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**MICROGRAVITY RESEARCH AND APPLICATIONS:
ROLES IN ECONOMIC PROSPERITY AND POVERTY
REDUCTION**

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PRESENTATION OUTLINE

- 1) Introduction: Microgravity
- 2) Microgravity Research Environments
- 3) Socio-Economy in Microgravity Research
- 4) Benefits of Microgravity Research in Agriculture
- 5) Benefits of Microgravity Research in Pharmacy
- 6) Benefits of Microgravity Research in Medicine
- 7) Benefits of Microgravity Research in Microbiology
- 8) Benefits of Microgravity Research in Biotechnology
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INTRODUCTION: MICROGRAVITY

- **Microgravity** (μg) literally means very little gravity.
- Some of the effects of microgravity environments are seen below.





MICROGRAVITY RESEARCH ENVIRONMENT

Microgravity research are those research conducted in **low gravity** environment. Such as in drop towers, sounding rockets, parabolic flight, ISS, clinostat etc.



International Space Station (ISS)



Drop Tower in Germany



Clinostat



ECONOMIC PROSPERITY OF MICROGRAVITY RESEARCH

- **Prosperity** encompasses **every good thing** of life. It involves wealth, riches, sound-health, well-being, success etc. **Economic prosperity** means having a sustainable and developed economy.
- **Sustainable development** in an economy includes **economic growth, environmental protection** and **social equality**.
- **Space technology applications** such as in microgravity, **stimulates economic growth** and **improves the quality of life** of people; thereby beneficial to mankind.
- **Microgravity research** provides **new insights** into **certain processes** and **phenomena**.
- **Overall products manufactured in microgravity environments** have **key properties** usually surpassing the **best terrestrial counterparts**. Commercially, these products have **attractive features** that facilitate marketing.



FOCUS OF REVIEW

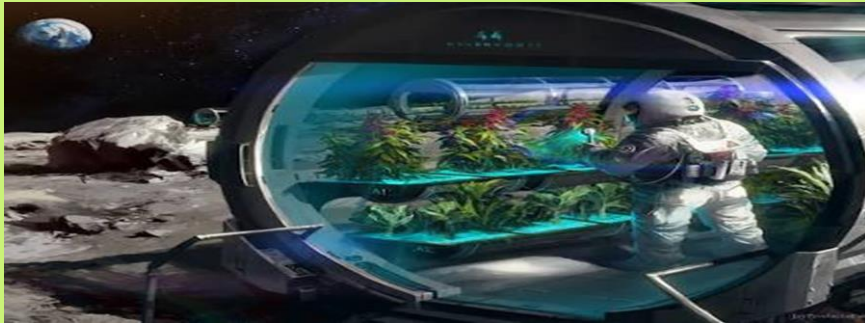
The focus of this work is on **benefits of microgravity research** in the **life sciences**.

- **Life sciences** comprise the fields of science that **involve the scientific study of living organisms**.
- The benefits are specific to the following fields:
 1. Agriculture
 2. Pharmacy
 3. Medicine
 4. Microbiology
 5. Biotechnology



BENEFITS OF MICROGRAVITY RESEARCH IN AGRICULTURE

- Developing **new plant variety adapted to extreme condition** and the production of better products.
- **Food security:** Being able to access enough food that is safe, nutritious and culturally-acceptable at all times that allows for healthy living.
- **Bio-KES** which includes increasing crop shelf life i.e **slows decaying process of plants.**
- Simulated-microgravity environs that **provides solution to land-scarcity and deforestation** for agricultural purposes .

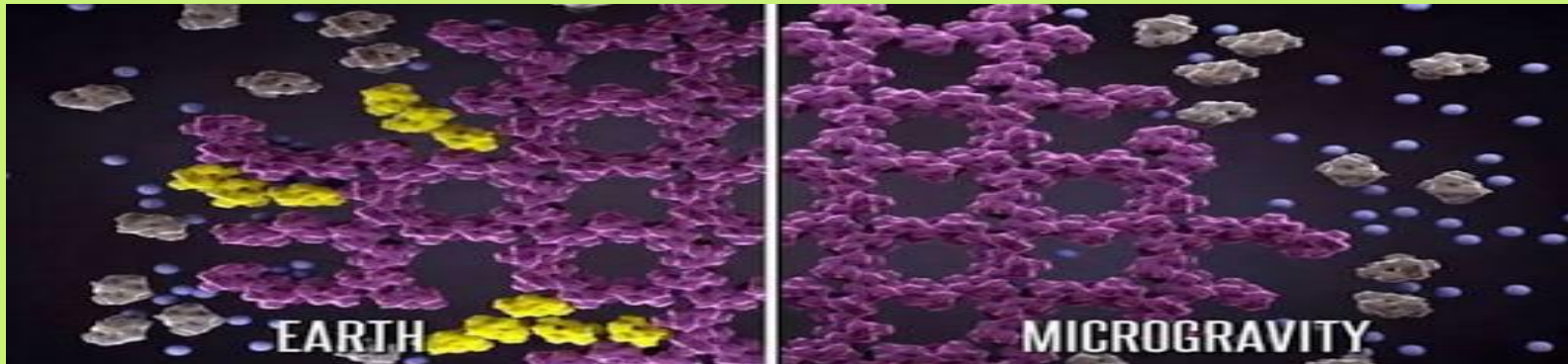


Picture Showing Planting in a Space Environment



BENEFITS OF MICROGRAVITY RESEARCH IN PHARMACY

- Better crystals
- Longer shelf life of drugs
- Better delivery routes
- Better packaging of drugs
- Reduce the cost of drug production

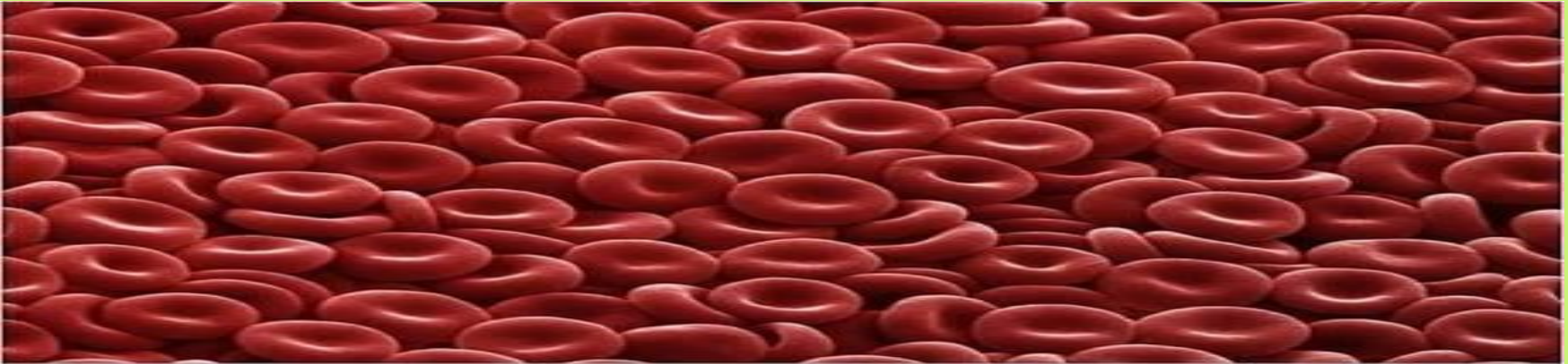


Impurities being Removed from Crystals under Microgravity



BENEFITS OF MICROGRAVITY RESEARCH IN MEDICINE

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



Red Blood Cells



BENEFITS OF MICROGRAVITY RESEARCH IN MICROBIOLOGY

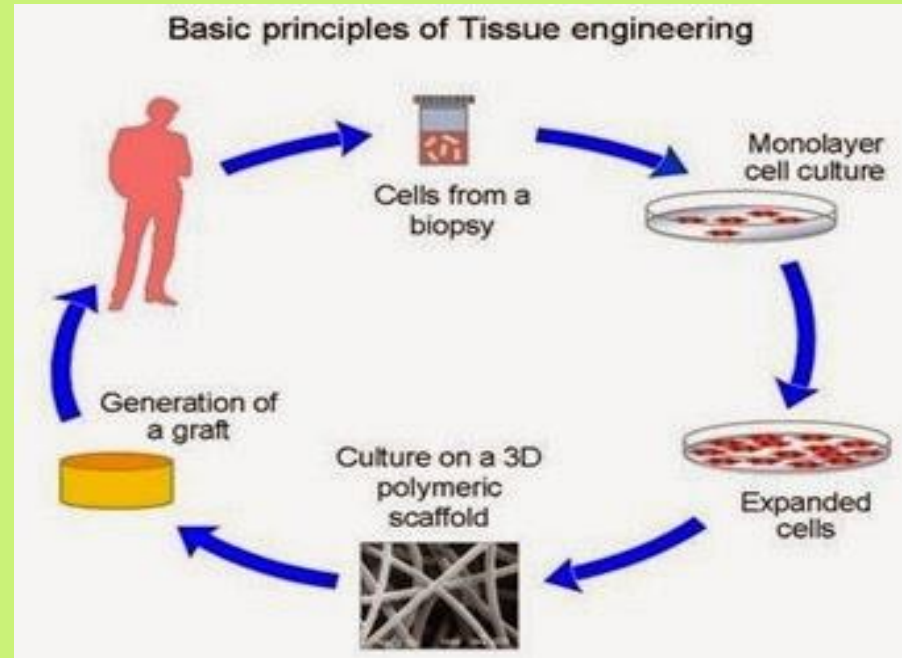
- **Micro-organisms** are living microbes that cannot be seen without an aid of a microscope.
- Microorganisms play essential role in human **health**, therefore their **behavior** under **microgravity** are **different** and are researched on.
- **Spaceflight microbes** have great potential for **novel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





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.





PLANT RESEARCH RESULT USING CLINOSTAT AT NASRDA, NIGERIA

At least **10 plants** has being worked on. They all showed **positive response to simulated microgravity** through their root curvature and **8 of the 10 plants had increased growth rate under simulated microgravity** while 2 (Cotton and Sorghum) showed decreased growth rate.



Microgravity Research Laboratory at NASRDA, Nigeria.

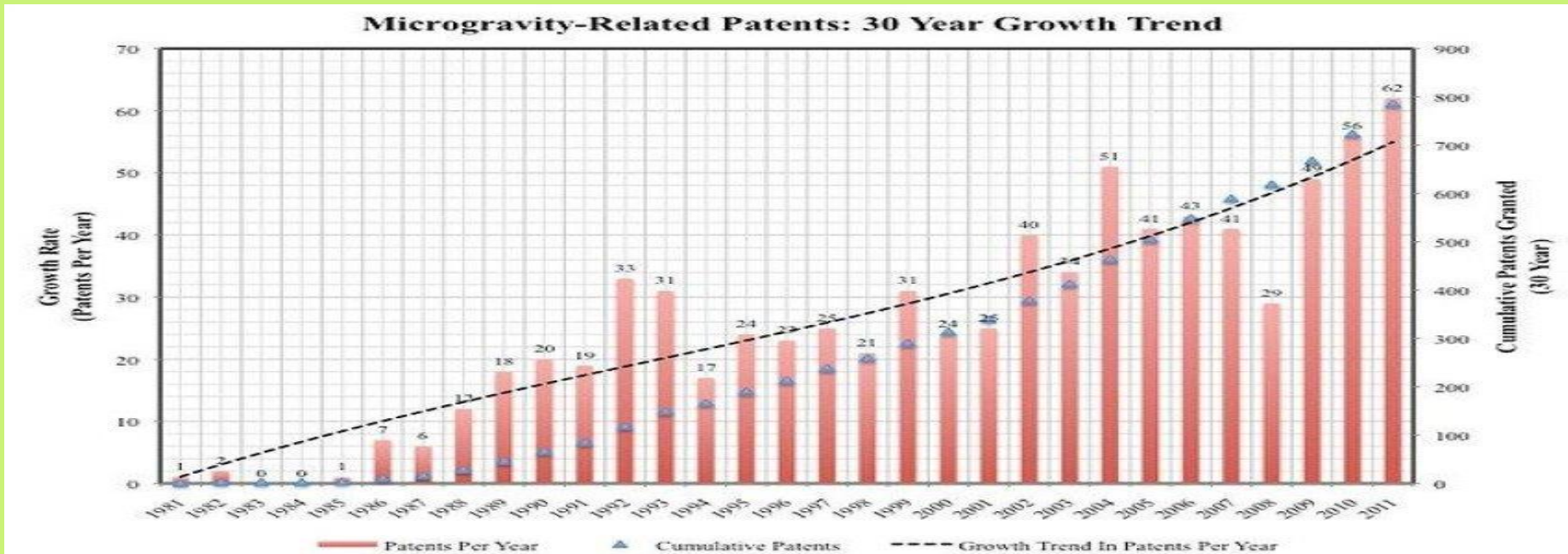
6th-9th Nov., 2017





PATENTS FROM MICROGRAVITY RESEARCH

Patents are government authority or license conferring a right or title for a set period, especially the sole right to exclude others from making, using, or selling an invention.



More than 818 patents granted from 1981 to 2011 as related to the subject of microgravity, the use of patents as an indicator of value creation signifies economic potential.



CONCLUSION

- The opportunity for advances offers an infinite horizon of possibilities that does not just lead to **new products** but to entirely new categories that can fundamentally **change the way we live**. Its quite clear that microgravity research and application has great role in **economic prosperity**, which of course will be **reducing poverty**.
- To pursue and sustain global prestige, influence and power, research under microgravity through all the microgravity/simulated microgravity means are **paramount to pursue to have a sustained economy**.
- In addition, patents resulting from microgravity research cannot be over-emphasized.
- The decisions made now on the approach to **funding the exploration, exploitation and development** of the resources required for **microgravity research** will determine the speed at which we will progress. To impede or accelerate progress towards achieving this potential is funding, not just funding but **consistent funding** to develop robust programs that will attract the best scientific talents.



CONCLUSION CONT'D

- NASA's budget related to microgravity research and development exceed \$350 million per year between 2016 and 2017.
- In 2013, with \$314 billion in commercial revenue and government spending, an average annual growth rate between 5% and nearly 8% was recorded.
- The space sector is one of the fastest growing sectors in the world.



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