12th Grade Swiss Online School USA

SCIENCE CURRICULUM

Advanced Scientific Exploration and Applications

Version July/2025

1. Introduction

The Role of Science Education in 12th Grade

In 12th grade, science education focuses on advanced concepts in biology, chemistry, physical sciences, and environmental applications. This curriculum emphasizes critical thinking, scientific inquiry, and real-world problem-solving to prepare students for college, careers, and responsible citizenship in a world driven by scientific advancements.

By the end of this course, students will:

✓ **Develop a deep understanding of biological, chemical, and physical sciences**.

✓ **Apply the scientific method to real-world problems and experimental design**.

✓ **Analyze data, conduct experiments, and interpret scientific findings**.

✓ **Explore the role of science in technology, medicine, and environmental sustainability**.

✓ **Understand how scientific principles shape the world and impact daily life**.

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2. Core Competence Areas

SCI.1 Advanced Biology and Life Sciences

Learning Outcomes

By the end of this unit, students will be able to:

✓ **Understand the structure and function of living organisms at the molecular and cellular levels**.

✓ **Analyze genetics, evolution, and the impact of biotechnology on society**.

✓ **Study ecosystems, biodiversity, and environmental sustainability**.

Competencies

SCI.1.A.1 – Understanding molecular biology and genetics.

- Study DNA, RNA, and protein synthesis.
- Explore genetic engineering, CRISPR, and biotechnology applications.
- Understand Mendelian and non-Mendelian inheritance patterns.

SCI.1.A.2 – Exploring ecological interactions and conservation.

- Investigate ecosystems, energy flow, and food webs.
- Analyze human impact on biodiversity and climate change.
- Learn sustainable practices for resource conservation.

SCI.2 Advanced Chemistry and Chemical Applications

Learning Outcomes

By the end of this unit, students will be able to:

✓ **Understand chemical reactions, bonding, and molecular structures**.

✓ **Apply principles of thermodynamics and equilibrium to real-world scenarios**.

✓ **Explore the role of chemistry in medicine, industry, and sustainability**.

Competencies

SCI.2.A.1 – Mastering advanced chemical reactions and stoichiometry.

- Balance complex chemical equations and predict reaction outcomes.
- Analyze acid-base reactions, titrations, and buffer systems.
- Explore oxidation-reduction reactions and electrochemistry.

SCI.2.A.2 – Understanding chemistry in industry and medicine.

- Study pharmaceutical chemistry and drug interactions.
- Investigate polymers, nanotechnology, and material science.
- Explore green chemistry and sustainable chemical processes.

SCI.3 Advanced Physics and Physical Sciences

Learning Outcomes

By the end of this unit, students will be able to:

✓ **Apply Newtonian mechanics, electromagnetism, and thermodynamics to real-life scenarios**.

✓ **Explore wave behavior, optics, and modern physics concepts**.

✓ **Understand how physics contributes to engineering, technology, and space exploration**.

Competencies

SCI.3.A.1 – Applying forces, motion, and energy concepts.

- Solve problems involving work, energy, and power.
- Understand the laws of motion and their applications in transportation and engineering.
- Analyze thermodynamics and heat transfer.

SCI.3.A.2 – Exploring modern physics and its real-world applications.

- Study quantum mechanics, relativity, and nuclear physics.
- Explore the principles of electromagnetism and circuitry.
- Investigate applications in medical imaging, space travel, and renewable energy.

- Analyze modern physics concepts, including relativity and quantum mechanics.

SCI.4 Natural Sciences and Environmental Systems

Learning Outcomes

By the end of this unit, students will be able to:

✓ **Examine Earth's geological processes, climate patterns, and sustainability challenges**.

✓ **Understand how human activity influences natural systems**.

✓ **Use scientific data to predict environmental changes and develop solutions**.

Competencies

SCI.4.A.1 – Understanding Earth's dynamic systems.

- Study plate tectonics, erosion, and natural disasters.
- Explore climate science and atmospheric patterns.
- Analyze water cycles, ocean currents, and weather systems.

SCI.4.A.2 – Exploring sustainable solutions for environmental challenges.

- Investigate renewable energy sources and carbon footprint reduction.
- Study waste management, pollution control, and ecosystem restoration.
- Apply scientific data to propose sustainability initiatives.

SCI.5 Agriculture and Biotechnology

Learning Outcomes

By the end of this unit, students will be able to:

✓ **Understand the role of agriculture in food production and sustainability**.

✓ **Explore biotechnology applications in genetics, medicine, and environmental science**.

✓ **Examine ethical issues in genetic engineering and food security**.

Competencies

SCI.5.A.1 – Investigating plant biology and agricultural systems.

- Study soil composition, plant growth, and nutrient cycles.
- Explore modern farming techniques, including hydroponics and precision agriculture.
- Understand the impact of climate change on food production.

SCI.5.A.2 – Exploring biotechnological advancements.

- Learn how biotechnology is used in medicine, agriculture, and conservation.
- Examine genetically modified organisms (GMOs) and their benefits/risks.
- Discuss the ethics of cloning, genetic engineering, and artificial selection.

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3. Assessment and Evaluation

Formative Assessments – Checking Progress Through Interactive Learning

✓ **Laboratory experiments and hands-on investigations**.
✓ **Class discussions and data analysis exercises**.
✓ **Quizzes on core scientific concepts and real-world applications**.

Summative Assessments – Final Projects and Exams

✓ **Comprehensive science exam covering all major topics**.
✓ **Research paper on a modern scientific issue**.
✓ **Independent science experiment with data analysis and presentation**.

Authentic Assessment – Real-World Applications

✓ **Students develop sustainability proposals for local environmental issues**.
✓ **Collaboration with science professionals for hands-on learning experiences**.
✓ **Participation in a science fair or capstone project applying interdisciplinary concepts**.

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4. Instructional Strategies for Online Learning

Inquiry-Based and Problem-Based Learning

✓ **Students investigate and propose solutions to real-world scientific challenges**.
✓ **Exploration of ethical dilemmas in biotechnology and environmental science**.

Project-Based Learning (PBL)

✓ **Students conduct long-term experiments and document findings**.
✓ **Developing science-based policy recommendations for local or global issues**.

Technology-Integrated Learning

✓ **Use of virtual labs and AI-driven science simulations**.
✓ **Data visualization and analysis tools for research and experimentation**.
✓ **Collaboration with online scientific communities and experts**.