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WP3 DigiOmica collaborative learning in Integrated omics for environmental sustainability

Module 6: *Environmental database and bioinformatics*

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- **Educational goals**: the aim of this module is to present knowledge about
  - Bioinformatics methods and software tools for understanding biological data
  - Data science - environmental databases that provide access to a wealth of information related to environmental science
  - Environmental science – field that study the environment and solve environmental problems
  - Challenges and perspective of environmental bioinformatics

Summary

Environmental biotechnology is the application of biotechnology principles and techniques to study and manage the natural environment. It involves microorganisms and other biological agents' usage for the performance of environmentally beneficial tasks such as cleaning up contaminated sites, enhancing soil health, and reducing greenhouse gas emissions. Examples of environmental biotechnology applications include the use of bacteria to break down pollutants in water and soil, the use of algae to absorb excess nutrients from wastewater, and the use of fungi to decompose organic matter in landfills. Environmental biotechnology has the potential to contribute to finding sustainable solutions to environmental problems, and it is an area of active research and development. Environmental database provides access to international scientific literature relating to all aspects of environmental quality, monitoring, resource management, and conservation. Bioinformatics is essential for understanding ecological processes, managing data, and developing tools to address global challenges.

- **Expected learning outcomes**: Upon completion of this Module the learners will be able to:
  - Describe the principles and key aspects of environmental bioinformatics and its methods and software tools
  - Use different environmental databases that cover all aspects of human impact on the environment.
  - Define the major categories of environmental science
  - Explain the application of environmental bioinformatics
  - Define the challenges, limits and perspective of environmental bioinformatics

Provisional Table of contents:

Presentation of the learning content

1. Introduction

- **What is Environmental Bioinformatics –** a dynamic interdisciplinary field combining biological data analysis with environmental science to tackle complex ecological and environmental challenges
- **What is Environmental science** - a field that integrates physics, biology, and geography to study the environment and solve environmental problems
- **Potential of environmental bioinformatics**
- **Challenges of environmental database and bioinformatics** in data presentation and interpretation

Presentation of the learning content

2. Environmental bioinformatics

- **History** – environmental bioinformatics is fuelled by the integration of biodiversity databases, remote sensing technologies, and genomic information

- **Evolution till Date** - environmental bioinformatics has evolved from basic data integration to sophisticated analyses of complex ecological interactions

3. Industrial Applications of Environmental bioinformatics

- Biodiversity conservation, Microbial ecology, Ecosystem modelling, Climate change studies, Biogeography, Pollution monitoring,

- Phylogenetics, Remote sensing, Species distribution modelling, Genomic adaptation

Presentation of the learning content

3. Industrial Applications of Environmental bioinformatics

- Epidemiology, Ecological network analysis, Conservation genomics, Pharmacology
- Sustainable agriculture, Aquatic ecology, Invasive species management, Population dynamics, Habitat restoration, Bioindicators

4. Environmental database

4.1. **EBSCO Environment Complete**: comprehensive research database that offers peer-reviewed, full-text journals covering various environmental studies topics

4.2. **Environment Index**: A bibliographic database specifically tailored for environmental studies and related disciplines

Presentation of the learning content

4. Environmental database

4.3 **GreenFILE:** A free research database that covers all aspects of human impact on the environment;

4.4 **Environmental Science Database (CABI):** international scientific literature related to environmental quality, monitoring, resource management, and conservation;

4.5 **Environmental Dataset Gateway (US EPA**): metadata and information describing geospatial and non-geospatial data resources;

4.6 **WTO's Environmental Database (EDB):** environment-related notifications submitted by WTO members, as well as environmental measures and policies

Presentation of the learning content

5. Future Prospects

- The integration of genomics, metagenomics, and remote sensing data will provide a comprehensive understanding of ecosystems;
- Advanced machine learning and AI techniques will improve predictive modeling and data analysis;
- Environmental bioinformatics stands poised to lead the way toward a more sustainable and resilient future.

Presentation of the learning content

6. References

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