

Molecular Muscle Experiment

Past worm space missions



- Early work showed that worms can grow and have babies in space
Worms can grow for at least 12 generations in space!
- Like people, worms displayed no major obvious long term health problems
- Like people, worms exposed to radiation did have health problems

Closer inspection revealed that:

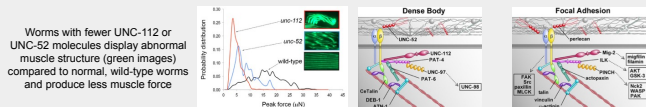


Worms and people show similar molecular changes in space, including alteration in muscle and ability to use energy



When such molecular changes happen on Earth, they cause health problems like muscular dystrophies and diabetes in people and also in worms

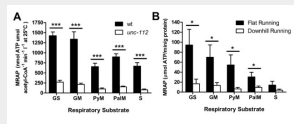
Worms and people have similar molecules that attach the inside of muscles to other muscles and to the skeleton



Worm muscle force is measured by seeing how far they can push tiny pillars



Disruption of molecules that attach muscles to each other causes less energy production in both worms (A) and people (B)!



Understanding why and how spaceflight causes these changes in worms in space may:



- Tell us why these same changes occur in astronauts
- Give us new treatments for muscular dystrophies
- Help improve treatments for diabetes
- Help make ageing muscle work better

Overview of Current Mission: 'Molecular Muscle Experiment (MME)'

The primary aims of this experiment are:

- Establish the precise molecules that cause muscle problems during spaceflight
- Test the effectiveness of novel therapies for preventing the muscle decline associated with spaceflight

Using combinations of gene manipulations and drugs we will be able to determine exactly how spaceflight causes muscle decline:

- Theory 1: Cell sensing of energy use causes muscle decline in space (e.g. genes associated with diabetes progression).
- Theory 2: Cell sensing of mechanical loads causes muscle decline in space (e.g. genes associated with strength).

This will be the first spaceflight experiment that establishes the precise molecular causes of muscle loss during spaceflight

Scheduled launch for
November 2018 – February 2019

An International Collaboration

Spaceflight is expensive. In order to make the most of space experiments scientists often work together with other countries.

Our International Team is collectively investigating how the following factors influence the body's responses to spaceflight:



- Insulin signalling and cell attachment



- Cells' energy producing units (mitochondria) and metabolism



- Nervous system and passing of genes to offspring



- Genes that regulate responses to endurance exercise

Pre-flight operations

Doing experiments in space is quite different from doing them in a laboratory on Earth. Different equipment is used on the International Space Station and scientists do not usually conduct experiments themselves. Pre-flight operations involve several stages:

Defining the technical requirements of the experiment

Worms, like people, require food, water, oxygen, and a comfortable temperature. Detailing how much of these things are required and how they could be given to the worms was needed.

Building and testing any equipment needed for the experiment



Experienced engineers from Kayser Italia evaluated the technical requirements of the experiment and determined that the worms could make their homes in bags full of food that allow gases (oxygen, carbon dioxide) to pass through (left). The worms also need to be put in special containers (right) to fit in an incubator called Kubik (below) to make sure the worms did not get too hot or cold.



Testing the experiment works as planned on Earth



A full run of the experiment on Earth is always conducted. MME's testing will take place in Switzerland at BIOTESC, the centre responsible for running the incubator on-board the International Space Station. Scientists, worms, and equipment will all have travel to BIOTESC in advance of the test which itself also tests the logistics of getting to the launch site!

Setting up the flight experiment and putting it on the rocket



As launch day approaches the scientists will converge on the launch site, currently Kennedy Space Center, Florida. Once there they will not only have to set up the experiment before launch, they will have to set up at least one back up experiment in case the launch is delayed. This process of setting up the experiment and a backup will continue until the experiment is successfully launched.

Flight operations

Launched and dock with ISS



Worms put into KUBIK incubator



Stored in freezer until return to



Worms grow on ISS for ~6 days



Further Information

For more information about the project, regular updates, interactive activities see:

www.wormsin.space.co.uk
<http://www.esa.int/ESA>
<http://www.kayser.it/>



This work is supported by