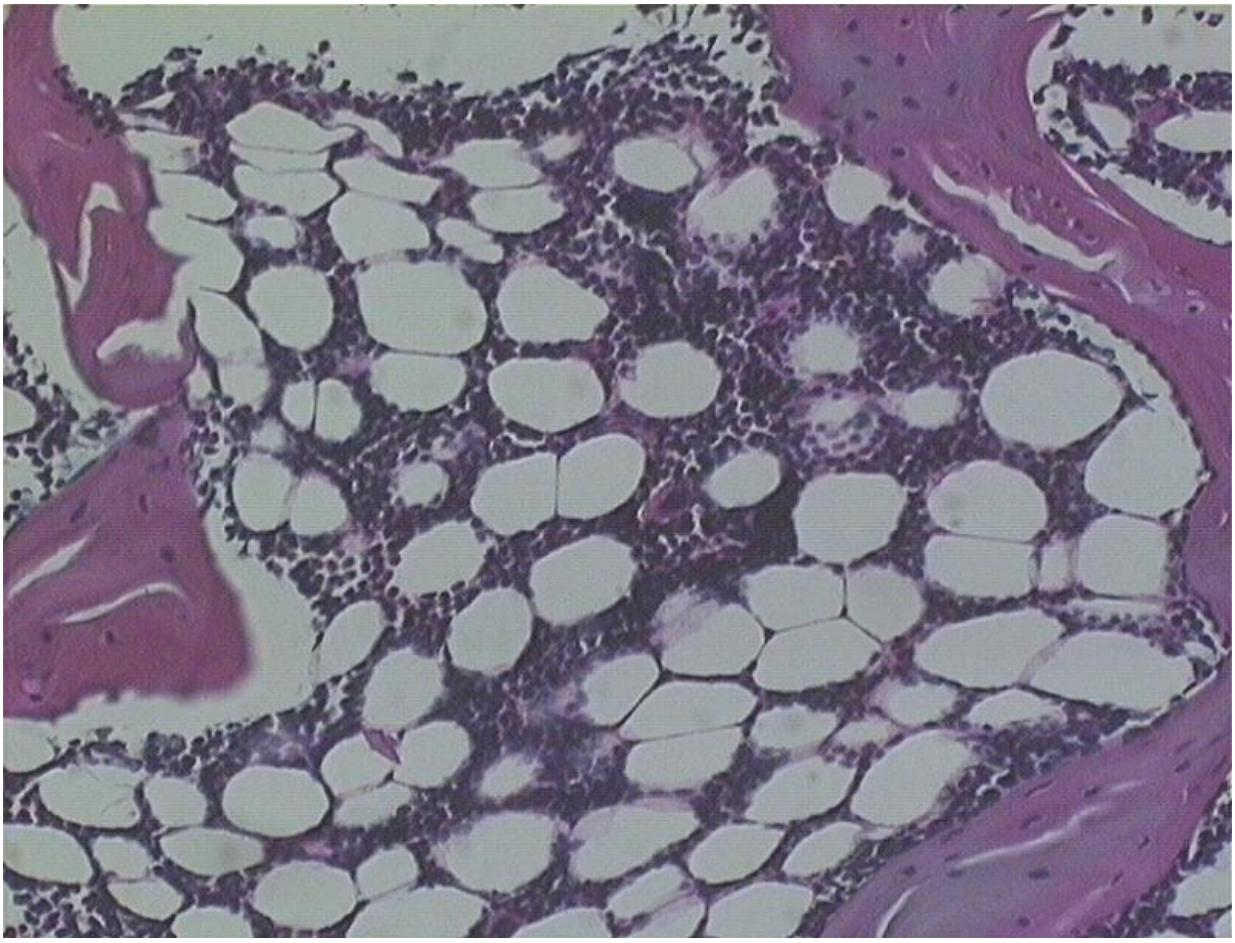
Red or white? Healthy humans need both

February 8 2016, by Melissa Gaskill



This bone marrow shows an increase in fat after a period of immobility. Credit: Bone and Joint Research Laboratory, University of Ottawa.

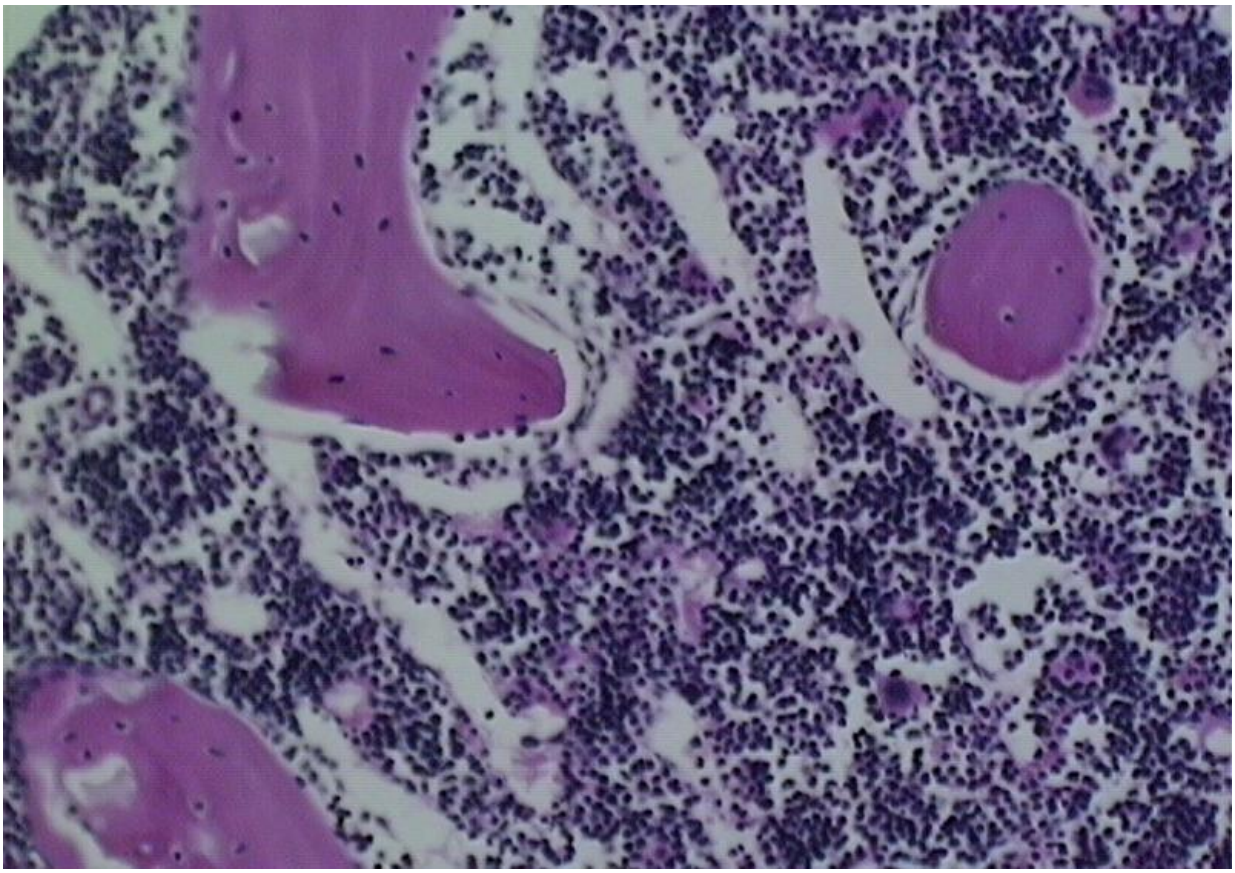
When it comes to wine, we can choose red or white depending on our tastes. With blood cells, however, we need both red and white in order to

stay healthy and function well.

Spending time in space is known to cause changes in these blood cells. We don't yet know for sure what causes this, but scientists suspect it may be due to how microgravity affects bone marrow. MARROW, a Canadian investigation recently launched to the International Space Station, will explore those effects. The results could lead to better mitigation strategies for spaceflight and crew return to Earth and gravity. The investigation also could advance understanding of how to minimize the effects of decreased activity in people with limited mobility or on bed rest on Earth.

Bone marrow contains cells that produce fat, erythrocytes (red blood cells) and leukocytes (white blood cells) within a confined and limited space. Previous research has shown that fat cells accumulate in marrow during life and more so during prolonged bed rest on Earth, an accumulation that comes at the expense of those blood-producing cells.

Red blood cells deliver oxygen to all the cells of the body and a lack of sufficient red blood cells results in anemia, which can affect physical and mental functions necessary on a space mission. This condition has been documented in astronauts after return to Earth and is known as "space anemia."



Normal bone marrow. Credit: Bone and Joint Research Laboratory, University of Ottawa.

"If you have fewer red blood cells, you may be more easily fatigued and have decreased strength, cognitive ability, and heart function," said principal investigator Dr. Guy Trudel, a professor at University of Ottawa in Canada. "Further, if inadequate red blood cell production occurs, crew members could be unable to mount an adequate response to a bleeding injury. They also would have difficulty performing duties upon returning to a gravity environment, such as landing on Mars or returning to Earth."

White blood cells defend the body against infection and remove

abnormal cells from the blood, thus helping to prevent cancer. That function is especially important for astronauts, who are exposed to increased radiation in space.

The investigation, funded by the Canadian Space Agency, will measure bone marrow fat pre- and post-flight using magnetic resonance. Researchers will analyze red and white blood cell function during flight as well as pre- and post-flight. They will measure red blood cell function by analyzing the breath of crew members, since the concentration of carbon monoxide in the breath indicates the extent of breakdown of red blood cells.

For white blood cell function, investigators will analyze genetic expression, explained co-investigator Dr. Odette Laneuville, also at the University of Ottawa, taking multiple profiles of gene expression over time. This will help identify specific genes that change in microgravity.

"One important component of the investigation is looking at reversibility, whether bone marrow composition returns to preflight levels and blood cell production recovers once crews return to Earth or land on another planet," said Trudel. "The results from this investigation could guide the search for specific countermeasures, such as exercise, or pharmacological or genetic treatments, as well as preventative interventions."

Accelerated fat accumulation was identified in previous research that measured fat in blood-producing bones during a specific form of bedrest used to simulate microgravity. Lack of physical activity - and therefore lack of mechanical stimulation of bone - could somehow flip a switch in stem cells that can become either bone or fat, pushing them toward becoming the latter.

On Earth, fat accumulation in bone marrow and changes in blood cell

function are associated with normal aging, conditions such as paralysis and osteoporosis, and prolonged periods of bed rest or limited mobility. So future space explorers and those of us on the ground will benefit from learning more about how to keep both red and white blood cells functioning well.

Provided by NASA

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