Syllabus

Topic 5: Soil systems and terrestrial food production systems and societies (12 hours)

Big questions: This topic may be particularly appropriate for considering big questions A, B, E and F.

5.1: Introduction to soil systems

Significant ideas:

- The soil system is a dynamic ecosystem that has inputs, outputs, storages and flows.
- The quality of soil influences the primary productivity of an area.

Knowledge and understanding:

- The soil system may be illustrated by a soil profile that has a layered structure (horizons).
- Soil system storages include organic matter, organisms, nutrients, minerals, air and water.
- Transfers of material within the soil, including biological mixing and leaching (minerals dissolved in water moving through soil), contribute to the organization of the soil.
- There are inputs of organic material including leaf litter and inorganic matter from parent material, precipitation and energy. Outputs include uptake by plants and soil erosion.
- Transformations include decomposition, weathering and nutrient cycling.

Guidance:

- Studies of specific soil profiles, such as podsol, are **not** required.
- Familiarity with the soil texture triangle diagram used for soil type classification based on the percentage of sand, silt, and clay in the soil is required.

International-mindedness:

- Significant differences exist in arable (potential to promote primary productivity) soil availability around the world. These differences have sociopolitical, economic and ecological influences.

Theory of knowledge:

- The soil system may be represented by a soil profile—since a model is, strictly speaking, not real, how can it lead to knowledge?

5.1: Introduction to soil systems	
• The structure and properties of sand, clay and loam soils differ in many ways, including mineral and nutrient content, drainage, water-holding capacity, air spaces, biota and potential to hold organic matter. Each of these variables is linked to the ability of the soil to promote primary productivity. • A soil texture triangle illustrates the differences in composition of soils. **Applications and skills:** • **Outline** the transfers, transformations, inputs, outputs, flows and storages within soil systems. • **Explain** how soil can be viewed as an ecosystem. • **Compare and contrast** the structure and properties of sand, clay and loam soils, with reference to a soil texture diagram, including their effect on primary productivity.	**Connections:** • ESS: Communities and ecosystems (2.2); flows of energy and matter (2.3); investigating ecosystems (2.5); biomes, zonation and succession (2.4); introduction to water systems (4.1); terrestrial food production systems and food choices (5.2); soil degradation and conservation (5.3); acid deposition (6.4); climate change (7.1 and 7.2); resource use in society (8.2); solid domestic waste (8.3) • Diploma Programme: Geography (topic 3)

5.2: Terrestrial food production systems and food choices	
Significant ideas: • The sustainability of terrestrial food production systems is influenced by sociopolitical, economic and ecological factors. • Consumers have a role to play through their support of different terrestrial food production systems. • The supply of food is inequitably available and land suitable for food production is unevenly distributed among societies, and this can lead to conflict and concerns.	
Knowledge and understanding: • The sustainability of terrestrial food production systems is influenced by factors such as scale; industrialization; mechanization; fossil fuel use; seed, crop and livestock choices; water use; fertilizers; pest control; pollinators; antibiotics; legislation; and levels of commercial versus subsistence food production. • Inequalities exist in food production and distribution around the world.	**Guidance:** • Possible examples for contrasting terrestrial food production systems include North American cereal farming and subsistence farming in Southeast Asia, or intensive beef production in South America and the Maasai tribal use of livestock. These examples are not meant to be prescriptive and appropriate local examples are also encouraged.

5.2: Terrestrial food production systems and food choices

- Food waste is prevalent in both LEDCs and more economically developed countries (MEDCs), but for different reasons.
- Socio-economic, cultural, ecological, political and economic factors can be seen to influence societies in their choices of food production systems.
- As the human population grows, along with urbanization and degradation of soil resources, the availability of land for food production per capita decreases.
- The yield of food per unit area from lower trophic levels is greater in quantity, lower in cost and may require fewer resources.
- Cultural choices my influence societies to harvest food from higher trophic levels.
- Terrestrial food production systems can be compared and contrasted according to inputs, outputs, system characteristics, environmental impact and socio-economic factors.
- Increased sustainability may be achieved through:
  - altering human activity to reduce meat consumption and increase consumption of organically grown and locally produced terrestrial food products
  - improving the accuracy of food labels to assist consumers in making informed food choices
  - monitoring and control of the standards and practices of multinational and national food corporations by governmental and intergovernmental bodies
  - planting of buffer zones around land suitable for food production to absorb nutrient runoff.
- Factors to be used in comparing and contrasting food production systems include:
  - inputs, such as fertilizers (artificial or organic); water (irrigation or rainfall); pest control (pesticides or natural predators); labour (mechanized and fossil-fuel dependent or physical labour); seed (genetically modified organisms—GMOs—or conventional); breeding stock (domestic or wild); livestock growth promoters (antibiotics or hormones versus organic or none)
  - outputs, such as food quality, food quantity, pollutants (air, soil, water), consumer health, soil quality (erosion, degradation, fertility); common pollutants released from food production systems include fertilizers, pesticides, fungicides, antibiotics, hormones and gases from the use of fossil fuels; transportation, processing and packaging of food may also lead to further pollution from fossil fuels
  - system characteristics, such as diversity (monoculture versus polyculture); sustainability; indigenous versus introduced crop species
  - environmental impacts, such as pollution (air, soil, water); habitat loss; biodiversity loss; soil erosion or degradation; desertification; disease epidemics from high-density livestock farming
  - socio-economic factors, such as farming for profit or subsistence, for export or local consumption, for quantity or quality; traditional or commercial farming.
- Food waste is an issue arising in MEDCs, where regulatory standards may be set according to commercial preferences so that consumable food is discarded. It can also be an issue in LEDCs, where the necessary refrigeration and transport infrastructure is insufficient to avoid food spoilage.

5.2: Terrestrial food production systems and food choices	
Applications and skills: • **Analyse** tables and graphs that illustrate the differences in inputs and outputs associated with food production systems. • **Compare and contrast** the inputs, outputs and system characteristics for two given food production systems. • **Evaluate** the relative environmental impacts of two given food production systems. • **Discuss** the links that exist between sociocultural systems and food production systems. • **Evaluate** strategies to increase sustainability in terrestrial food production systems.	**International-mindedness:** • Food choices can be influenced by culture, religion or regional food production differences. **Theory of knowledge:** • Consumer behaviour plays an important role in food production systems—are there general laws that can describe human behaviour? **Connections:** • ESS: Environmental value systems (1.1); flows of energy and matter (2.3); communities and ecosystems (2.2); investigating ecosystems (2.5); threats to biodiversity (3.3); water pollution (4.4); introduction to soil systems (5.1); soil degradation and conservation (5.3); resource use in society (8.2); solid domestic waste (8.3); human population carrying capacity (8.4) • Diploma Programme: Biology (options B and C); chemistry (options B and C); geography (option F); economics

5.3 Soil degradation and conservation

Significant Ideas:

- Fertile soils require significant time to develop through the process of succession.
- Human activities may reduce soil fertility and increase soil erosion.
- Soil conservation strategies exist and may be used to preserve soil fertility and reduce soil erosion.

Knowledge and understanding:	**Guidance:**
• Soil ecosystems change through succession. Fertile soil contains a community of organisms that work to maintain functioning nutrient cycles and that are resistant to soil erosion.	• Applying knowledge of specific food production systems to their associated soil degradation and consequent soil conservation management strategies is recommended.
• Human activities that can reduce soil fertility include deforestation, intensive grazing, urbanization and certain agricultural practices (such as irrigation and monoculture). • Commercial, industrialized food production systems generally tend to reduce soil fertility more than small-scale subsistence farming methods. • Reduced soil fertility may result in soil erosion, toxification, salination and desertification. • Soil conservation measures include soil conditioners (such as organic materials and lime), wind reduction techniques (wind breaks, shelter belts), cultivation techniques (terracing, contour ploughing, strip cultivation) and avoiding the use of marginal lands. **Applications and skills:** • **Explain** the relationship between soil ecosystem succession and soil fertility. • **Discuss** the influences of human activities on soil fertility and soil erosion. • **Evaluate** the soil management strategies of a given commercial farming system and of a given subsistence farming system.	**International-mindedness:** • Variant use of soil systems can lead to different degradation and conservation. **Theory of knowledge:** • Our understanding of soil conservation has progressed in recent years—what constitutes progress in different areas of knowledge? • Fertile soil can be considered as a non-renewable resource because once depleted, it can take significant time to restore the fertility—how does our perception of time influence our understanding of change? **Connections:** • ESS: Communities and ecosystems (2.2); investigating ecosystems (2.5); introduction to soil systems (5.1); terrestrial food production systems and food choices (5.2); biomes, zonation and succession (2.4); climate change—causes and impacts (7.2); resource use in society (8.2) • Diploma Programme: Chemistry (options A and C); geography (topic 3)