JSS ACADEMY OF HIGHER EDUCATION & RESEARCH
(DEEMED TO BE UNIVERSITY) MYSURU

DEPARTMENT OF MICROBIOLOGY
JSS AHER

SUSTAINABLE DEVELOPMENT GOALS

Education for Sustainable Development Goals

Education 2030

Teaching & Learning Objective Handbook

Education for Sustainable Development Goals

Teaching & Learning Objective Handbook

By 2030, ensure that all learners acquire knowledge and skills needed to promote sustainable development, including, among others, through education for sustainable development and sustainable lifestyles, human rights, gender equality, promotion of a culture of peace and non- violence, global citizenship and appreciation of cultural diversity and of culture's contribution to sustainable development.

Source: United Nations, 2015

Foreword

The Sustainable Development Goals (SDGs) introduced in the year 2015 is a follow up of the Millennium Development Goals (MDGs) implemented in 2000. It is a vital framework, which calls attention to meet the challenges towards creating a sustainable future with an impressive target of “Leaving No One Behind”. Achievement of SDGs calls for collective efforts of stakeholders from Government, Non-governmental organizations, Higher Educational Institutions, Multi-national agencies, Civilian organizations, and Public.

While the countries around the globe are seriously addressingseveral issues on the way towards achieving the SDGs, it is becoming evident that these goals cannot be achieved in complete if the younger generation are not made aware of the goals. The best possible means of reaching the youth is through the curriculum, either in schools orin universities. The United Nations has called upon the countries to incorporate the SGDs intothe existing curriculum, aligning the teaching and learning aspects in line with the goals. JSSAcademy of Higher Education & Research has emerged as a renowned institute in the country by providing quality education of highest standards through innovation in academic and research activities even during the most difficult times, for instance, the recent pandemic. JSS AHER has initiated the task of educating students and staff on the SDGs by incorporating the goals into the existing curriculum. Under the able guidance of the HEI, School of Life Sciences is committed to contribute towards achieving the SDGs through its multi-disciplinary academic excellence, research, innovation, environmental protection, and inclusiveness. Since its inception, the School of Life Sciences has seen an exponential growth in a short span of time due to the unique programs, which are being offered in five departments and eight divisions, keeping in mind the problems of the society. The School sees that most of the activities are closely aligned with the vision of sustainable development goals. The programs are designedto address the issues of the society pertaining to water, health, food and environment. The school stands today as a unique institution in the country known for multidisciplinary and interdisciplinary teaching and research in Life Sciences. We have attempted to identify potential courses that can be aligned to the tune of SDGs in the curriculum across the syllabi, which were recently revised according to the NEP 2020.

I take this opportunity to express my sincere gratitude to the leadership of JSS Academy of Higher Education & Research for their constant support and cooperation towards all our initiatives. I thank all the faculty members both teaching and non-teaching for having contributedtowards a noble cause of achieving the SDGs through Education.

Dr.K.A. Raveesha
Professor & Head
School of Life Sciences
JSSAHER

PREFACE

Modernization and urbanization though improved the quality of life has yet unknowingly created problems for humanity and human sustenance. The natural resources have been exploited and climate change has resulted in increase in number of natural disasters, threat to global human health and economic losses. Hence, it is high time to implement, integrate and execute sustainable practices at all levels right from education and include all stakeholders to mitigate further problems and for continuation of life on earth. The UN SDGs comprise 17 goals and 169 targets which on implementing will reduce the health, environmental, and economic threats and ensure a sustainable future. In this handbook, the use of microbiology knowledge and microbes to achieve sustainable development goals (SDGs) have been discussed. Microbiology involves the study of microbes and their activities on land, water and extreme environments. Microbes have a considerable influence on our lives and in ecosystem. Microbes have a significant role and impact health, climate change and food security, environmental sustainability and bioremediation. Microbes can be used for sustainable crop production using biofertilizers and biopesticides and mass production of protein rich foods. They can be used for generation of bio fuels and electricity and for synthesis of bio-products and novel drugs. Therefore, for the implementation and actualization of the 17 SDGs, microbes and microbiology have to be integrated into interdisciplinary sciences, in policy and strategic advocacies to combat climate change, improve global health and economy.

MICROBIOLOGY – TEAM MEMEBERS

Dr. Ashwini P
Coordinator

Dr. Sumana K

Dr. Archer Ann Catherine

Dr. Nagalambika Prasad

Dr. Supreeth M

Dr. Umamaheshwari S

Dr. Sindhu R

Dr. Jamuna Bai A

Dr. Jagadeep Chandra S

Dr. Sunita C Mesta

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INTRODUCTION

The Sustainable Development Goals – an ambitious and universal agenda to transform our world

On 25 September 2015, the UN General Assembly adopted the 2030 Agenda for Sustainable Development (UN, 2015). This new global framework to redirect humanity towards a sustainable path was developed following the United Nations Conference on Sustainable Development (Rio+20) in Rio de Janeiro, Brazil in June 2012, in a three-year process involving UN Member States, national surveys engaging millions of people and thousands of actors from all over the world.

At the core of the 2030 Agenda are 17 Sustainable Development Goals (SDGs). The universal, transformational and inclusive SDGs describe major development challenges for humanity. The aim of the 17 SDGs is to secure a sustainable, peaceful, prosperous, and equitable life on earth for everyone now and in the future. The goals cover global challenges that are crucial for the survival of humanity. They set environmental limits and set critical thresholds for the use of natural resources. The goals recognize that ending poverty must go together with strategies that build economic development. They address a range of social needs including education, health, social protection, and job opportunities while tackling climate change and environmental protection. The SDGs address key systemic barriers to sustainable development such as inequality, unsustainable consumption patterns, weak institutional capacity, and environmental degradation.

For the goals to be reached, everyone needs to do their part: governments, the private sector, civil society and every human being across the world. Governments are expected to take ownership and establish national frameworks, policies, and measures for the implementation of the 2030 Agenda.

A key feature of the 2030 Agenda for Sustainable Development is its universality and indivisibility. It addresses all countries – from the Global South and the Global North – as target countries. All countries subscribing to the 2030 Agenda are to align their own development efforts with the aim of promoting prosperity while protecting the planet to achieve sustainable development. Thus, with respect to the SDGs, all countries can be considered as developing and all countries need to take urgent action.

The 17 Sustainable Development Goals (SDGs)

No Poverty – End poverty in all its forms everywhere

Zero Hunger – End hunger, achieve food security and improved nutrition and promote sustainable agriculture

Good Health and Well-Being – Ensure healthy lives and promote well-being for all at all ages

Quality Education – Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all

Gender Equality – Achieve gender equality and empower all women and girls

Clean Water and Sanitation – Ensure availability and sustainable management of water and sanitation for all

Affordable and Clean Energy – Ensure access to affordable, reliable, sustainable, and clean energy for all

Decent Work and Economic Growth – Promote sustained, inclusive, and sustainable economic growth, full and productive employment and decent work for all

Industry, Innovation and Infrastructure – Build resilient infrastructure, promote inclusive and sustainable industrialization and foster innovation

Reduced Inequalities – Reduce inequality within and among countries

Sustainable Cities and Communities – Make cities and human settlements inclusive, safe, resilient and sustainable

Responsible Consumption and Production – Ensure sustainable consumption and production patterns

Climate Action – Take urgent action to combat climate change and its impacts

Life below Water – Conserve and sustainably use the oceans, seas and marine resources for sustainable development

Life on Land – Protect, restore and promote sustainable use of terrestrial ecosystems, sustainably manage forests, combat desertification, and halt and reverse land degradation and halt biodiversity loss

Peace, Justice and Strong Institutions – Promote peaceful and inclusive societies for sustainable

development, provide access to justice for all and build effective, accountable and inclusive institutions at all levels

Partnerships for the Goals – Strengthen the means of implementation and revitalize the global partnership for sustainable development

Source: http://www.un.org/sustainabledevelopment/sustainable- development-goals

SDG 1 – NO POVERTY

End poverty in all its forms everywhere

Teaching & Learning objectives for SDG 1 "No Poverty"

Subject/ topic/ course in regular curriculum relating to SDG 1	• Environmental Microbiology (BSc V Sem) • Medical Microbiology, Industrial Microbiology (BSc VI Sem) • Soil Microbiology & Plant Health; Industrial Microbiology & Fermentation technology (MSc II Sem)
Cognitive Teaching & learning objectives	• The poverty and the demographic implications towards the normal cultural and habitual practices • Eradication of extreme poverty that includes the study of sufficient nourishment to the society with proper nourishment of planned diet, potable water supply and proper hygienic practices
Socio-emotional Teaching & learning objectives	• The learner can create awareness about the economic status of the current scenario which meets the basic requirement of an individual to lead a normal convenient life. • The learner can collaborate with industries to empower the individuals and communities that brings about a change in the distribution of power and resources in the society.
Behaviorial Teaching & Learning objectives	• The learner can analyze the issues and causes of poverty and find the solutions to overcome the core areas that needs to be addressed. • The learner can contribute to various decision-making aspects of poverty eradication. • The learner can propose the plans for the optimum execution that reaches every citizen intended to be in the country.

Learning approaches and methods for SDG 1 "No Poverty"

- Infectious diseases of poverty (IDP) such as diseases prevalent among poorer sections (tuberculosis, malaria, HIV/AIDS and the neglected tropical diseases)
- Research to stop antimicrobial resistance
- Develop malarial vaccines and other endemic diseases
- Discover sustainable antimicrobials to fight poverty

Suggested topics for SDG 1 "No Poverty" for students workshop

- Spirulina & Mushroom cultivation for weaker economic sections
- Epidemiology and control measures for Infectious diseases of poverty
- Prevention of malaria, dengue, and other endemic diseases

SDG 2 - ZERO HUNGER

End hunger, achieve food security and improved nutrition and promote sustainable agriculture

Teaching & Learning objectives for SDG 2 "Zero Hunger"

Subject/ topic/ course in regular curriculum relating to SDG 2	•Biofertilizers & Biopesticides (BSc IV Sem) •Food & Diary Microbiology; Agricultural Microbiology (BSc V Sem) •Food & Diary Technology; Biofertilizer, Biomanure & Biopesticides (MSc II Sem)
Cognitive Teaching & learning objectives	• Understands the concepts of hunger and malnutrition and their impacts on human life with particular reference to our economies, health, education, equality and social development. • Understands the importance for sustainable agriculture, roles played by food and dairy industries to combat hunger and malnutrition.
Socio-emotional Teaching & learning objectives	•Establish connections with the stakeholders and promote sustainable agriculture, food and dairy technologies for improved nourishment and to overcome malnutrition. •Can create awareness on the importance and the applications of biofertilizers, biopesticides and organic farming for the sustainable agriculture
Behaviorial Teaching & Learning objectives	•The learner shall get experienced through the experiments that can be performed to visualize the impact of biofertilizers and biopesticides in the sustainable agriculture and productivity. •The learner can promote the soil health through the enrichment of nutrients in-turn addressing the plant health and crop health targetting for better productivity. •The learner can influence decision-making aspects related to hunger and malnutrition and bring about a change in the production and consumption practices of various agricultural, food and dairy commodities to have a focused balanced diet.

Learning approaches and methods for

SDG 2 “Zero Hunger”

- Strategies to reduce food spoilage and food-borne outbreaks,
- Strategies to increase food production
- Study microbe–plant interaction to increase crop yield.
- Gut microbiota and satiety research.

Suggested topics for SDG 2 “Zero Hunger”for students workshop

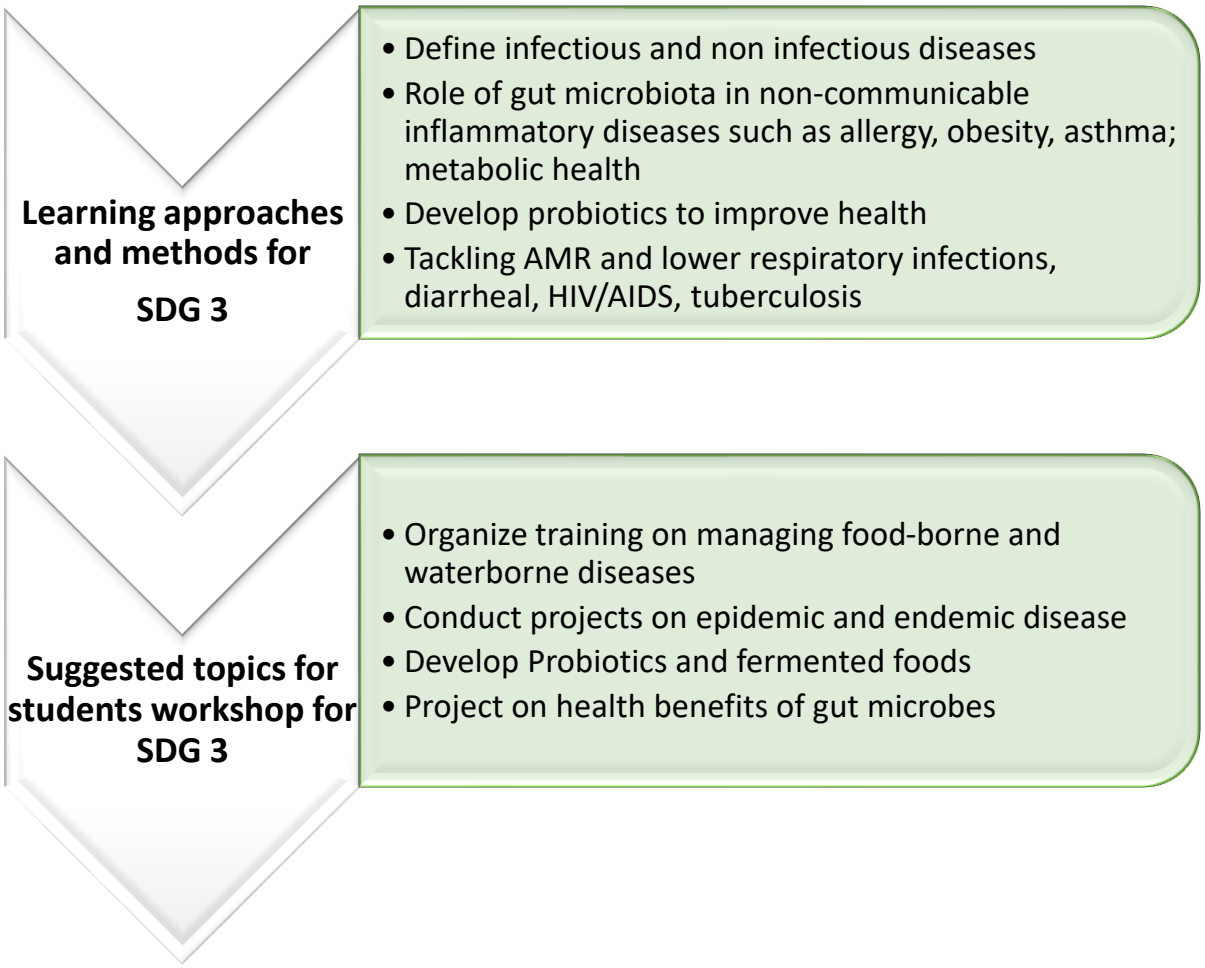
- Training program for production of fermented foods and probiotics
- Detection of food spoilage & food-borne bacteria & fungi
- Promote sustainable agriculture practices
- Cultivation of mushroom and other single cell proteins
- Prevent post harvest losses and hygienic storage of food

SDG 3 - Good Health and Well-being

Ensure healthy lives and promote well-being for all at all ages

Teaching & Learning objectives for SDG 3 "Good Health & Well being"

Subject/ topic/ course in regular curriculum relating to SDG 3	• Clinical Microbiology (BSc IV Sem) • Medical Microbiology; Antimicrobial Resistance (BSc VI Sem) • Pharmaceutical Microbiology (MSc II Sem) • Medical Microbiology & Immunology; Disease Diagnostic Technology; Industrial Microbiology & Fermentation technology (MSc III Sem)
Cognitive Teaching & learning objectives	• Concepts of health, hygiene and well-being of an individual and understands. • Consequences of severe communicable and non-communicable diseases, among most vulnerable & non vulnerable populations. • Aspects of mental health and negotiable socio-economical impacts of alcohol consumption, tobacco or other drugs addictions on health and well-being.
Socio-emotional Teaching & learning objectives	• Exposed to the health issues viz., critical and infectious diseases and interact with the section of population of illnesses, counsel and educate the advanced diagnostics and therapeutics ; communicate to encourage on the aspects of good clinical health and hygiene practices; create awareness on the emergence of antimicrobial resistance and their impacts on the livelihood of the people.
Behaviorial Teaching & Learning objectives	• The learner can get experienced through good hygienic practices towards critical and infectious diseases and anti-microbial agents. • The learner can promote good health practices and behaviors in the daily routines. The good hygienic and health practices can be evaluated, planned, implemented, executed and shared the same among the family, in-turn to the surroundings and finally to the society.

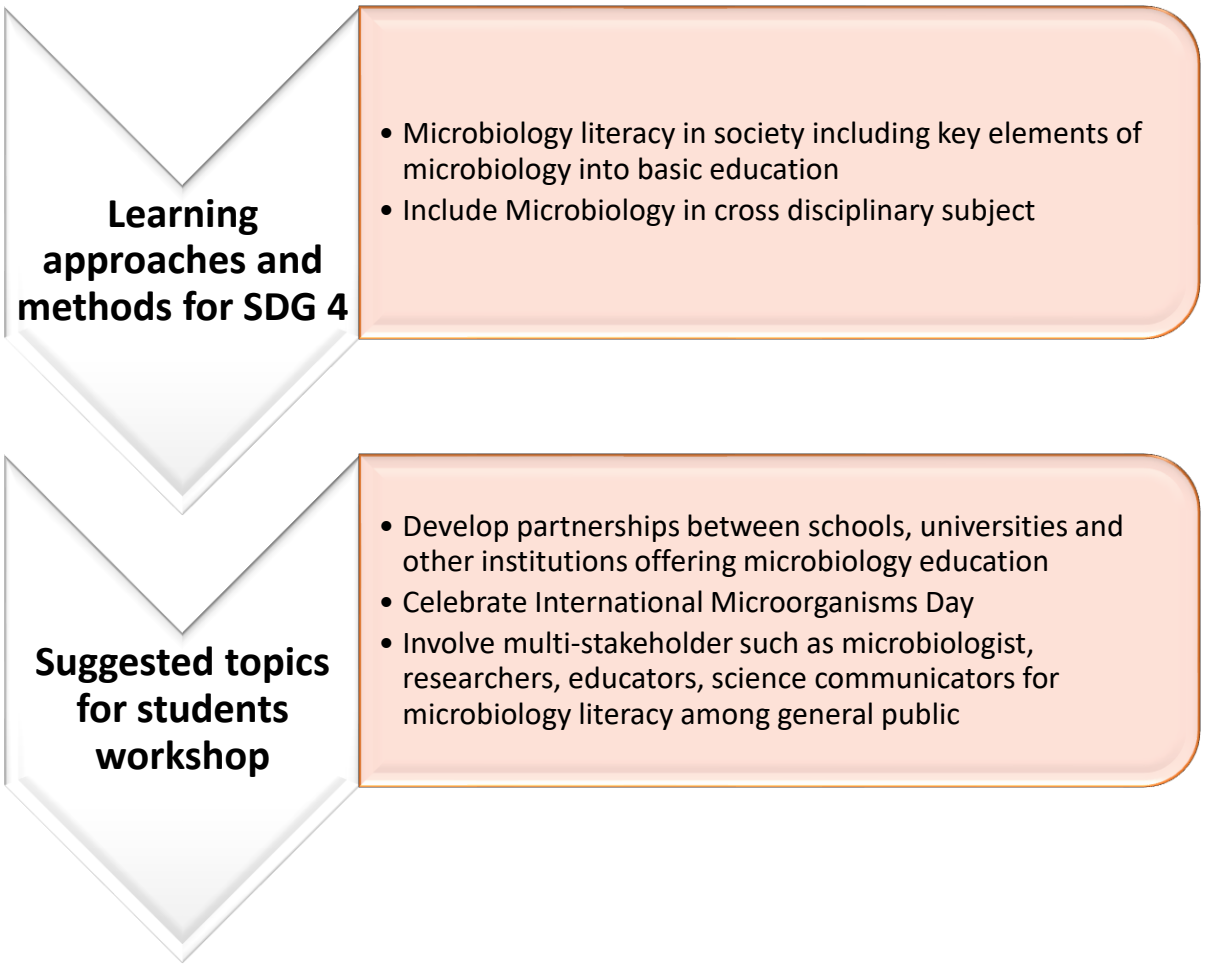

Learning approaches and methods for SDG 3
• Define infectious and non infectious diseases
• Role of gut microbiota in non-communicable inflammatory diseases such as allergy, obesity, asthma; metabolic health
• Develop probiotics to improve health
• Tackling AMR and lower respiratory infections, diarrheal, HIV/AIDS, tuberculosis
Suggested topics for students workshop for SDG 3
• Organize training on managing food-borne and waterborne diseases
• Conduct projects on epidemic and endemic disease
• Develop Probiotics and fermented foods
• Project on health benefits of gut microbes

SDG 4 - Quality Education

Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all

Teaching & Learning objectives for SDG 4 "Quality Education"

Subject/ topic/ course in regular curriculum relating to SDG 4	• **Implementation of NEP 2020 and Upgradation of PG Syllabus to LOCF Pattern to improve Quality Education**
Cognitive Teaching & learning objectives	• The learner understands the opportunities for all formal, non-formal and informal learning as main drivers of sustainable development, for improving people's lives and in achieving the SDGs; understands education as a public good, a global common good, a fundamental human right and a basis for guaranteeing the realization of other
Socio-emotional Teaching & learning objectives	• The learner can raise awareness of the importance of quality education for all, a humanistic and holistic approach to education; motivate and empower others to demand and use educational opportunities; recognize the intrinsic value of education and analyse and identify their own learning needs; recognize the importance of their own skills for improving their life, for employment and entrepreneurship
Behaviorial Teaching & Learning objectives	• The learner can contribute to facilitating and implementing quality education for all, ESD and related approaches at different levels; promote gender equality in education; spport the development of policies promoting free, equitable and quality education for all, ESD and related approaches as well as aiming at safe, accessible, and inclusive educational facilities


Learning approaches and methods for SDG 4
• Microbiology literacy in society including key elements of microbiology into basic education
• Include Microbiology in cross disciplinary subject
Suggested topics for students workshop
• Develop partnerships between schools, universities and other institutions offering microbiology education
• Celebrate International Microorganisms Day
• Involve multi-stakeholder such as microbiologist, researchers, educators, science communicators for microbiology literacy among general public

SDG - 5 Gender Equality

Achieve gender equality and empower all women and girls

Teaching & Learning objectives for SDG 5 "Gender Equality"

Subject/ topic/ course in regular curriculum relating to SDG 5	• Value Based Course 01 Health & Wellness (BSc I Sem); Cyber Security (BSc III Sem); Food & Dairy Microbiology (BSc V Sem); Agriculture Microbiology (BSc V Sem); Value Based Course 01 Ethics & Self awareness (BSc V Sem)
Cognitive Teaching & learning objectives	• The learner understands about the gender discrimination and how to overcome through skill development, technology and entrepreneurship; understands the basic rights of women, their right to freedom from exploitation and violence; knows the opportunities and benefits provided by full gender equality through participation in all fields, public and private decision-making.
Socio-emotional Teaching & learning objectives	• The learner can recognize and question traditional perception of gender roles in a critical approach; can identify and speak up against all forms of gender discrimination and debate the benefits of full empowerment of all genders; can connect with others who work to end gender discrimination and violence; feel empathy with those who differ from personal or community gender expectations.
Behaviorial Teaching & Learning objectives	• The learner can take the measure of their surroundings to empower themselves or others who are discriminated against because of their gender; evaluate, participate in and influence decision-making about gender equality and participation; support others in developing empathy across genders and breaking down gender discrimination and violence.

Learning approaches and methods for SDG 5

- Sensitizing women about urinary tract infection and STI's
- Focus on infectious diseases to improve maternal and child health

Suggested topics for students workshop

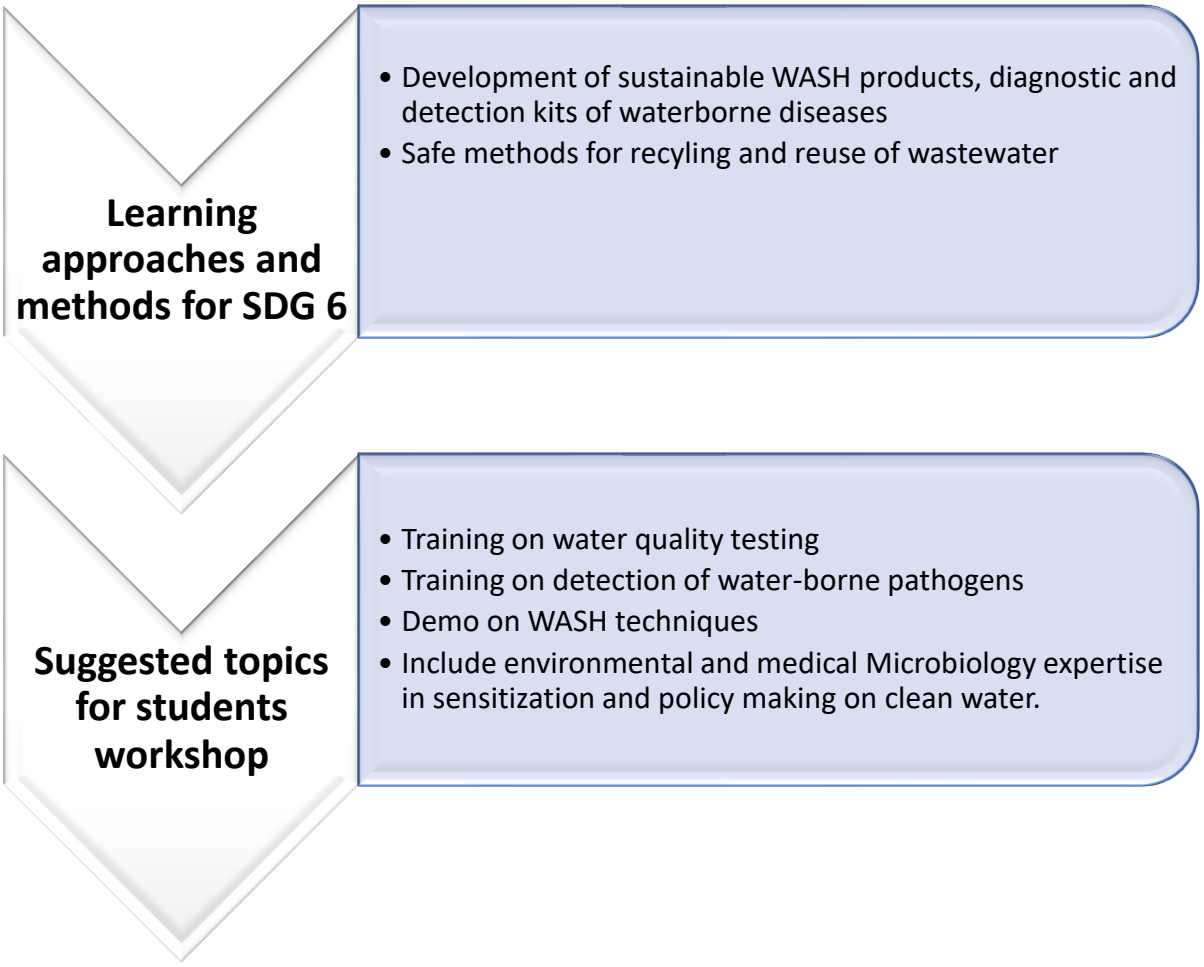
- Training Programs for Women to take up Entrepreneurship such as in Mushroom Cultivation and other courses providing financial independence
- Training program on safe hygienic practices for women

SDG 6 - Clean Water and Sanitation

Ensure availability and sustainable management of water and sanitation for all

Teaching & Learning objectives for SDG 6 "Clean Water and Sanitation"

Subject/ topic/ course in regular curriculum relating to SDG 6	• Value Based Course (VBC) 01 Health & Wellness (BSc I Sem); Environmental Microbiology (MSc V Sem); Medical Microbiology & Immunology (MSc III Sem); Disease Diagnostic Technology (MSc III Sem); Microbiological Analysis of Air & Water (BSc III Sem)
Cognitive Teaching & learning objectives	•The learner understands the importance of water quality and quantity, the causes, effects and consequences of water pollution and water scarcity; unhygienic water as the source of disease, their effects to the public, testing protocols and treatment; need for improvement and access to safe drinking water and sanitation facilities; concept of Integrated Water Resources Management for ensuring the availability and sustainable management of water and sanitation, including flood and drought risk management.
Socio-emotional Teaching & learning objectives	• The learner can participate in activities of improving water and sanitation management in local communities; communicate about water pollution, water access and water saving measures and to create visibility about success stories; know their responsibility for water usage; acquire the knowledge of good sanitation and hygiene standards.
Behaviorial Teaching & Learning objectives	• The learner can cooperate with local authorities and improve the hygienic and sanitation condition; contribute to water resources management at the local level; reduce their individual water footprint and to save water practicing their daily habits; plan, implement, evaluate and replicate activities that contribute to increasing water quality and safety; participate in decision-making on management strategies of local, national and international enterprises related to water pollution.


Learning approaches and methods for SDG 6
• Development of sustainable WASH products, diagnostic and detection kits of waterborne diseases
• Safe methods for recyling and reuse of wastewater
Suggested topics for students workshop
• Training on water quality testing
• Training on detection of water-borne pathogens
• Demo on WASH techniques
• Include environmental and medical Microbiology expertise in sensitization and policy making on clean water.

SDG 7 - Affordable and Clean Energy

Ensure access to affordable, reliable, sustainable and clean energy for all

Teaching & Learning objectives for SDG 7 "Affordable and Clean Energy"

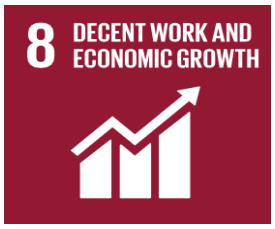
Subject/ topic/ course in regular curriculum relating to SDG 7	• Biofertilizers and Biopesticides (BSc IV Sem); Microbial Nanotechnology (BSc VIII Sem); Biofertilizers, Biomanure and Biopesticides (MSc II Sem); Bioremediation & Microbial Technology (BSc V Sem); Microbial Biotechnology (BSc VI Sem)
Cognitive Teaching & learning objectives	• The learners will understand the metabolism and metabolites produced from the microorganisms; Know the use of microorganisms as fertilizers in enrichment of soil fertility; Elucidates the knowledge on mass production of biofertilizers, biomanure, organic farming and biopesticides; know about the microbial synthesis of nanoparticles; Study the application of bionanomaterials
Socio-emotional Teaching & learning objectives	• The learners will be able to research on microbial fuel cells for producing high – voltage – output; Work on the production of third generation bio-fuels including bio-ethanol, bio-gases and bio-electricity with the help of microorganisms; research on nanotechnology in the field of bio-pesticides and biomanure preparation
Behaviorial Teaching & Learning objectives	• Major and minor projects regarding the production in large scale of bioethanol, biofertilizers, biomanure and biopesticides; Educating the farmers regarding the application of biomanures and biopesticides to the agricultural fields; Demonstration techniques used for synthesis of nanoparticles.

Learning approaches and methods for SDG 7

- Microbes for production of third-generation bio-fuels including bio-ethanol, bio- gases and bio-electricity
- Microbial Fuel Cells for producing higher-voltage-output
- Microbes for clean and green synthesis of nanoparticles

Suggested topics for students workshop

- Project work on bioethanol production
- Experiments on microbial mediated synthesis of nanoparticles
- Experiments on design of microbial fuel cell



SDG 8 - Decent Work and Economic Growth

Promote sustained inclusive and sustainable economic growth, full and productive employment, and decent work for all

Teaching & Learning objectives for SDG 8 "Decent Work and Economic Growth"

Subject/ topic/ course in regular curriculum relating to SDG 8	• Biosafety and Bioethics (BSc V Sem); Instrumentation and Bioanalytical Techniques (BSc II Sem); Bioremediation and Microbial Technology (BSc V Sem); Intellecutal Propery Rights, Biosafety and Bioethics (MSc II Sem); Bioinstrumentation and Bioanalytical Techniques(MSc II Sem)
Cognitive Teaching & learning objectives	• Explain about patents, patent laws, agreements, concepts of patents; Understand the treaties, agreements, and amendments in IPR; Critically analyze the patent applications for novelty and utility; Describe biosafety levels, regulations of biosafety and bioethics; knowledge on construction and working principle of various instruments; Imparts skills in handling and operations of various instruments.
Socio-emotional Teaching & learning objectives	• Provides the knowledge on the types of bioremediations, bioleaching and extraction of metals from ores using microbes; provides with sound theoretical knowledge on intellectual property rights, biosafety and bioethics; Imparts the knowledge on patent filing and types of patents
Behaviorial Teaching & Learning objectives	• Visiting the industries to know and get the knowledge of biosafety principles; Visiting the different laboratories and get the knowledge of different instruments and their application

Learning approaches and methods for SDG 8

- Microbial bio-technology for sustaining economic development, industry, innovation and facilitating workforce growth.

Suggested topics for students workshop

- Workshop on innovation and entrepreneurship.
- Internship in food, pharma and life sciences industries

SDG 9 - Industry, Innovation and Infrastructure

Build infrastructure, promote inclusive and sustainable industrialization and foster innovation

Teaching & Learning objectives for SDG 9 "Industry, Innovation and Infrastructure"

Subject/ topic/ course in regular curriculum relating to SDG 9	• Industrial Microbiology (BSc VI Sem); Microbial Biotechnology (BSc VI Sem); Industrial Training And Entrepreneurship (BSc VIII Sem); Food And Dairy Technology (MSc II Sem); Pharmaceutical Microbiology (MSc II Sem); Industrial Microbiology and Fermentation Technology (MSc III Sem)
Cognitive Teaching & learning objectives	• Emphasizes on principles and concepts of entrepreneurship, its historical development, and the importance of entrepreneurship in economic development; Enables to effectively apply the theories and various approaches of entrepreneurship; Provides the knowledge of applications of microorganisms in biotransformation processes; Understand the potential of microbes to manufacture genetically engineered therapeutics.
Socio-emotional Teaching & learning objectives	• Appreciate the importance of entrepreneurship and value the characteristics of successful entrepreneur; Identify business opportunities in chosen sector / sub-sector; Develop a small business enterprise by liaising with different stake holders; Implement business ethics and operate small scale enterprises;
Behaviorial Teaching & Learning objectives	• Visiting food, dairy, pharmaceutical and beverage industries and learn the techniques; Know about the patent filing, product discovery and also start up the company in regarding to the nutritional and therapeutic values of microorganisms.

Learning approaches and methods for SDG 9

- Developing information and communication technology (ICT) based sustainable infrastructure
- Role of microbiologists in Industries
- Explain the importance of microbes in biotechnological applications; Demonstrate the application of microorganisms in the production of vaccines, antibiotics and biofertilizers; Demonstrate the role of microorganisms in biotransformation industries;

Suggested topics for students workshop

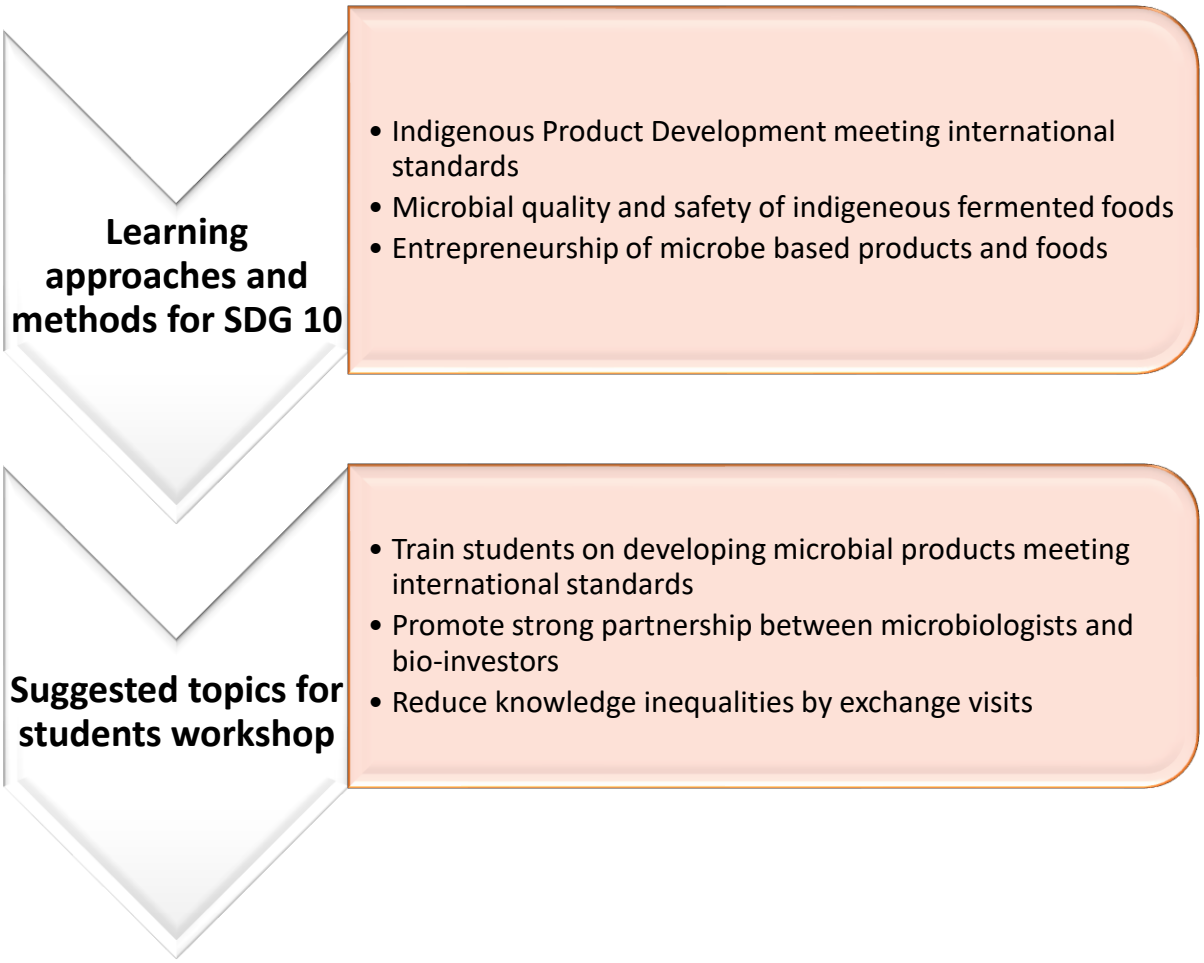
- Develop microbe based products for industrial infrastructure
- Train students in Innovation for sustainable development
- Develop pilot scale microbial fuel cell based transport systems
- Appraise the role of microorganisms in industrial productions and also an understanding of advance technologies in microbial biotechnology.

SDG 10 - Reduced Inequalities

Reduce inequality within and among countries

Teaching & Learning objectives for SDG 10 "Reduced Inequalities"

Subject/ topic/ course in regular curriculum relating to SDG 10	• Environmental Microbiology (BSc V Sem); Industrial Microbiology (BSc VI Sem); Industrial Training & Entrepreneurship (BSc VI Sem)
Cognitive Teaching & learning objectives	• The learner knows different dimensions of entrepreneurship; indicators that measure and describe various opportunities regarding solid waste management, vermicomposting and microbial based products for decision-making; understands requirements for investment opportunities.
Socio-emotional Teaching & learning objectives	• The learner can raise awareness about different polices in industries; show solidarity with people for farmers in creating commercial opportunities; can negotiate product value according to market demand; maintain a vision of an equal world with his survival by increasing his income level.
Behaviorial Teaching & Learning objectives	• The learner can evaluate inequalities and provide solidarity support to lower-level income people by providing employment opportunities; plan, implement and evaluate strategies to counter the monopoly of MNCs.

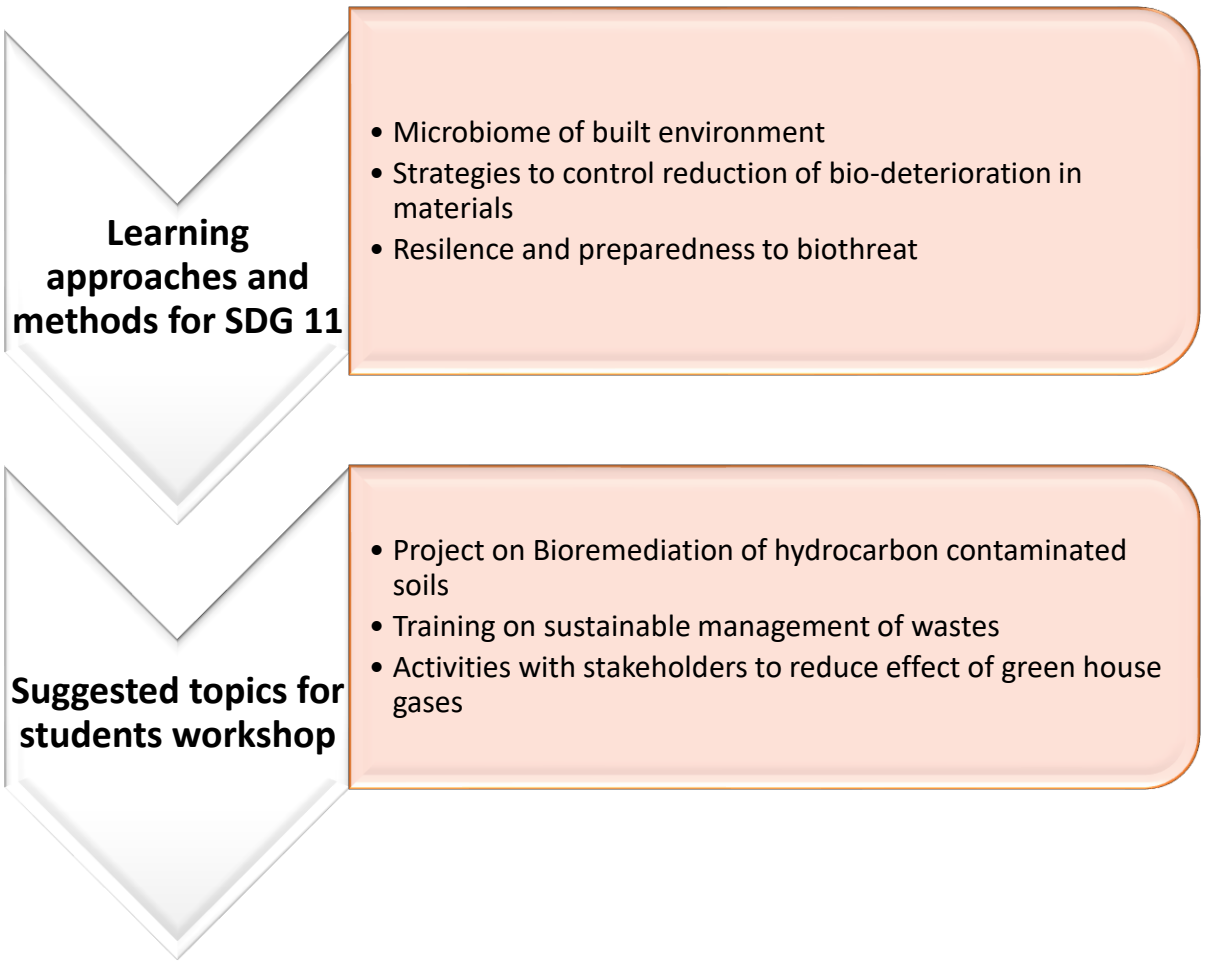

Learning approaches and methods for SDG 10
• Indigenous Product Development meeting international standards
• Microbial quality and safety of indigeneous fermented foods
• Entrepreneurship of microbe based products and foods
Suggested topics for students workshop
• Train students on developing microbial products meeting international standards
• Promote strong partnership between microbiologists and bio-investors
• Reduce knowledge inequalities by exchange visits

SDG 11 - Sustainable Cities and Communities

Make cities and human settlements inclusive, safe, resilient and sustainable

Teaching & Learning objectives for SDG 11 "Sustainable Cities and Communities"

Subject/ topic/ course in regular curriculum relating to SDG 11	• Biofertilizers & Biopesticides (BSc VI Sem); Bioremediation & Microbial Technology (BSc V Sem)
Cognitive Teaching & learning objectives	• The learner understands the negative affect of chemically synthesized pesticides; studies alternatives to chemically synthesized pesticides such as biopesticides and biofertilizers; understands usage of microorganisms in improving crop productivity and quality of soil; managing wastes by using microorganisms; the role of sustainable management of soil, air and water.
Socio-emotional Teaching & learning objectives	• The learner can connect with local farmers and tribal people to improve their socio-economic status by adopting biofertilizers and biopesticides; join hands with government and non - governmental organizations in managing waste; feel responsible for the environmental and social impacts of their own individual lifestyle
Behaviorial Teaching & Learning objectives	• The learner can plan Programmes in reduction of greenhouse gases; can develop startup ideas for sustainable management for waste; develop new alternatives from using fossil fuels; promote low carbon approaches at the local level.


Learning approaches and methods for SDG 11
• Microbiome of built environment
• Strategies to control reduction of bio-deterioration in materials
• Resilence and preparedness to biothreat
Suggested topics for students workshop
• Project on Bioremediation of hydrocarbon contaminated soils
• Training on sustainable management of wastes
• Activities with stakeholders to reduce effect of green house gases

SDG 12 - Responsible Consumption and Production

Ensure sustainable consumption and production patterns

Teaching & Learning objectives for SDG 12 "Responsible Consumption and Production"

Subject/ topic/ course in regular curriculum relating to SDG 12	• Food & Dairy Technology (MSc II Sem); Industrial Microbiology & Fermentation Technology (MSc III Sem); Microbial Biotechnology (BSc VI Sem)
Cognitive Teaching & learning objectives	• The learner understands processing of different food commodities; production and consumption of healthy food; knows roles, played by microorganisms in improving the quality of food; studies isolation of agriculturally and industrially important microorganisms; labelling of genetically modified food materials.
Socio-emotional Teaching & learning objectives	• The learner can communicate with local farmers for sustainable practices in production and consumption; encourage others to engage in sustainable practices in consumption and production; recognize genetically modified food; responsible for the environmental and social impacts of their own individual behaviour as a producer or consumer.
Behaviorial Teaching & Learning objectives	• The learner can improve quality control and quality assurance in food production; evaluate, effect of various pathogen responsible for crop loss; promote sustainable management of microbial pathogens; able take on critically on their role as an active stakeholder in the market.

Learning approaches and methods for SDG 12

- Design of Microbial Fuel Cells
- Micro-organisms for large-scale production of chemical commodities, industrial bioproducts and NP synthesis
- Microbial bio-technology for sustainable recovery of precious metal from waste streams

Suggested topics for students workshop

- Training on promoting Organic Farming and use of integrated technologies
- Workshop on production of sustainable bioproducts

SDG 13 - Climate Action

Take urgent action to combat climate change and its impacts

Teaching & Learning objectives for SDG 13 "Climate Action"

Subject/ topic/ course in regular curriculum relating to SDG 13	• Environmental Microbiology (BSc V Sem); Bioremediation & Microbial Technology (BSc VI Sem); Soil Microbiology & Plant Health (BSc VI Sem); Soil Microbiology & Plant Health (MSc II Sem); Biofertilizers, Biomanure & Biopesticides (MSc II Sem); Advances in Bioremediation & Microbial Technology (MSc II Sem)
Cognitive Teaching & learning objectives	• The learner understands the role of microorganisms in climate change; understands the current climate change depends on microbial response; knows the beneficial microbes are required for achieving an environmentally sustainable future; use of microbes to prevent and mitigate disasters due to climate change.
Socio-emotional Teaching & learning objectives	• The learner can explain the role of microbes in ecosystem dynamics and its impact on climate change at socio-economic level; encourage others to use the microbes for sustainable agricultural and industrial production to reduce CO_2 emission; recognize unsustainable development patterns that increase climate hazards and how to mitigate it as microbiologists with domain expertise.
Behaviorial Teaching & Learning objectives	• The learner can evaluate whether the experiments and microbial activities are climate friendly; train people about microbes and their activities in global warming; educate public about prominent role of microbes in climate change; promote microbial mediated recycling; support and assist in preparing policies on avoiding consequences of climate change on microbial life in environment.

Learning approaches and methods for SDG 13

- Role of microbes both users and producers of greenhouse gases
- Role of microbes in climate change and recycling.
- Importance of microbiomes and nutrient cycling, and their impact on climate change and food security.
- Methods for reduction of microbial greenhouse gases and control the detrimental impacts of microbes

Suggested topics for students workshop

- Experiments on the controlled studies related to climate change on microbial processes.
- Training on interventions using microbes and their biotransformations for production of recyclable and biodegradable products.
- Workshop on using microbial process data for modeling climate change.
- Using One Health approach to understand microbes and their role in climate change.
- Conduct lab experiments on microbes adapt to climate change

SDG 14 - Life below Water

Conserve and sustainably use the oceans, seas and marine resources for sustainable development

Teaching & Learning objectives for SDG 14 "Life below Water"

Subject/ topic/ course in regular curriculum relating to SDG 14	• Microbial Diversity (BSc I Sem); Microbiological Analysis of Air & Water (BSc III Sem); Bioremediation & Microbial Technology (BSc V Sem); Microbial Biotechnology (BSc VI Sem); Extremophilic Microbiology (BSc VIII Sem); Advances in Bioremediation & Microbial Technology (MSc III Sem); Medical Microbiology & Immunology (MSc III Sem)
Cognitive Teaching & learning objectives	•The learner understands basic marine and freshwater microbiology, and role of microbes in ecosystems and food chain; understands the beneficial and pathogenic behavior of marine and freshwater microbes; knows the natural and bio-based products for sustainable use that can be derived from marine microbes; understands the impacts of global warming on microbial communities; understands the use of bioremediation and cleaning oil spill in marine environment.
Socio-emotional Teaching & learning objectives	• The learner can speak for sustainable use of marine microbial resources; show people the impact of microbial activity in maintaining equilibrium of ocean ecostytems; influence and educate about sustainable production and consumption of ocean products by using microbial techniques; reflect on their own dietary needs using microbes cultivated in aqua systems rich in proteins such as Spirulina and other microalgae.
Behaviorial Teaching & Learning objectives	• The learner can research their country's freshwater and marine water microbial diversity; debate sustainable methods of maintaining coral reefs with beneficial marine microbes; to produce and market sustainably harvested marine microbes and their products that are ecolabel certified; contact their representatives to discuss about pathogenic marine microbes and their control measures to protect aquaculture; campaign for safeguarding marine and fresh water environments from contamination with pathogens, eutrophication and algal blooms.

Learning approaches and methods for SDG 14

- Role of microbes in reducing marine pollution (degrade plastic), protecting and restoring ecosystem, reducing ocean acidification
- Use of marine microbes to produce bioproducts and enzymes from cold marine environments and hot hydrothermal vents
- Use of microbes to prevent coral-reef degradation
- Detection of pathogenic microbes from aquatic ecosystem
- Understand diversity of microbes in fresh and marine waters

Suggested topics for students workshop

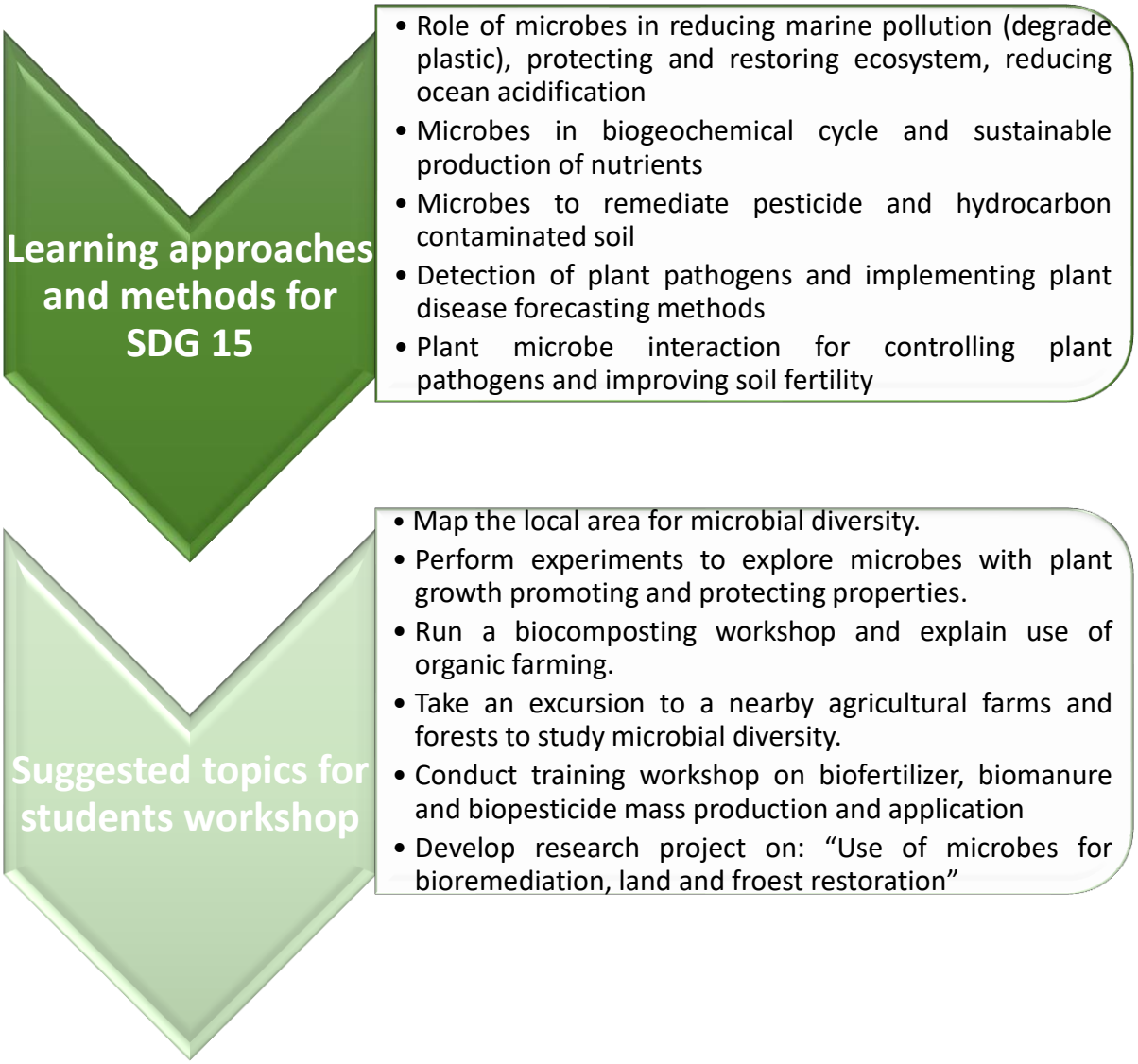
- Develop protocols for prospecting microbial bioproducts
- Debate sustainable use and management of microbes in water
- Conduct a case study on endosymbiotic relation of microbes with other aquatic organisms
- Conduct lab experiments on bioremediation and microbial degradation of plastics in marine waters
- Develop project: “cleaning oil spill in marine environment using robust growing microbes”

SDG 15 - Life on Land

Protect, restore and promote sustainable use of terrestrial ecosystems, sustainably manage forests, combat desertification, and halt and reverse land degradation and halt biodiversity loss

Teaching & Learning objectives for SDG 15 "Life on Land"

Subject/ topic/ course in regular curriculum relating to SDG 15	•DSC 02 Microbial Diversity (BSc I sem); DSE 01b. Bioremediation & Microbial Technology (BSc V Sem); DSE 02a. Microbial Biotechnology (BSc VI Sem); OEC 04 Biofertilizers & Biopesticides (BSc VI Sem); DSC 11 Agricultural Microbiology (BSc V Sem); DSE 03a Advances in Bioremediation & Microbial Technology (MSc III Sem); DSC 07 Soil Microbiology & Plant Health (MSc II Sem); DSE 01b Biofertilizers, Biomanure & Biopesticides (MSc II Sem)
Cognitive Teaching & learning objectives	•The learner understands role of microbes in local and global ecosystems, identifying local microbial species and understanding the biodiversity; the beneficial role of microbes in land remediation, restoration and soil generation; the use of microbes as Biofertilizers, Biomanure & Biopesticides for sustainable agricultural practice; role of microbes in biogeochemical cycling and in soil and plant interactions.
Socio-emotional Teaching & learning objectives	• The learner can argue on use of microbe based products for preventing excess use of chemical fertilizers and pesticides; connect with their local natural areas and search for microbial intervention based solutions for land restoration; think of methods to reduce plant diseases by pathogensfor economic and environmental sustainability and to obtain healthy crops; create a vision of sustainable practices using the concept of integrated plant disease management.
Behaviorial Teaching & Learning objectives	• The learner can connect with local groups working toward microbe mediated remediation and restoration; effectively speak on topics related to agro-environmental schemes for biofertilizer, biomanure and biopesticide production; able to highlight the importance of soil-microbe and plant –microbe interaction for obtaining healthy crops and high yield; campaign and work for the implementation and development of sustainable agricultural practices and bioremediation of land.


Learning approaches and methods for SDG 15
• Role of microbes in reducing marine pollution (degrade plastic), protecting and restoring ecosystem, reducing ocean acidification
• Microbes in biogeochemical cycle and sustainable production of nutrients
• Microbes to remediate pesticide and hydrocarbon contaminated soil
• Detection of plant pathogens and implementing plant disease forecasting methods
• Plant microbe interaction for controlling plant pathogens and improving soil fertility
Suggested topics for students workshop
• Map the local area for microbial diversity.
• Perform experiments to explore microbes with plant growth promoting and protecting properties.
• Run a biocomposting workshop and explain use of organic farming.
• Take an excursion to a nearby agricultural farms and forests to study microbial diversity.
• Conduct training workshop on biofertilizer, biomanure and biopesticide mass production and application
• Develop research project on: “Use of microbes for bioremediation, land and froest restoration”

CONCLUSION

Institution & individual can contribute to achieving the SDGs by developing cross-cutting sustainability competencies that are needed to deal with many different sustainability challenges and to relate the different SDGs to each other. Institution can equip learners with the specific cognitive, socio-emotional and behavioral learning outcomes that enable them to deal with the particular challenges of each SDG.

To make it possible for everyone around the world to take action in favor of the SDGs, all educational institutions must consider it their responsibility to deal intensively with sustainable development issues, to foster the development of sustainability competencies and to develop the specific learning outcomes related to all SDGs. Therefore, it is vital not only to include SDG-related contents in the curricula, but also to use action-oriented transformative pedagogy.

Education officials, policymakers, educators, curriculum developers and others are called upon to rethink education in order to contribute to the achievement of the SDGs within their timeframe, between now and 2030. This guidance provides an orientation to the sustainability competencies and specific cognitive, socio-emotional and behavioral learning outcomes that are relevant to this goal, and it outlines what is needed to implement learning for the SDGs through Educational Institutions.

Education for Sustainable Development Goals - Teaching & Learning Objectives

To create a more sustainable world and to engage with issues related to sustainability as described in the Sustainable Development Goals (SDGs), individuals must become sustainability change-makers. They require the knowledge, skills, values and attitudes that empower them to contribute to sustainable development. Education is thus crucial for the achievement of sustainable development, and Education for Sustainable Development is particularly needed because it empowers learners to take informed decisions and act responsibly for environmental integrity, economic viability and a just society, for present and future generations.

This handbook guides readers on how to use education, especially to achieve the SDGs. It identifies teaching & learning objectives, suggests topics and learning activities for each SDG, and describes implementation at different levels from course design to national strategies. The document aims to support policymakers, curriculum developers and educators in designing strategies, curricula and courses to promote learning for the SDGs.

Learning objectives for teachers to promote SDG

Know about sustainable development, the different SDGs and the related topics and challenges

Understand the discourse on and the practice of in local, national and global context

Develop their own integrative view of the issues and challenges of sustainable development by considering the social, ecological, economic and cultural dimensions from the perspective of the principles andvalues of sustainable development, including that of intergenerational and global justice

Take disciplinary, interdisciplinary and transdisciplinary perspectives on issues of global change and their local manifestations

Reflect on the concept of sustainable development, the challenges in achieving the SGDs, the importance of their own field of expertise for achieving the SDGs and their ownrole in this process

Understand how cultural diversity, gender equality, social justice, environmental protection and personal
development are integral elements of ESD and how to makethem a part of educational processes

Practice an action-oriented transformative pedagogy thatengages learners in participative, systemic, creative and innovative thinking and acting processes in the context oflocal communities and learners' daily lives

Act as a change agent in a process of organizational learning that advances their school towards sustainabledevelopment

Identify local learning opportunities related to sustainabledevelopment and build cooperative relationships

Evaluate and assess the learners' development of cross-cutting sustainability competencies and specific sustainability-related learning outcomes

'Touching the lives of Millions'

Focusing on a purpose as expansive and yet as specific as improving quality of life through Human Development, the JSS Mahavidyapeetha has grown from strength to strength. A long and healthy life, Education for all and a decent standard of living, the indicators of Human development, have been the underlying philosophy of Jagadguru Sri Veerasimhasana Mahasamsthana Math, Suttur Srikshethra, for centuries. This is also the philosophy for which the Mahaidyapeetha today stands for.

Under the untiring efforts of Jagadguru Dr. Sri Shivarathri Rajendra Mahaswamiji, the Mahavidyapeetha has witnessed enormous growth in the field of education and today has over 300 institutions under its fold, from kindergartens to postgraduate centres and postdoctoral research catering to the educational needs of more than 1,00,000 students.

The Mahavidyapeetha continues to play an important role in expanding the scope of its activities to several branches of knowledge, welfare, and culture. Its educational efforts span crèches for toddlers of working rural women, schools to impart primary and secondary education in both Kannada and English medium, Colleges, Polytechnics, Technical, Medicine, etc. For realizing its mission, it has equipped itself with an extensive infrastructure and an army of dedicated and highly qualified human resource. These institutions, located in strategic areas, serve a broad spectrum of society, from virtually remote tribal villages to metropolitan cities such as Bengaluru, Noida, New Delhi, Ooty, and Coimbatore, besides their presence in United States, Mauritius, and Dubai.

Apart from formal education, the initiatives stretch to integrated rural development through training and empowering of rural folk, reaching out healthcare to people through modern and traditional Indian systems of medicine, patronizing literary activities, visual arts, performing arts, restoration of temples and historical monuments.

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