

MIGHTY MICE IN SPACE

LESSON ONE



JAX MIGHTY MICE IN SPACE

The Jackson Laboratory's Dr. Se-jin Lee sent genetically engineered mice onto the International Space Station. Learn about Dr. Lee's research and why his mice traveled to space.

DR. LEE'S MIGHTY MICE

Dr. Lee's research team studies how muscle and bones are built and what genes control those processes. His team discovered that myostatin protein, encoded by the myostatin gene (*MSTN*), normally acts to limit muscle growth. Dr. Lee's research group showed that mice genetically engineered to lack MSTN (*Mstn* $-/-$ mice) have muscles nearly twice as big as non-engineered mice (Figure panel A). Additional research found naturally occurring mutations that block normal MSTN function also cause increased muscling in cattle, sheep, dogs, and humans (Figure panels B and C). This suggests that MSTN functions as a negative regulator of muscle mass in many species, including mice and humans. Now that scientists know about this important molecule regulating muscle mass, they are looking for a way to use this information to design therapies that can be used to treat muscle disease.

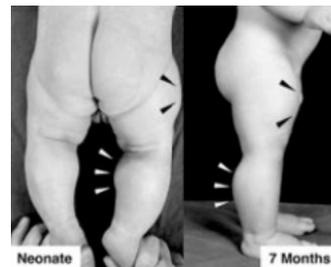
A



B



C



Thought Question:

If myostatin limits muscle growth, what do you predict would be the result if a person was treated with a drug that blocks myostatin function?

Answer:

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WHY SPACE?

Since there is no gravity in space, astronauts rarely use their muscles to get around. Such long periods with little muscle use can lead to muscle loss. Even though astronauts spend 2.5 hours per day exercising to reduce the effects of muscle loss, astronauts can still experience up to 20% of muscle loss on space flights as short as 5-11 days. Sending mice into the zero-gravity environment of space can speed up muscle loss in order to perform experiments that examine regulation of muscle growth.

Thought Question:

Two mice that are the same age participate in an experiment. One mouse is sent into outer space and spends 2 months orbiting the earth at the International Space Station. The other mouse stays on Earth. When the first mouse returns to Earth, the muscle mass of the two mice are compared. What do you predict to be the outcome? Will the two mice have similar muscle masses, or do you expect them to be different? Why?

Answer:

Mighty Mice in Space

The goal of Dr. Lee's latest project is to investigate the potential beneficial effects of targeting myostatin (MSTN) to prevent skeletal muscle and bone loss. Dr. Lee's team will send mice into space to stay on the International Space Station (ISS) for one month.

Thought Question:

After a stay on the International Space Station, the muscle mass of a mouse lacking myostatin function (Mstn -/-) is compared to a control mouse with normal myostatin function. What do you predict to be the outcome? Will the two mice have similar muscle masses, or do you expect them to be different? Why?

Answer:

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Implications in Human Health

Astronauts are not the only humans who experience muscle loss. Age-related muscle loss is a major issue for the elderly. Many people around the world have muscle disorders such as muscular dystrophy. Additionally, individuals who must remain in bed for long periods of time, who are in comas, who are paralyzed, etc. struggle with muscle loss from lack of muscle use. The basic research findings from this project may be the first step towards new clinical trials for testing similar drugs that block myostatin function.

Thought Question:

How might a drug that blocks myostatin function prevent muscle loss during the aging process?

Answer:

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References & further reading

Follow the story of the JAX Mighty Mice in Space

- jax.org/miceinspace
- #MiceInSpace

Dr. Lee's Mighty Mice

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- https://www.hopkinsmedicine.org/news/media/releases/mighty_mice_made_mightier
- <https://www.scientificamerican.com/article/genetically-engineered-mi/>
- <https://www.nature.com/news/2007/070827/full/070827-3.html>

Using mice for biomedical research

- <https://www.jax.org/about-us/why-mice>

Muscle loss in space

- https://www.nasa.gov/pdf/64249main_ffs_factsheets_hbp_atrophy.pdf

Other animal studies in space

- <https://www.nasa.gov/spacebio/animal/our-experiments>
- https://www.nasa.gov/audience/forstudents/9-12/features/F_Animals_in_Space_9-12.html