a woman with long dark hair, smiling warmly. She is wearing a blue long-sleeved top. The background is a blurred, textured wall.

A cancer survivor and busy mother of four, Tanya Salituro founded CanPrev in 2005 to share the passion she developed for natural health during her three separate journeys with breast cancer.

“Natural health is about the whole person. It goes beyond treating the symptoms - it also strengthens the body, mind and spirit. It leads to stronger people, stronger families, stronger communities and a stronger planet.”

Tanya Salituro
Founder, CanPrev

Why choose us?



In-house experts

Natural health practitioners are involved in everything we do: research & development, quality assurance, and education. They shape how we think and how we act - always in the best interests of the people using our products.



Premium ingredients

Only the finest quality materials are chosen, and our team thoughtfully reviews every ingredient to meet our exact specifications for identity, purity and potency.



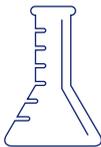
Used by practitioners

Health professionals believe in CanPrev and trust our research, ingredient selection and formulations. Canadian practitioners confidently recommend them in practice.



Quality guaranteed

Health Canada licensed and manufactured at GMP licensed Canadian facilities. Every batch is tested by independent laboratories for that extra level of quality.



Advanced formulations

Our formulations combine the latest research with the best creative and critical thinking.



We are Canadian

CanPrev is proudly Canadian-owned, with natural health products developed by Canadian licensed healthcare practitioners and made right here

Courage.

Being responsible for your future health.
It's an act of courage.

It's the act of eating home-cooked, not fast food. Walking more and driving less. Seeking answers but not easy answers.

It's paying attention to symptoms. Understanding your body and making decisions. Putting yourself to bed when you're too tired to care. Helping yourself when no one else can help.

We know that these acts, while seemingly simple, are not easy. But they're important, because the best health care happens when you care about your own health.

By taking back control of your health, you inspire us to create the best possible natural health options we can, set to the highest standards. Health products that practitioners and responsible Canadians can use.

We're driven to help those who help themselves.



Jordan Bryden
CanPrev Ambassador,
Canadian Triathlete

Understand your health needs, then take advantage of **more than 100 premium natural health products** to achieve your goals. Designed by natural healthcare practitioners to offer therapeutic doses, the best ingredient forms, and evidence-based formulations that make sense.



Adrenal-Pro



Blood Sugar Support



Cold-Pro



Detox-Pro



Digestion & IBS



Eye-Pro



Healthy Heart



Healthy Lungs



Healthy Bones



Healthy Mood



Immuno Multi



Joint-Pro



Meno-Prev



Mind-Pro



Osteo Prolong



Pain-Pro



Prostate-Pro +
Maca Support



Slim-Pro



Thyroid-Pro



Green Up!
with GRAMS



Myc010



L-Glutamine



5-HTP 100



Adult Multi



Antioxidant
Network



Alpha Lipoic
Acid 600



Calcium
Malate Bis-Glycinate 200



Curcumin-Pro



D3 Softgels



D3 Drops



D3 Drops
for kids



D3 & K2 Softgels



D3 & K2 Drops



K2 Softgels



K2 Drops



I-3-C 200



Iron Bis-Glycinate 20



Iron Bis-Glycinate 25



L-Theanine



Magnesium Bis-Glycinate 200 Gentle



Magnesium Bis-Glycinate 140 Extra Gentle



Magnesium Bis-Glycinate 80 Ultra Gentle



Magnesium Bis-Glycinate 200 Gentle Powder



Magnesium + GABA & Melatonin for Sleep



Magnesium + Taurine, B6 & Zinc for Cardio



Magnesium Malate



Magnesium + Vegan D3 & K2



Magnesium Multi Mineral



Omega-Pro HP 40/20



pH-Pro



Prenatal Multi



Pro-Biotik 15B



Pro-Biotik Powder



Resvera-Pro



Selenium Glycinate 200



Synergy B



Synergy C



Ubiquinol 100



ElectroMag



Joint Pro Concentrate



Oil of Oregano



Vitamin A Drops



Zinc Bis-Glycinate 25



Zinc Bis-Glycinate 50 Ultra Strength



Zinc 50 Ultra Immune + Vitamin C



Fibre Feel



Myo-Inositol



Active Multi

FEATURED PRODUCTS



Healthy Mood

- Features saffron, GABA, 5-HTP, active B vitamins, magnesium and zinc
- Promotes healthy mood balance
- Reduces the severity and duration of migraines



BioActive B

- A complete formula in preferred active forms for maximum absorption
- Especially needed during times of physical and mental stress
- Available in liquid and capsules



GABA 500

- 500mg dose of GABA
- Promotes a restful, relaxed state without diminishing alertness
- Low GABA activity is linked to insomnia and disrupted sleep



Beautiful Skin

- Clinically proven to reduce wrinkles in 15 days
- Increases skin elasticity and skin moisturization
- Plant-based formula



Hyaluronic Acid

- Helps to increase skin smoothness and sustain skin hydration
- Paired with silicon and biotin for healthy hair, skin and nails
- Produced using vegan microbial fermentation



Silicon + Biotin

- A nourishing combination to help maintain beautiful hair, skin and nails
- Featuring 100% soluble MMST silicon, derived from Nova Scotian quartz
- The most soluble and bioavailable silicon plus biotin for better skin



Magnesium
Drink Mix
Juicy Blueberry



Magnesium
Drink Mix
Orange Zest



Magnesium
Drink Mix
Fruit Punch

Tantalize your taste buds with three delicious natural fruit flavours. Mix in Juicy Blueberry, Orange Zest or Fruit Punch magnesium - 250mg per scoop. Stir it in some refreshingly cold water and enjoy!

magnesium.ca



Magnesium
Bis-Glycinate 50
Chewable
Tropical Pineapple

- Delicious natural tropical pineapple taste
- Great for kids and adults
- Easy-to-digest buffered bis-glycinate chelate
- 50mg magnesium in each piece



Magnesium
Bis-Glycinate 250
Ultra Gentle Liquid
Juicy Blueberry

- 250mg of pure elemental magnesium per tablespoon
- Designed for maximum potency and gentleness
- With a delicious blueberry taste that the whole family can enjoy



Magnesium
Bis-Glycinate 300
Ultra Gentle Liquid

- Easy and gentle on the bowels
- 300mg of pure elemental magnesium per tablespoon
- Recommended for those with multiple prescriptions or digestive conditions like Crohn's and colitis

FEATURED PRODUCTS



Omega Twist
Lime-Licious



Omega Twist
Peachy Mango



Omega Twist
Tangerine Tang

CanPrev's Omega Twist fish oils are a mouthwatering way to get your daily dose of omega-3 fats. Don't let these mega tasty flavours fool you - they are chock full of highly concentrated EPA and DHA, plus 1000 IU of vitamin D3 and E for easy absorption. Enjoy this fun twist to taking your omegas. Sustainably sourced and available in three tasty flavours: **Lime-Licious**, **Peachy Mango** and **Tangerine Tang**.



Omega-Pro
Balance

- 2550mg of EPA + DHA
- 4400mg of wild deep sea fish oil
- Native triglyceride form
- Delicious goji lemon taste



Omega-Pro
High EPA

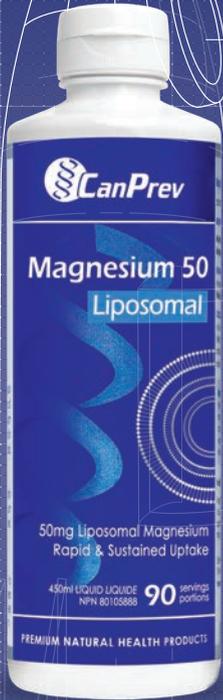
- 2200mg of EPA
- 4400mg of wild deep sea fish oil
- Native triglyceride form
- Delicious goji lemon taste



Omega-Pro
High DHA 1-5

- 2020mg of DHA
- 4400mg of wild deep sea fish oil
- Native triglyceride form
- Delicious goji lemon taste

NUTRIENT DELIVERY THAT'S OUT OF THIS WORLD.



EVERYONE GETS THERE SAFELY

Liposomal nutrients are shielded in a bubble of phospholipids, protecting them against the hazards of digestive travel.

CONTINUAL RESUPPLY

Our multilamellar delivery system supplies a steady stream of nutrients in one dose. That's one convenient dose from daybreak to dark.

ACCELERATED ENTRY

From spoon to circulation in minutes. Our liposomals are built from the same stuff as cells, allowing for enhanced intestinal and cellular absorption.

YOUR FAVOURITE SUPPLEMENTS ARE GETTING A BOOST.

Curcumin · Vitamin C · Magnesium · Milk Thistle · Coenzyme Q10

Now available at your friendly neighbourhood health food store.
Learn more about how liposomals work at liposomals.ca.



FEATURED PRODUCTS



Meno-Prev
+ Mood & Memory



Iron
Bis-Glycinate 20



Thyroid-Pro

Your body. Your health.

Tell yourself this. You can choose your health first. It's okay to choose your self first. Self care builds self worth. And by listening to your body, and searching for what's right for you, you have more power than you believe.

canprevwomen.ca



Adrenal Chill

- Providing 600mg of KSM-66®, the highest concentration, full-spectrum extract of Ashwagandha
- KSM-66® reduces cortisol, stress and anxiety
- Plus 200mg of L-Theanine to promote relaxation without sedation



Healthy Hormones

- Relieves menstrual cycle symptoms and PMS
- Relieves pain, breast tenderness and nervous tension
- Includes 400mg of Indole-3-carbinol to detoxify harmful estrogen by-products
- For estrogen dominance related conditions



Cramp Relief

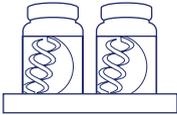
- Features cramp bark, an antispasmodic herb that helps relieve cramping
- With Ginger, Sweet fennel, Skullcap, magnesium and vitamin B6
- Relieves nervousness and tension associated with painful periods
- Targets pain in the lower back and thighs

Find CanPrev



Natural health practitioners

Naturopathic doctors, nutritionists and other healthcare practitioners are all good sources for obtaining great advice and getting you started on the road to good health! Ask your ND today



Health food retailers

You can also find our vitamins, supplements and shakes on the shelves of your friendly local health food retailer - as well as online!

www.canprev.ca/find

K2 Primer

The ultimate primer on vitamin K2. Learn the difference between K1 and K2, how K2 works in your body, strategies to assess how much you need, and more.

Request or download your copy, visit vitamink2.ca

Magnesium Primer

The ultimate primer on magnesium. Learn why magnesium is important, how it works in your body, strategies to assess how much you need and more.

Request or download your copy, visit magnesium.ca



Chocolate Collagen Almond Butter Smoothie

- 1 cup plant-based milk
- 1 banana
- 1 tbsp almond butter
- 1 tbsp raw cacao powder
- 1 tsp honey or maple syrup (optional)
- 1 scoop grass-fed Collagen Full Spectrum

Instructions:

Place ingredients in a blender and blend until smooth.

CanPrev's Collagen Full Spectrum contains peptides that support healthy skin, strong bones, muscles, cartilage and joints. Enjoy as an afternoon snack or as a healthy dessert!



Collagen

Full Spectrum

PEPTIPLUS[®]
Collagen Protein

2-5kDa

100% Pure Hydrolyzed Peptides
Enhanced Solubility & Bioavailability
Stimulates Collagen Building

PRO ESSENTIALS[™]

250 GRAMS GRAMMES
NPN 80088688

50 servings
portions

PREMIUM NATURAL HEALTH PRODUCTS

The CanPrev Promise

We take your health as seriously as you do, and we want you to feel confident about choosing CanPrev. If you are not 100% satisfied with your CanPrev product, just return it where you bought it for a full refund, or call us for a hassle-free replacement or exchange.

Whatever the reason, whatever the product, we'll do what it takes to make it right. Every time. That's our promise to you.



Pangnirtung Fjord, Nunavut

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The CanPrev Promise

We want you to be sure about your supplements. That's why we offer an iron-clad, hassle-free guarantee on all our products.



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