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SPACE TECHNOLOGIES APPLICATION MICROS STUDIES IN GLOBAL HEALTH FOR SUSTAINABLE DEVELOPMENT: MICROGRAVITY, MICROPLASTICS, MICROBIOLOGY

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PRESENTATION OUTLINE

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INTRODUCTION

- The famous saying "**Health is Wealth**" refers to the importance of health.
- Healthiness is a state of **physical**, **mental** and **social well-being**.
- The use of **space-science and technologies** significantly contributes to our daily lives and has transformative power when applied to **public-health practice**.
- The applied science programs of the space-agencies and administrations have produced many **technologies applicable to health**.
- Leveraging space-technologies, such as **satellite-based imageries and earth-observation data** may bring substantial benefits to public-health practice.
- Space-science and technologies have wide applications in managing **public-health emergencies, forecasting epidemics, facilitating early-warning and disaster-management plans, as well as monitoring environmental parameters**.

MICRO STUDIES OF SPACE TECHNOLOGIES IN APPLICATION TO GLOBAL HEALTH

- Micro studies may be described as **studying at a greatly reduced amount of something**.
- Another way to think of micro is in **measurement-systems**, such as the **metric-system**, where **micro means one part in a million**.
- The **Focus** of this work is on:

- Microgravity
- Microbiology
- Microplastics

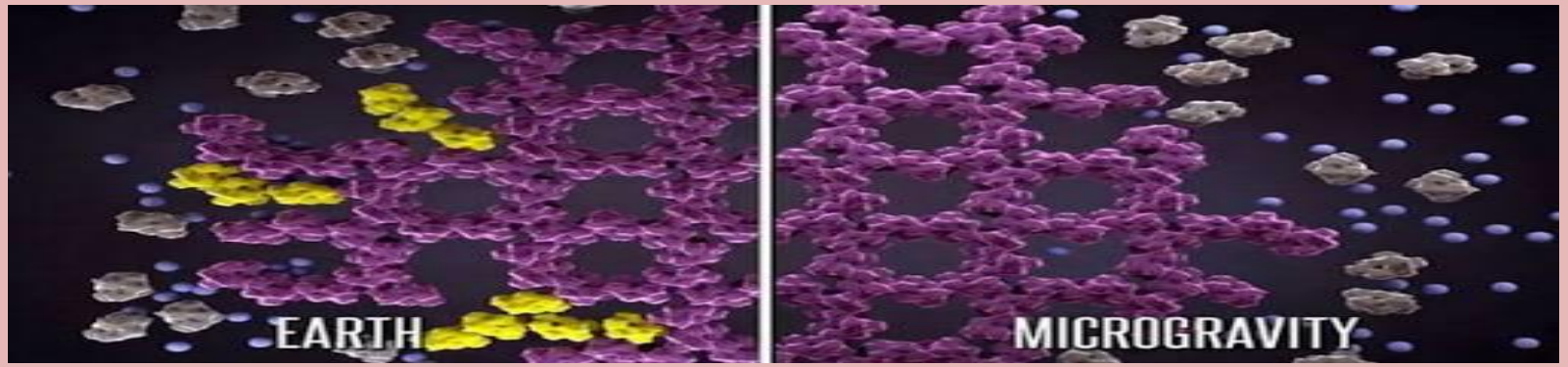
MICROGRAVITY

- **Microgravity** literally means very little-gravity.
- The **microgravity-environment** (µg) is an environment where some of the effects of gravity are reduced compared to what is experienced at Earth's surface.
- It's known as a condition of **weightlessness**. Scientists conduct **impossible experiment** on Earth under microgravity.
- Monitoring reactions and processes in absence of gravity variable can mask subtle observations, **provide new insights/better understanding of certain processes and phenomena**.
- Microgravity research/experiments are performed in microgravity-platforms using **both spaceflight and ground-based facilities** which could be **real or simulated**-avenues.
- **Cells, microbes, plants, macromolecules and materials** behave differently in space.

MICROGRAVITY CONT'D:
BENEFITS OF MICROGRAVITY RESEARCH IN PHARMACY

Under microgravity there is development of better-drug and administration routes such as:

- **Better crystals for drugs**
- **Longer shelf life of drugs**
- **Better delivery routes**
- **Better packaging of drugs**
- **Reduction of the cost of drug production**



Impurities being Removed from Crystals under Microgravity

MICROGRAVITY CONT'D:
BENEFITS OF MICROGRAVITY RESEARCH IN MEDICINE

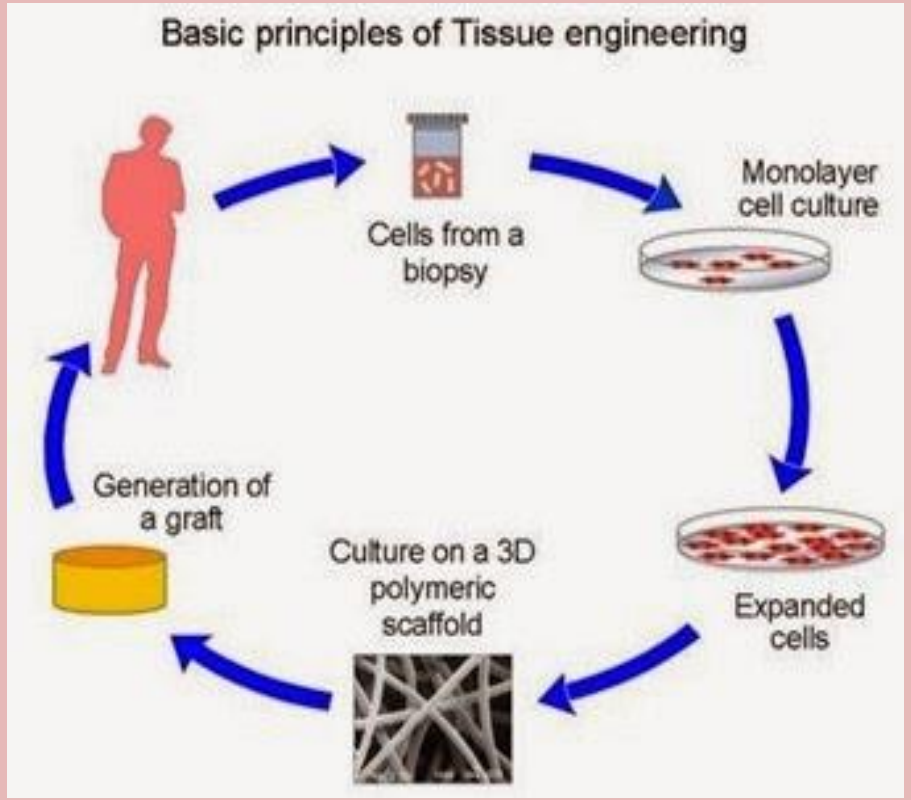
So many people loose their body parts to sickness and accidents yearly. This research allows:

- **Growing tissue sample outside the body**
- **Longer shelf life of blood banks**
- **Insights to avoid the spread of cancerous cells**

Red Blood Cells

MICROGRAVITY CONT'D:
BENEFITS OF MICROGRAVITY RESEARCH IN BIOTECHNOLOGY

- **Tissue Engineering:** Is the use of a combination of cells, engineering and materials, and **suitable biochemical and physicochemical factors to improve or replace biological tissues.** It involves the use of a scaffold for the formation of **new viable tissue** for a medical purpose. Microgravity platform serves as the scaffold.
- **Bioremediation:** Very useful in environmental clean-up.



MICROBIOLOGY AND MICROGRAVITY:
BENEFITS OF MICROGRAVITY RESEARCH IN MICROBIOLOGY

- **Micro-organisms** are living microbes that cannot be seen without an aid of a microscope.
- Microorganisms play essential role in human **health,** therefore their **behavior** under **microgravity are different** and are researched on**.**
- **Spaceflight microbes** have great potential for **novel therapeutics** and **vaccine .**
- Microorganisms can form **biofilm** which are **mainly antibiotics resistant**.

MICROPLASTICS

- Recently there have been **environmental interests** regarding **“microplastics”.**
- **Microplastics are microscopic sized plastics having less than 5mm in diameter**, which emerge mainly from the production of personal care products and fragments of larger plastics by mechanical degradation or by UV light. e.g mechanical degradation of bottles, food rappers, plastic bags etc. (National Ocean Service, 2017).
- This area of study could be classified under **Biogeochemistry.**

Images for Microplastics

WAYS MICROPLASTICS GET INTO WATER BODIES

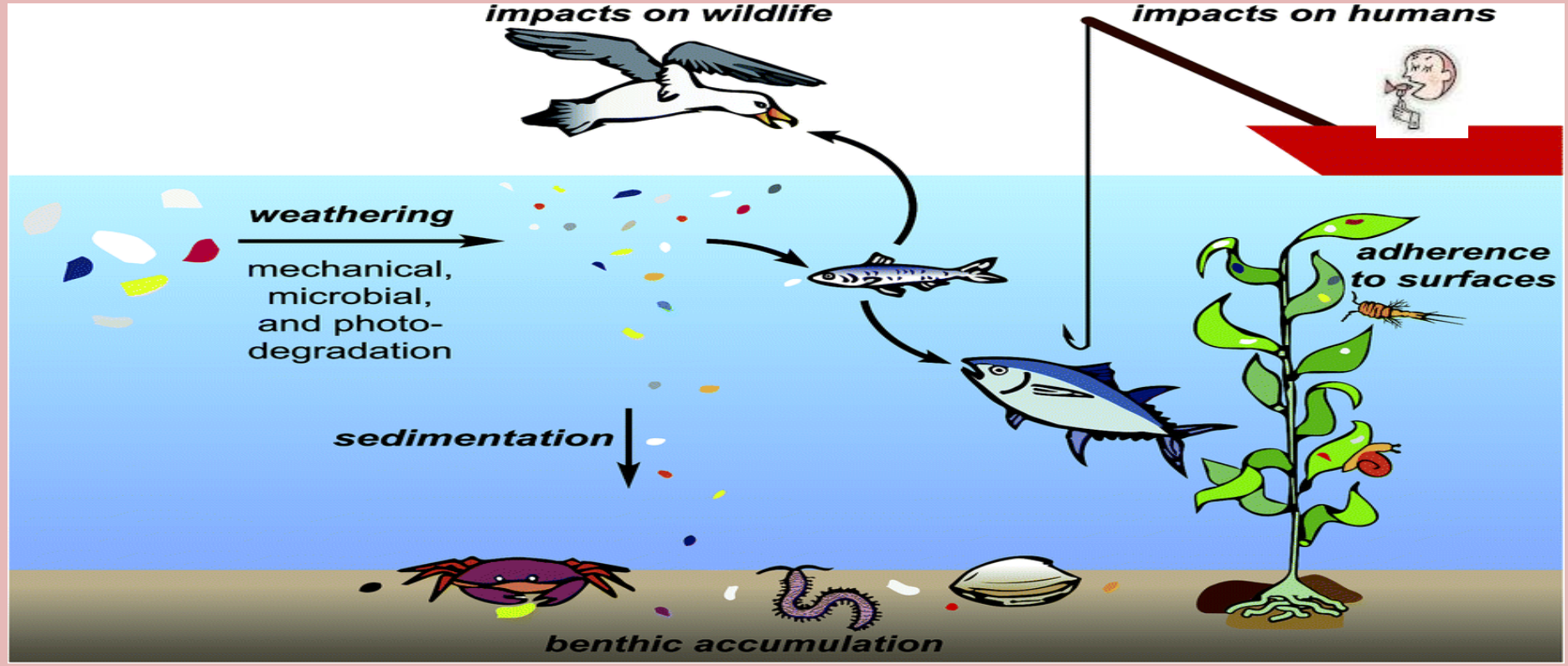
- Microplastics are dumped **indirectly** and **directly** into the oceans e.g industries dumping them directly while rain and wind gets heaped-up plastic household materials outside home into water bodies (Louisa, 2017).

- They have being identified as **debris** and as **sediments** of **marine** and **freshwater** across ecosystems.

- It is difficult to separate the microplastics from other **organic particles** in the sediment.

IMAGES FOR WAYS MICROPLASTICS GET INTO WATER BODIES

MOVEMENT PATHWAYS FOR MICROPLASTICS IN THE WATER BODIES



BIOAVAILABILITY OF MICROPLASTICS TO ZOOPLANKTON

- **Zooplankton** encompasses a range of **aquatic animals** that form a **key trophic link** between **primary producers** and the rest of the **marine food web**.

- Microplastics are **bioavailable** to a range of aquatic organisms (zooplanton) which are of low trophic fauna such as algae, amphipods, barnacles, lugworms, mussels, sea cucumbers, echinoderms, bryozoans, bivalves, lobsters, fishes, seabirds and benthic invertebrates, and can be **trophically transferred**.

Sea Turtle Taking in Plastic Product

Picture Showing Fishes with Microplastics Inside of them

Picture Showing Fishes that Contain an Abnormal Compound that looks Like Egg


HOW LONG UNTIL IT'S GONE?
Estimated decomposition rates of common marine debris items
Plastic Grocery Bag
10 - 20 years
Plywood
1 - 3 years
Disposable Diaper
450 years
Cigarette Butt
1 - 5 years
Foamed Buoy
50 years
Wool Socks
1 - 5 years
Plastic Bottle
450 years
Aluminium Can
200 years
Fishing Line
600 years
Styrofoam Cup
50 years
Tin Can
50 years
Plastic Beverage Holder
400 years
Glass Bottle
undetermined

EFFECTS OF PLASTIC DEBRIS ON MARINE ORGANISMS

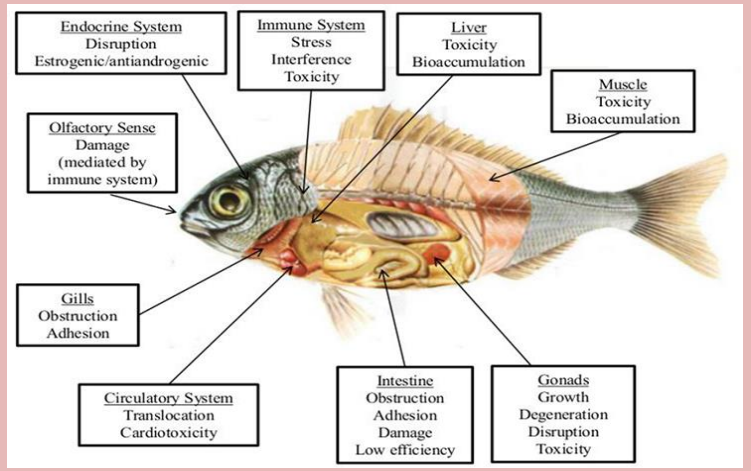
Ecotoxicological and calcification studies has being explored on the effects of microplastics on **marine zooplankton** as case studies for effect on human health and the results has being threatening.

The **effects of plastic debris on marine organisms** as a result of ingestion include:

- gut blockages
- heightened immune response
- loss of lipid reserves
- Disrupting of other normal physiological functions in respect to:

✓ photosynthetic
✓ respiratory
✓ reproductive processes

- other uncertain consequences to the health of the organism.



EFFECTS OF PLASTIC DEBRIS ON MAN

Microplastic itself can move across the **food chain** and pose significant **public health issues** to society.

- The harmful effects potentially **cascades** through **ecosystem's trophic layers**.
- Potential risk to **food insecurity**.
- There has not being too much experiments done in this area as human samples for experimental purposes are difficult, but the various **negative and threatening results** of the effects of microplastics on animals has given so much clue to the effects of microplastics on man mostly as a result of being trophically transferred. These animals used are also **mammals** so it gives most likely result on man.
- The experiments are done by injecting microplastics such as **polyethylene** terephthalate (PET), polyvinylchloride (PVC) etc into mammal (animal) and after a specified period such as three months the effects on the animal's sample body systems such as digestive, reproductive, respiratory etc are done.
- Microplastics are **measured** by analytical laboratory **techniques such as FPA-based Micro-FTIR** (Focal Plane Array-based Micro-Foutier Transform Infrared), or Micro-Raman Spectroscopy.

WHAT ARE THE SOLUTIONS TO THIS MENACE: MICROPLASTIC BIOAVAILABILITY IN THE WATER BODIES

SOLUTIONS BY REGULATORS, SCIENTISTS, GOVERNMENT AND MANUFACTURING INDUSTRIES

Microplastics are **tiny** and may not be easily noticed as a treat to both sea and human life, therefore there is an **urgent need to combat it**.

The **potential risk** to food security, and thereby human health, has led:

- **regulators** to call for
- ✓ **better understanding**
- ✓ **education** and
- ✓ **public awareness** of the fate and effects of microplastic debris on marine life.

- to the call for urgent actions by
- ✓ **scientists (researching more)**
- ✓ **government (putting right policies in place)** and the
- ✓ **manufacturing industries** on the need for the reduction of the production and activities resulting in the availability and spread of microplastic into the marine environment.

- To the need to **strengthen international and regional cooperation** in this area among:
- ✓ **decision-makers**
- ✓ **researchers** and
- ✓ **academias** to raise awareness in addressing water-related issues.

WHAT ARE THE SOLUTIONS TO THIS MENACE:

MICROPLASTIC BIOAVAILABILITY IN THE WATER BODIES CONT'D

PUTTING IN PLACE APPRORIATE PROHIBITIONS , LAWS AND BANS

The following should be done:

- For **Countries**: **prohibiting** or disincentivizing **land-based materials causing marine litter** such as the use of microbead plastics for toothpaste.
- For **Manufacturing**: **National law and sub-national law** should be put in place.
- At **Retail Level**: **National Law and sub-national law** should be put in place

WHAT ARE THE SOLUTIONS TO THIS MENACE: MICROPLASTIC BIOAVAILABILITY IN THE WATER BODIES CONT'D

WHAT TO DO AS AN INDIVIDUAL

- Report plastics pollutions e.g by using hashtag **#plasticspollution** with the photo, date and location in social media.
- Cut **down on plastics** by staying clear of plastic products. Look for natural alternatives or reuseable containers. Don't buy cleansers and cosmetics with microbeads.
- **Clean-up plastic pollution**. When possible use a pool or aquarium skimmer to **remove plastics debris from the water** and throw the debris in the garbage.
- Gathering of **wax worm** to degrade heap-up plastics. The worms live in honeycombs, where they feed on wax. 100 wax worms degrade 92 milligrams of a plastic shopping bag. At this rate, it will take 100 worms nearly a month to completely break down an average of 5.5gram plastic bag.

Wax worms

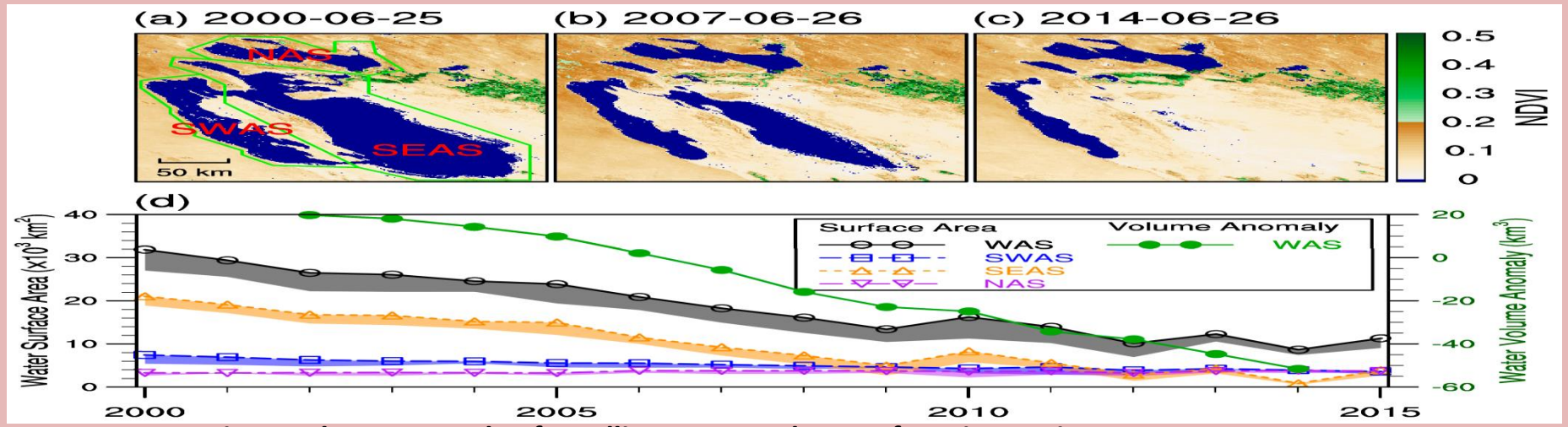
The worms in honeycombs feeding on wax

WHAT ARE THE SOLUTIONS TO THIS MENACE:

MICROPLASTIC BIOAVAILABILITY IN THE WATER BODIES CONT'D

SOLUTIONS USING SPACE BASED TECHNOLOGIES

- Space based **technologies**, **applications** and **services** such as **satellite remote sensing** through space observations could be used to study plastic and microplastic related pollutions in the oceans for **better water management** for the benefit of humankind and the environment (Bagchi and Bussa, 2011).
- This is because this technology is able to address the challenge on **global scale**.



Picture Shows Example of Satellite Image and Data of Marine Environment

WHAT ARE THE SOLUTIONS TO THIS MENACE: MICROPLASTIC BIOAVAILABILITY IN THE WATER BODIES CONT'D

SOLUTIONS USING SPACE BASED TECHNOLOGIES CONT'D

- **Satellites** provide researchers and policy-makers with **vital information about the Earth's water system**, enabling the prevention/preparedness to response/post-recovery through:

✓ Monitoring
✓ Prediction
✓ modelling and
✓ implementation of mitigation and adaptation measures.

- Satellites **provides information before and after disaster**, as well as ensures **timely response** to emergencies such as flood, drought, tsunami, hurricane etc.
- High-resolution satellites are able to **map** polluted water bodies e.g. with microplastics.
- Possible-solutions are **evacuations** of the microplastics and **education** of those living around.

CONCLUSION

- Applications and benefits of microgravity/microgravity-simulations research as applicable to global health including microbiology and the use of space-technology to combat microplastics-menace in water-bodies as applicable to global health have being discussed on micros studies.

- These all involve some contributory-roles of space-science and technologies in advancement of health sustainable-development goal.

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THANK YOU FOR YOUR ATTENTION