



# TECHNOLOGY DEMONSTRATE OF BONE-LOSS-REDUCING BACTERIA CULTURE FOR DEEP SPACE

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# OUTLINE

INTRODUCTION

MISSION OBJECTIVES

KEY PERFORMANCE PARAMETERS

EXPERIMENT CONCEPT DESIGN AND SETUP

IMPLEMENTATION PLAN

RISK

# DEEP SPACE EXPLORATION

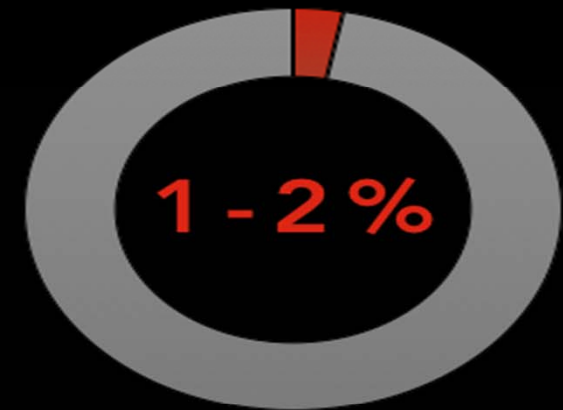


# INTRODUCTION

Weightless



Bone mineral density **loss**



Radiation



**MONTHLY !!!**  
3-4 years recovery  
after returning on Earth

# INTRODUCTION



Drug therapies



Weight-bearing  
exercises



Dietary  
supplements



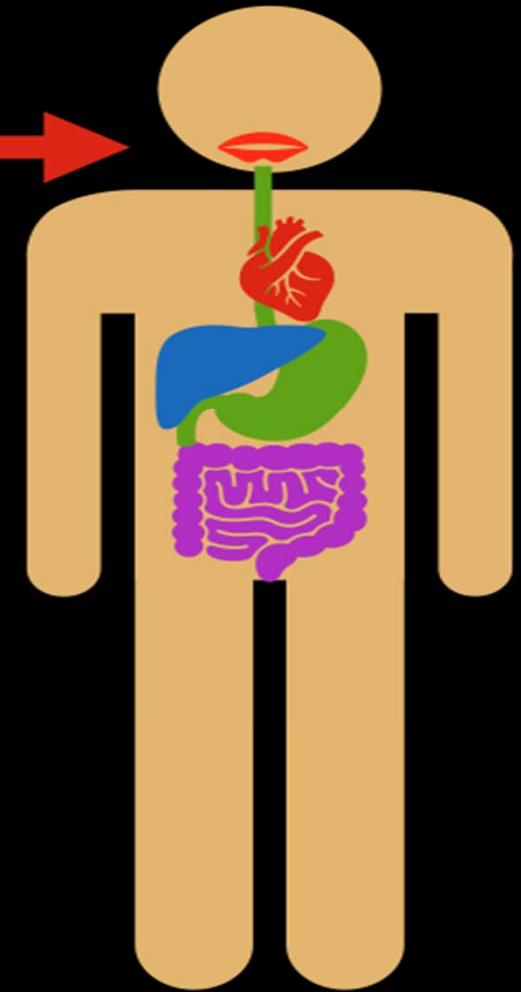
# INTRODUCTION

## PROBIOTICS

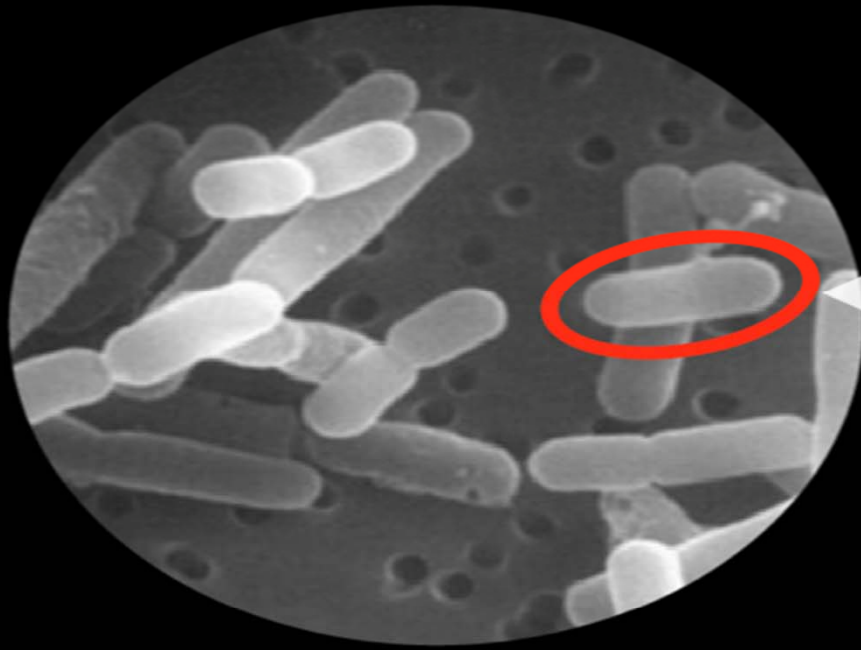
Maintain a healthy community of microorganisms in our body

Substances production with desirable effects

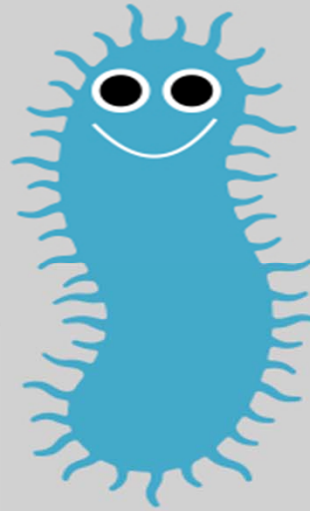
Influence the body's immune response



# INTRODUCTION



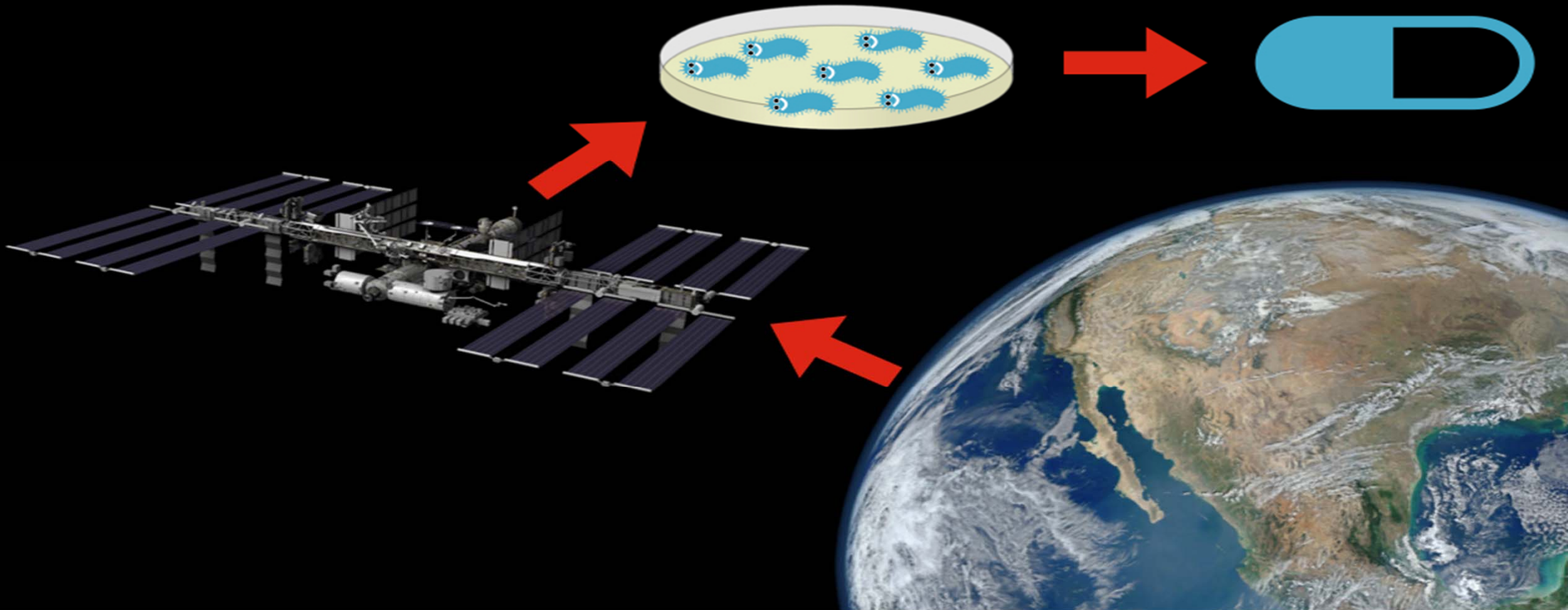
***Lactobacillus reuteri***  
**(*L.reuteri*)**



- Has been widely used as a probiotic
- Beneficial effect on bone density
- A safe and effective way to prevent bone loss



# INTRODUCTION





# INTRODUCTION



## SUSTAINABLE DEVELOPMENT GOALS

<b>1</b> NO POVERTY 	<b>2</b> ZERO HUNGER 	<b>3</b> GOOD HEALTH AND WELL-BEING 	<b>4</b> QUALITY EDUCATION 	<b>5</b> GENDER EQUALITY 	<b>6</b> CLEAN WATER AND SANITATION 
<b>7</b> AFFORDABLE AND CLEAN ENERGY 	<b>8</b> DECENT WORK AND ECONOMIC GROWTH 	<b>9</b> INDUSTRY, INNOVATION AND INFRASTRUCTURE 	<b>10</b> REDUCED INEQUALITIES 	<b>11</b> SUSTAINABLE CITIES AND COMMUNITIES 	<b>12</b> RESPONSIBLE CONSUMPTION AND PRODUCTION 
<b>13</b> CLIMATE ACTION 	<b>14</b> LIFE BELOW WATER 	<b>15</b> LIFE ON LAND 	<b>16</b> PEACE, JUSTICE AND STRONG INSTITUTIONS 	<b>17</b> PARTNERSHIPS FOR THE GOALS 	 <b>SUSTAINABLE DEVELOPMENT GOALS</b>

# MISSION OBJECTIVES



To apply the results from the experiment for developing *Lactobacillus reuteri* (ATCC 6475) to be probiotic food that could reduce bone loss and increase the immunity of astronauts and people on Earth



To study the effects of microgravity on bacterial growth



To compare the growth rate of bacteria cultured in space bay using broth medium and agar medium



To apply the results from the experiment for further developing a bacteria culture system for deep space exploration

# KEY PERFORMANCE PARAMETERS



During the operation, bacteria in broth medium and agar medium must be increased as composed to an initial state



The color in each broth medium must be changed to indicate the bacterial growth



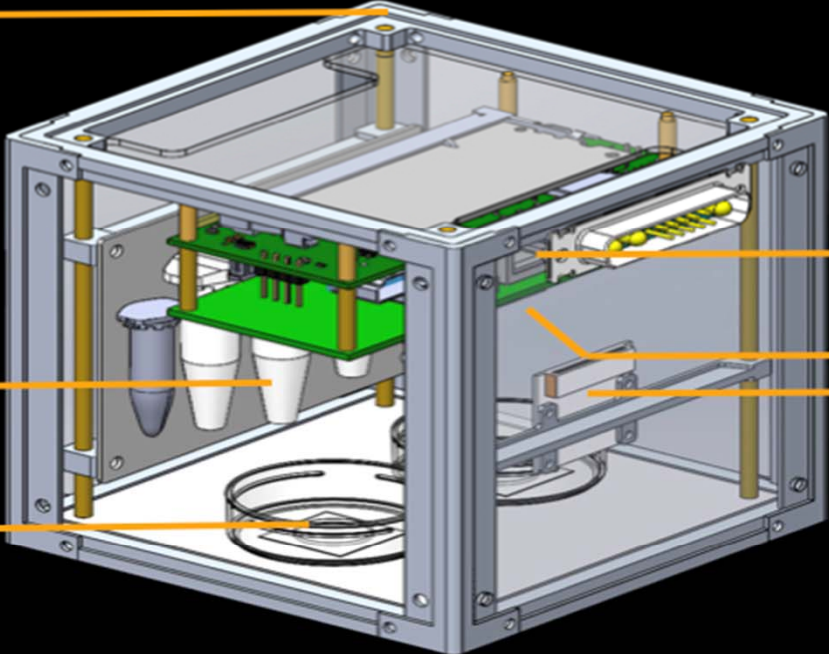
All sensors must be able to measure the temperature, pressure, and humidity



Payload must be able to connect with International Space Station and downlink data to user

# SPACE SEGMENT DESIGN

Structure



Controller

Cameras

Microcentrifuge tubes

Petri dishes

# SPACE SEGMENT DESIGN

Primary Camera  
for Microcentrifuge

Secondary Camera  
for Culture Dishes

White 6500K LED Strip

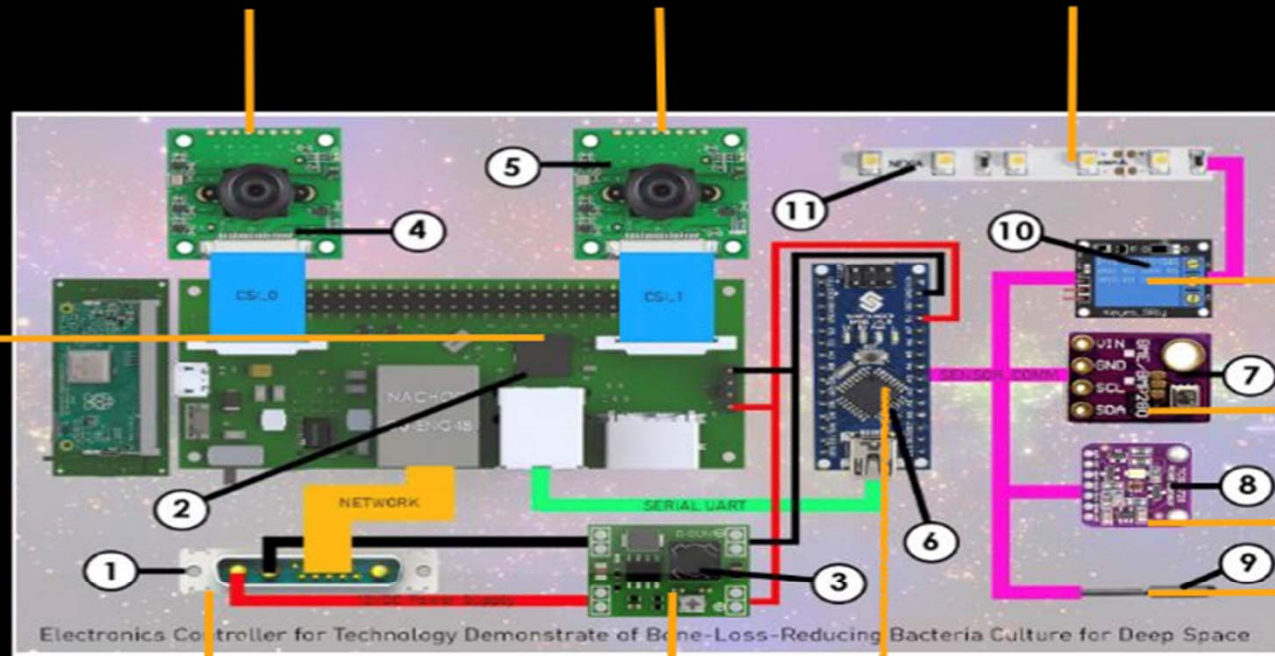
Raspberry Pi CM3+  
& StereoPi

Relay with  
Opto-isolated

BME280 Sensor

RGB Color Sensor

DS18B20  
Temperature  
Probe



D13BW3P Male Plug

MP2307DN  
buck regulator

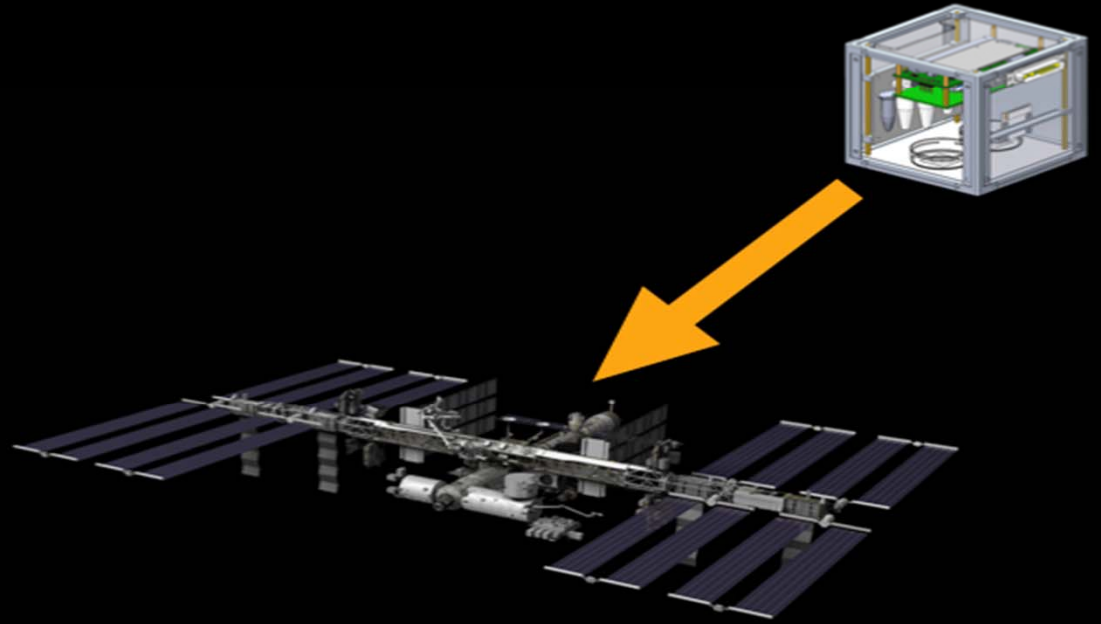
Arduino NANO



# CONCEPT OF OPERATION

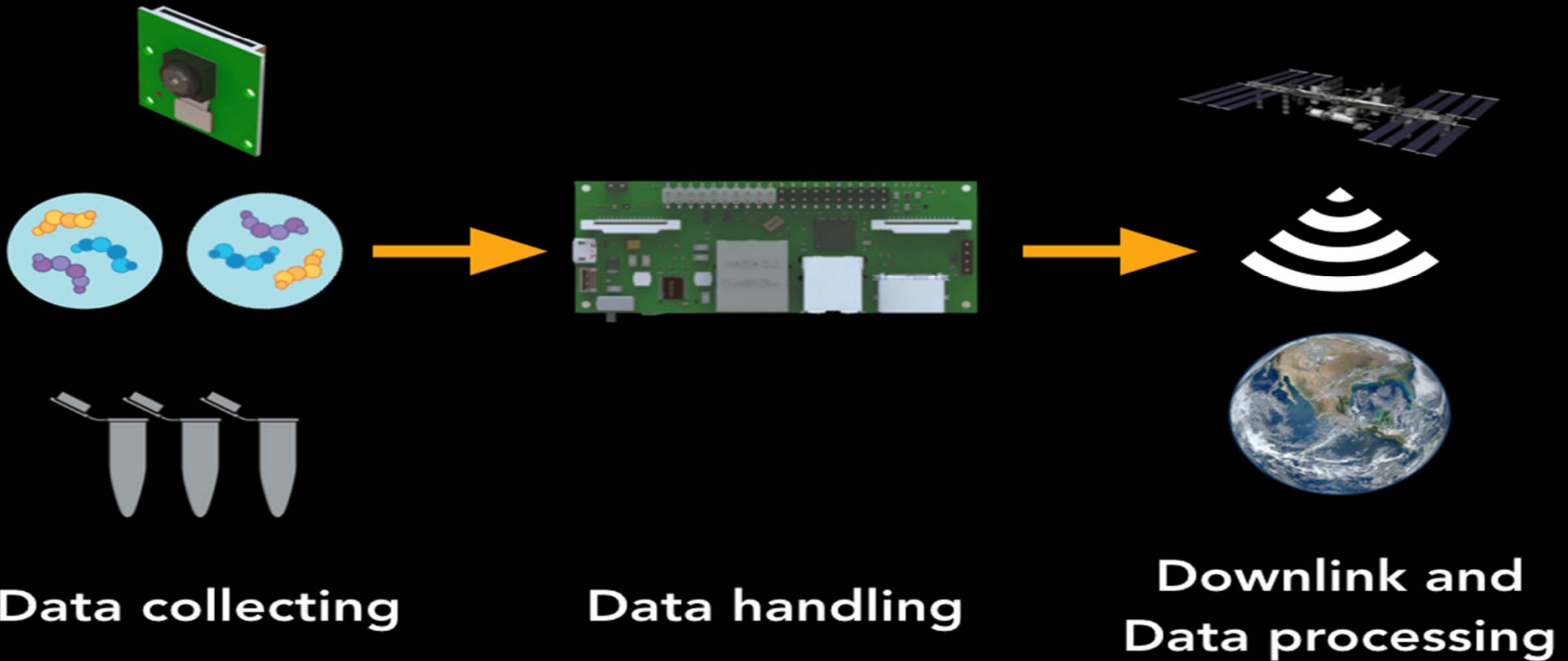


Laboratory & Clinostat



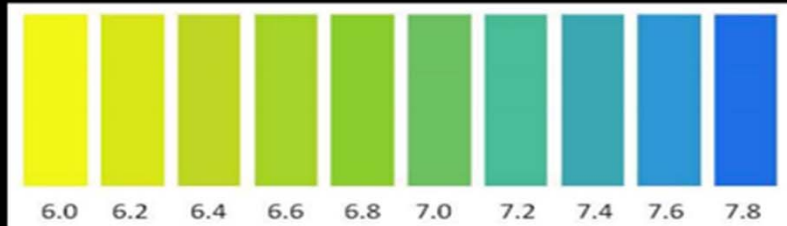
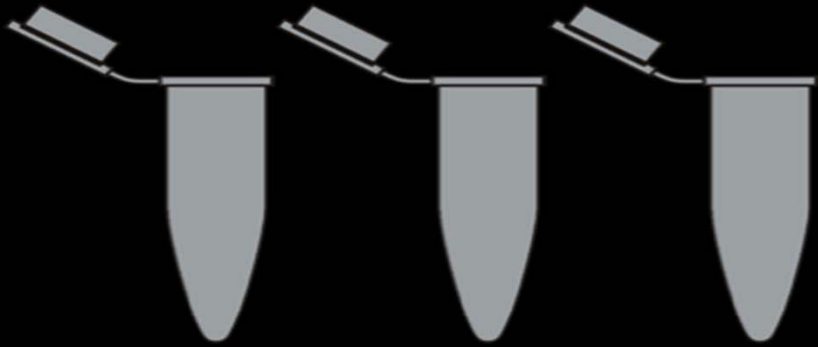
International Space Station

# CONCEPT OF OPERATION





# CONCEPT OF OPERATION



**pH Measurement  
(Using Bromothymol Blue)**



**Growth area comparison**



# RISK

## RISK LEVEL

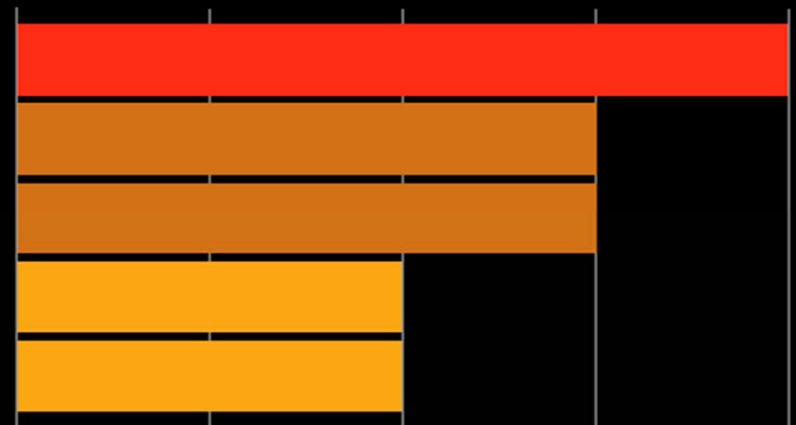
Communication between ISS and payload failure

Bacteria not surviving during operation

Power failure

The experiment is contaminated

Loss of funding and team member



# CONCLUSIONS

EFFECTS OF MICROGRAVITY ON BACTERIAL  
GROWTH

CULTURING PROBIOTIC BACTERIA IN SPACE

REDUCE BONE LOSS FOR DEEP SPACE  
EXPLORATION

THANK YOU