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Advanced Biogeosciences Syllabus (進階生物地球科學教學大綱)

The study of biogeosciences encompasses the interactions between living organisms and their surrounding environment, including the physical and chemical processes that affect the cycling of energy and matter. The course of "Advanced Biogeosciences" builds on this foundation by exploring the complex relationships between biotic and abiotic components of ecosystems. In this course, we will discuss the importance of five research topics in Advanced Biogeosciences:

- **The impact of climate change on biogeochemical cycles and ecosystem processes**

  Climate change is one of the greatest environmental challenges of our time, with significant implications for the functioning of ecosystems worldwide. The impact of climate change on biogeochemical cycles and ecosystem processes is of particular concern, as changes in temperature, precipitation, and other climatic factors can alter the rate and direction of nutrient cycling, carbon sequestration, and other key ecosystem processes. For example, changes in precipitation patterns can affect the availability of water and nutrients for plants, while changes in temperature can affect the activity of soil microbes and the rate of decomposition. Understanding the impact of climate change on biogeochemical cycles and ecosystem processes is essential for predicting how ecosystems will respond to future environmental changes and for developing effective strategies for mitigating or adapting to these changes.

- **The role of microbial communities in biogeochemical cycling and ecosystem function**

  Microbial communities play a crucial role in biogeochemical cycling and ecosystem function, as they are responsible for many of the key processes that drive nutrient cycling, carbon sequestration, and other ecosystem processes. For example, soil microbes are responsible for the decomposition of organic matter, which releases nutrients that are essential for plant growth. Microbes also play a key role in nitrogen fixation, the process by which nitrogen gas is converted into forms that can be used by plants. Understanding the role of microbial communities in biogeochemical cycling and ecosystem function is essential for predicting how ecosystems will respond to environmental changes, as well as for developing strategies to promote sustainable agriculture, forestry, and other land use practices.

- **The impact of land use change on biodiversity and ecosystem function**

  Land use change, such as deforestation, urbanization, and agriculture, can have significant impacts on biodiversity and ecosystem function. For example, deforestation can lead to the loss of habitat for many species and can alter the water balance of an ecosystem. Agriculture can also have significant impacts on ecosystem function, as it often involves the use of fertilizers, pesticides, and other inputs that can alter nutrient cycling and other ecosystem processes. Understanding the impact of land use change on biodiversity and ecosystem function is essential for developing sustainable land use practices and for conserving biodiversity.

- **The dynamics of nutrient cycling in coastal ecosystems**

  Coastal ecosystems are essential for the survival of marine life and human populations. These ecosystems are highly dynamic, and the cycling of nutrients plays a critical role in maintaining their ecological balance. Nutrients such as nitrogen and phosphorus are essential for the growth and survival of marine organisms. However, excess nutrient input from human activities such as agricultural and industrial activities, can cause harmful algal blooms and reduce the amount of oxygen available in the water column. This can lead to the death of marine organisms and create dead zones. Understanding the dynamics of nutrient cycling in coastal ecosystems is essential for developing effective management strategies to reduce nutrient pollution and prevent the formation of dead zones. Research in this area can provide insights into the sources of nutrient input, the transport and transformation of nutrients, and the factors that regulate nutrient availability in coastal ecosystems. This can inform the development of nutrient management policies that promote sustainable use of coastal resources.

- **The relationship between plant-microbe interactions and nutrient cycling in terrestrial ecosystems**

  Terrestrial ecosystems are home to a wide variety of plants and microbes that play critical roles in nutrient cycling. Plants rely on microbes to convert organic matter into nutrients that are essential for their growth and survival. In return, plants provide carbon and other resources to microbes. This relationship between plants and microbes is essential for maintaining the ecological balance of terrestrial ecosystems. Research on the relationship between plant-microbe interactions and nutrient cycling in terrestrial ecosystems is essential for understanding the factors that regulate nutrient availability and the response of ecosystems to environmental change. This research can provide insights into the

mechanisms that control the transfer of nutrients from organic matter to plants, the factors that regulate microbial activity, and the effects of environmental change on plant-microbe interactions. This can inform the development of management strategies that promote sustainable use of terrestrial resources.

Syllabus:

Week 1: Introduction to Research Topics in Advanced Biogeosciences

- Overview of research topics and their importance in understanding biogeochemical cycles and ecosystem function
- Review of current research in biogeosciences

Week 2-4: Research Topic 1: The Impact of Climate Change on Biogeochemical Cycles and Ecosystem Processes

- Overview of the impact of climate change on biogeochemical cycles and ecosystem processes
- Methods for studying the impact of climate change on biogeochemical cycles and ecosystem processes
- Case studies of the impact of climate change on biogeochemical cycles and ecosystem processes

Week 5-7: Research Topic 2: The Role of Microbial Communities in Biogeochemical Cycling and Ecosystem Function

- Overview of microbial communities and their role in biogeochemical cycling and ecosystem function
- Methods for studying microbial communities and their function in ecosystems
- Case studies of microbial communities in different ecosystems

Week 8-10: Research Topic 3: The Impact of Land Use Change on Biodiversity and Ecosystem Function

- Overview of the impact of land use change on biodiversity and ecosystem function
- Methods for studying the impact of land use change on biodiversity and ecosystem function
- Case studies of the impact of land use change on biodiversity and ecosystem function

Week 11-13: Research Topic 4: The Dynamics of Nutrient Cycling in Coastal Ecosystems

- Overview of nutrient cycling in coastal ecosystems
- Methods for studying nutrient cycling in coastal ecosystems
- Case studies of nutrient cycling in different coastal ecosystems

Week 14-16: Research Topic 5: The Relationship between Plant-Microbe Interactions and Nutrient Cycling in Terrestrial Ecosystems

- Overview of plant-microbe interactions and their role in nutrient cycling in terrestrial ecosystems
- Methods for studying plant-microbe interactions and nutrient cycling in terrestrial ecosystems
- Case studies of plant-microbe interactions and nutrient cycling in different terrestrial ecosystems

Week 17-18: Synthesis and Conclusion

- Synthesis of research topics and their interrelationships
- Discussion of future research directions in Advanced Biogeosciences
- Conclusion of the course and final assessments.

TA's work:

The TA assigned to the upcoming semester has outlined their strategies for fulfilling their responsibilities effectively. Their primary responsibilities include assisting the professor in teaching the course and providing academic support to students. The following work plan details the approach the TA will take to achieve their objectives.

I. Teaching Materials

The TA will conduct a literature review on the topics covered in the course to stay updated on the latest research and teaching methods. They will use academic databases such as JSTOR and Google Scholar to search for relevant articles. Additionally, they will explore online forums and blogs to find new teaching resources. The TA will also search for relevant video materials to enhance student engagement and understanding of the course content. This includes instructional videos, case studies, and real-world examples. They will use platforms such as YouTube and TED Talks to find high-quality video resources.

II. Homework Examples

The TA will develop homework examples to help students apply the concepts learned in class to real-world scenarios. These examples will be tailored to the course objectives and will cover a range of difficulty levels to challenge students of different abilities. The TA will provide detailed explanations and feedback on each example to help students understand where they went wrong and how to improve.

III. Student Homework Review and Grading

The TA will review and grade student homework assignments according to the grading rubric provided by the professor. They will ensure that grading is fair and consistent and provide timely feedback to students on their performance. The TA will also be available to answer any questions or concerns students may have about their assignments and provide additional resources to help them improve their work.

IV. Conclusion

The TA's goal is to help students succeed in the course by providing them with the support and resources they need to excel. By staying up-to-date on the latest research and teaching methods, providing clear and challenging homework examples, and reviewing and grading student work fairly and consistently, the TA believes they can make a positive impact on the learning experience of students in the course.