



Cell culture

Five reasons

To enhance your cell culture using a
CO₂ incubator with variable oxygen control

Discovery thrives in a culture of confidence

“We use the tri-gas incubator because the integrity of the cells is better, they develop better, and they are healthier.”

—Neurobiology researcher,
clinical research institute



Thermo Scientific™ Variable Oxygen Control CO₂ incubators are uniquely designed to optimize growth of mammalian cells in an environment that closely mimics *in vivo* conditions.

For many decades, animal and human cells have been cultured in air supplemented with carbon dioxide. But new technologies and applications for cell therapies require conditions that better mimic those *in vivo*.

Inside the body, oxygen concentrations range from 1-14%, rather than the 20-21% found in the atmosphere. Cells cultured in low oxygen (hypoxia) grow faster, live longer, and show lower stress. Our variable oxygen control (or “tri-gas”) incubators will generate hypoxic conditions to help your cells grow faster and healthier.

Maximize your productivity by surrounding your important cells in an environment you can trust.

Here are **5 reasons** for CO₂
incubators with O₂ control



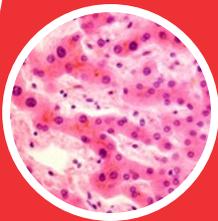
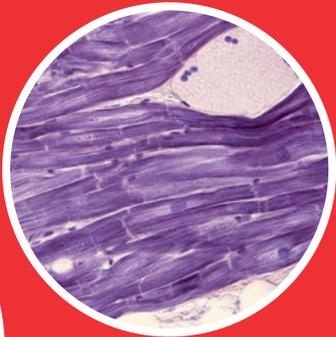
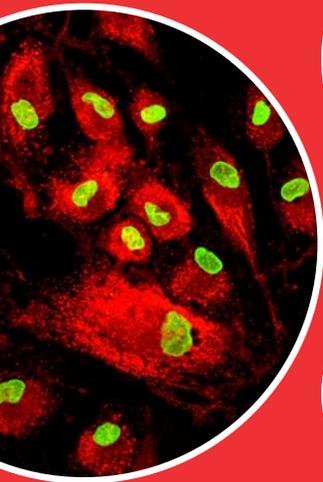


1 Increased biological relevance



Oxygen levels in human tissues

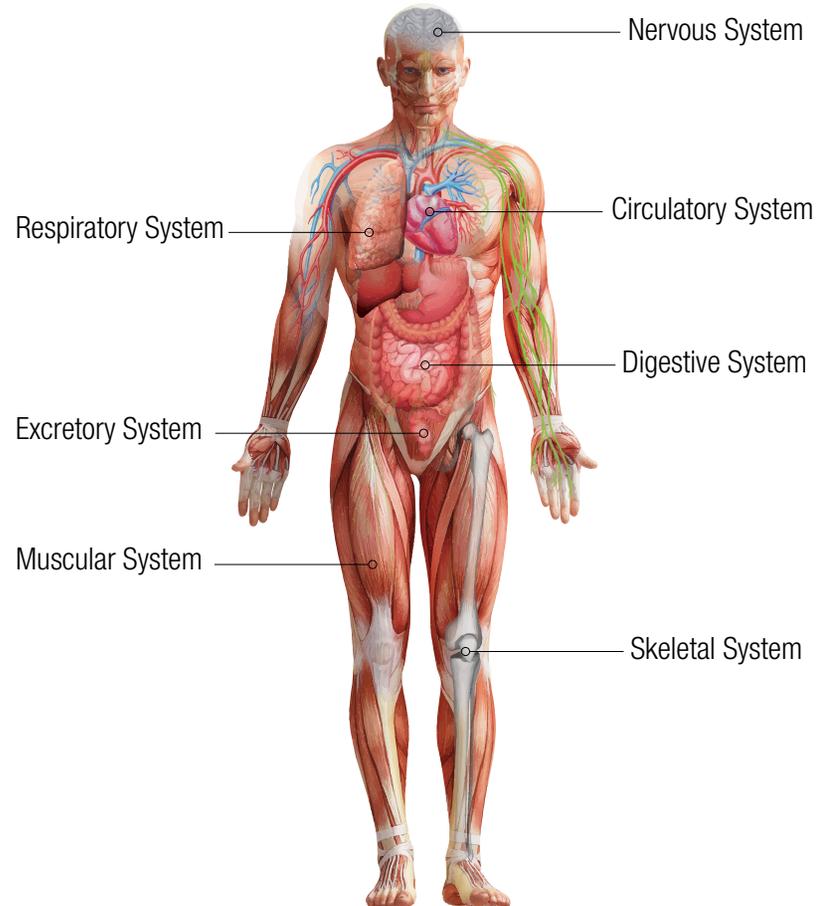
Lungs	14%
Arteries	12%
Liver, heart, kidneys	4-12%
Eyes	1-5%
Brain	0.5-7%
Bone marrow	0-4%



The air we breathe is 21% oxygen but conditions are different inside our bodies. Oxygen levels in tissues can be as low as 1-2%. Culturing your cells at lower oxygen concentration can better simulate physiological conditions, which can result in cell behaviors that are more predictive of an *in vivo* environment.

Applications:

- Cell biology
- Basic and applied research and production
- Pharmaceutical testing
- Cell therapy research



2

Greater cell number and longer life



Research shows that experiments using primary cells better mimic how cells will react *in vivo*. Many primary cell types grow faster and live longer when cultured under hypoxic conditions.

Applications:

- Vaccine and biopharma production
- Basic and applied research

Primary Cell Growth in Atmospheric and Physiological Oxygen

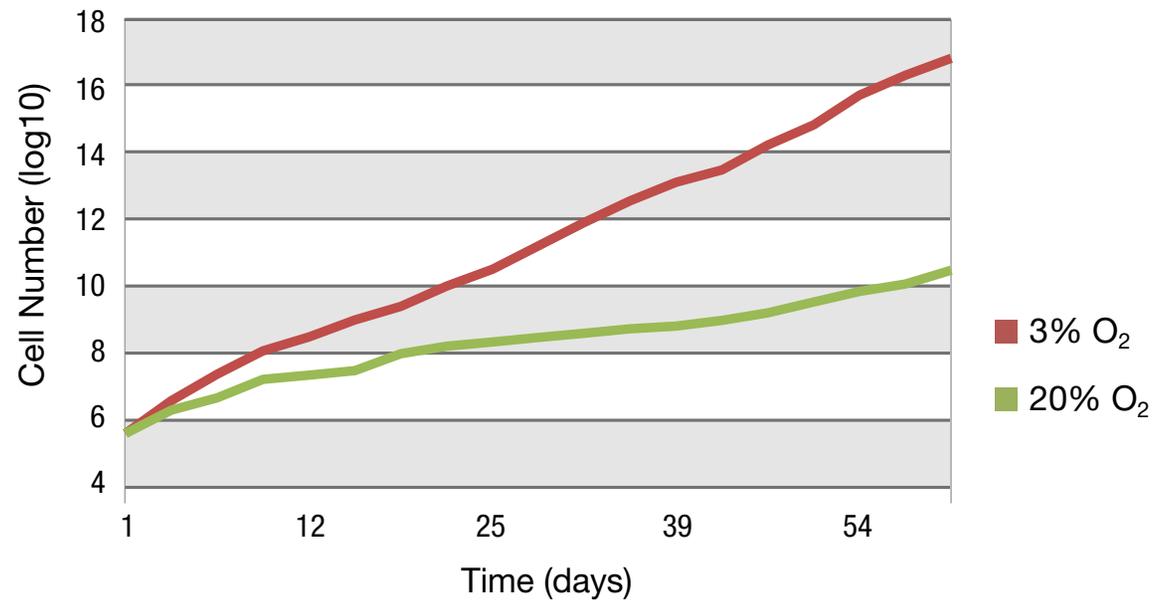


Figure 1. Newly isolated mouse embryonic fibroblast (MEF) cells avoid senescence and grow faster at physiological (3%) oxygen compared to atmospheric (20%) oxygen. (Adapted from Parrinello et al. Nature Cell Biology 2003.)

3

Reduced differentiation and stress responses



“Our lab mandates this [5% oxygen in the tri-gas incubator] in order to mimic conditions in the body, so that cells are as close to those conditions as possible and nothing is different. All of the signals for proper epigenetics are there.”

—Stem cell researcher at biomedical research institute

Oxygen concentration is an important determiner of cell fate and modulates expression of stress markers. Human stem cells grown at 20% oxygen show an increase in oxidative stress and DNA damage. Shifting the cells to a lower oxygen concentration that mimics physiological levels increases lifespan while limiting oxidative damage, genetic instability, and telomere shortening.

Applications:

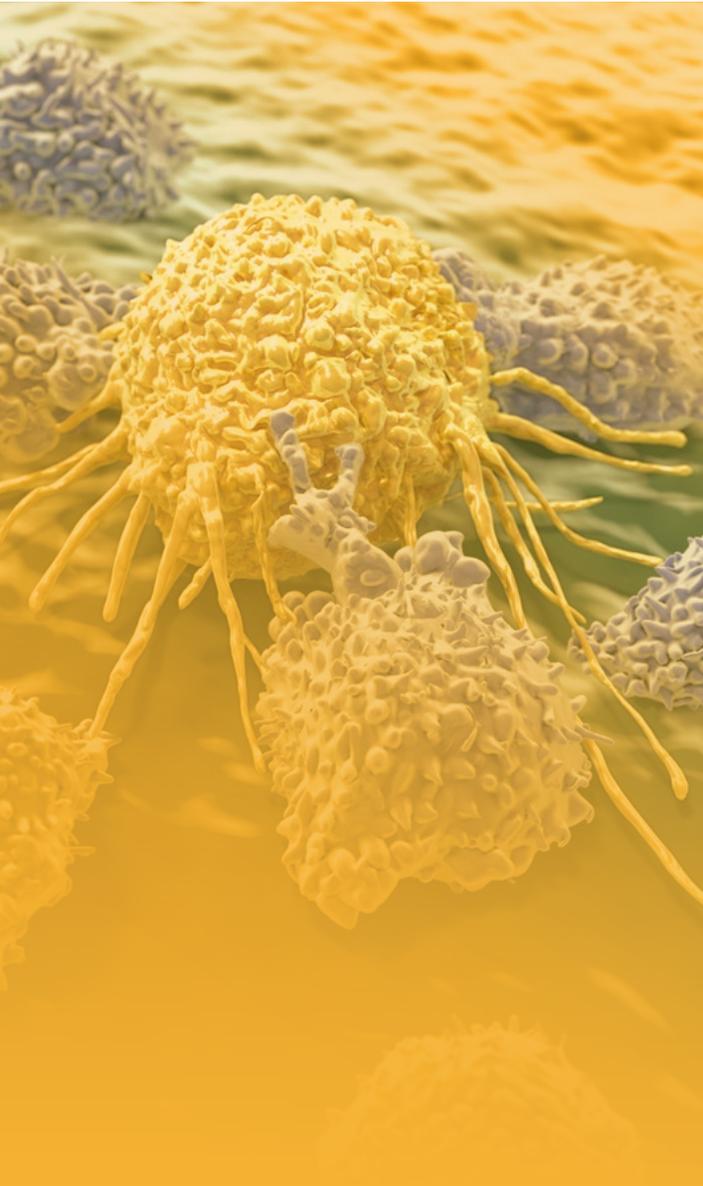
- Developmental biology
- Neurology
- Stem cell research
- Regenerative medicine
- Physiology



Figure 2. Thermo Scientific™ Heracell™ VIOS™ CO₂ Incubators, Thermo Scientific™ Forma™ Steri-Cycle CO₂ Incubators and their cleanroom (CR) versions are available with variable oxygen control. Other models with optional O₂ control are: Thermo Scientific™ Heracell™ i CO₂ Incubators, Forma™ Series 2 Water-Jacketed (WJ) CO₂ Incubators, Forma™ Series 3 WJ CO₂ Incubators and Forma™ 8000 Series WJ CO₂ Incubators.

4

Better simulation of tumor microenvironments



In a solid tumor there is a decreasing oxygen gradient from the outer edge of the tumor, where cells contact oxygenated capillary blood, toward the center. In the tumor's center, very low oxygen results in necrotic (dying) cells. This area of necrosis is associated with increased resistance to chemotherapy and radiation, and with continued tumor progression.

Applications:

- Cancer research
- Drug discovery
- Cell therapy research

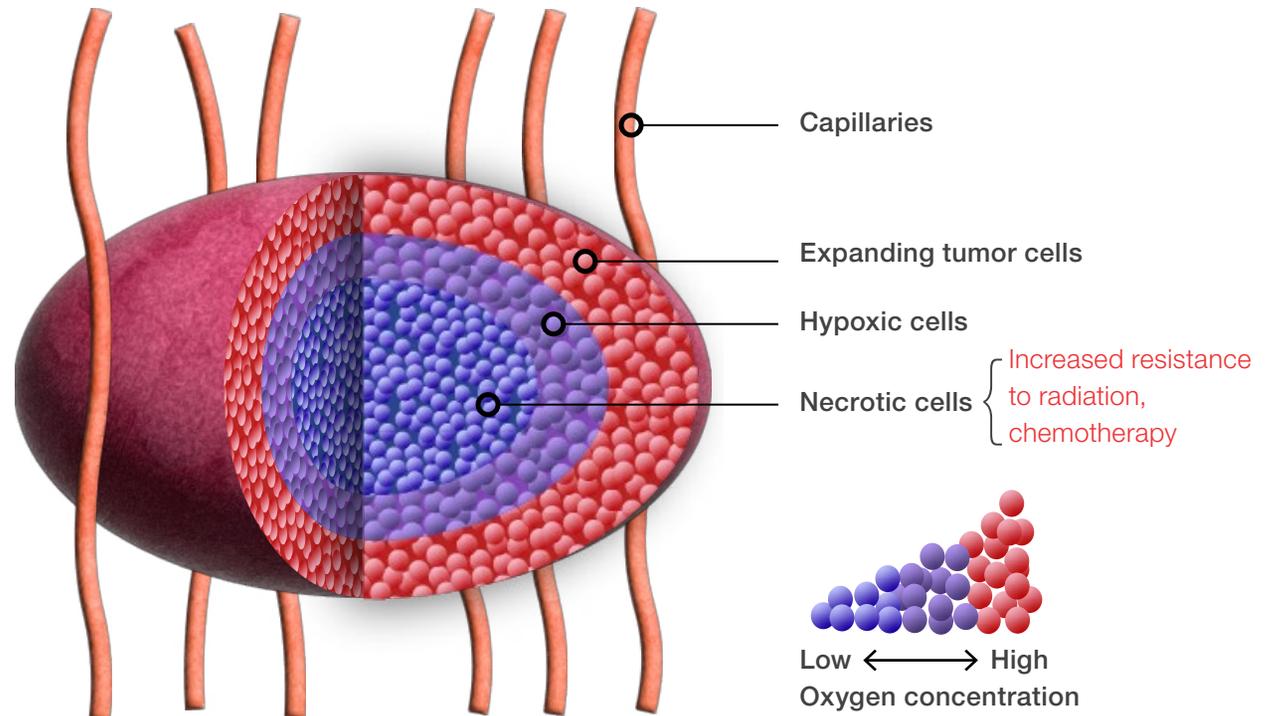


Figure 2. The center of a solid tumor has very little oxygen and contains necrotic cells that are resistant to radiation and chemotherapy. These cells are also associated with continued tumor progression. (Adapted from Brahim-Horn et al. J Mol Med, 2007.)

5

Optimal growth



“The Thermo Scientific™ Heracell™ 150i Incubator quickly adjusts the oxygen concentration from normal (about 20%) to hypoxia conditions (3%). Furthermore, the design of three separated inner doors allows us to quickly put in or take out our samples without changing the oxygen concentration much. Since HIF protein is short-lived, the time efficiency is really important.”

—Neurobiology researcher,
clinical research institute

We introduced the tri-gas incubator in 1979, only two years after Packer and Fuehr (Nature, 1977) proved that cells cultured in low oxygen had longer lifespans. Our decades of engineering innovative variable oxygen control technology provide you with:

- Exceptional interactive control and precise control technology
- Proven contamination prevention solutions providing 24/7 sample protection (in-chamber HEPA filtration, automated high temperature decontamination)
- Choice of oxygen control ranges 1-21% or 5-90% for application flexibility



Figure 3. The segmented inner doors are standard on every Thermo Scientific Heracell tri-gas incubator, allowing access to individual areas and further reducing potential for incubator contamination. The zirconium oxide sensor provides fast recovery to desired hypoxic conditions.

- Water jacket or direct heat temperature management
- Advanced oxygen sensor technology for reliable and accurate control
- Innovative segmented inner doors to minimize disturbance of culturing conditions with reduced operating costs

Applications:

- All areas of cell biology
- Basic and applied research and production



Figure 4. In-chamber HEPA filtration in Thermo Scientific Heracell VIOS and Forma Steri-Cycle CO₂ Incubators with variable oxygen control filters the entire chamber air volume every 60 seconds, providing outstanding air quality to protect cultures from airborne contamination.

Summary

5 reasons

Oxygen affects nearly every cellular process, and most cells in the body exist in oxygen concentrations much lower than in the earth's atmosphere, the air we breathe. If we cultivate cells in vitro as a model for reactions in the body, or to develop a therapy, it's important to mimic conditions in the body as closely as possible. Oxygen can determine which genes are switched on or off, whether the cell enters the growth cycle or remains quiescent, and even the ultimate fate of a cell. To decide whether hypoxic culturing is important for your work, search the literature in your field.

A "tri-gas" incubator can be used as a standard CO₂ incubator, and when you are ready for hypoxic culturing for stem cells, primary cells, neural tissue and more, you have the ability to connect nitrogen to reduce the oxygen concentration without adding more equipment.

References:

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- Packer, L.; Fuehr, K. Low oxygen concentration extends the lifespan of cultured human diploid cells. *Nature* 1977, 267, 423–5.

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