موهبة
Mawhiba

Mawhiba Academic Enrichment Program

Introduction To the Enrichment Units

Contents

Mawhiba academic enrichment program

Mawhiba academic enrichment program is one of the most important global methods used to enrich the knowledge of gifted students. This program includes a scientific enrichment content representing 75% and a skill content representing 25% of the total weight of the program. From this standpoint, Mawhiba designed a variety of enrichment units to enrich and deepen students' knowledge and experiences and challenging their abilities in a number of scientific fields within four main tracks: engineering sciences, medical, biological and chemical sciences, physics, earth and space sciences, and computer sciences and applied mathematics in cooperation with the best international expert houses in the field of Giftedness and creativity, provided with progressive levels of knowledge; with the aim of continuing to build quality cumulative scientific experiences, which increase in depth and diversity as students' progress in participation year after year.

Due to the importance of the skill aspect, Mawhiba included in this program a set of skill packages that deal with building basic and important life skills for gifted students, and contribute to the development of personal, social, and innovative skills that keep pace with the skills of the twenty-first century, such as communication skills, leadership, critical and creative thinking, decision-making, problem-solving, digital security, and other skills.

Water and Energy Engineering: Solutions for the Future

Stage: Empowerment
Path: Engineering science + Physics, Earth & Space Sciences

Unit description

Students in the unit focus on the relationship between water and energy. Through discussions and hands-on activities, students learn about the water cycle and energy depletion, types of water and energy sources, water and energy availability and sustainability, and the challenges faced by water and energy dependencies. For instance, students learn about the water cycle before conducting experiments related to evaporation and condensation. Students consider the differences between fresh water and salt water by exploring their physical properties.

Throughout the unit, students are introduced to various concepts and topics; they extend their understanding of those concepts and topics through experimentation. For example, a discussion of water scarcity precedes desalination and filtration experiments. Students consider the power of moving water before designing and constructing a hydromill and a tidal turbine model. After learning about aquifers, groundwater, and global water challenges, students test the pH of soil samples to locate sources of groundwater contamination, simulate aquifer exchange and water purification, and test for water quality. Students create their own geoexchange system to simulate geothermal energy production. As a culminating project, students select an area of interest pertaining to water and energy sustainability. They research their topics and create posters for a presentation showcase.

The skills that students will acquire

Students will be able to build and develop basic skills, such as “teamwork, problem solving, reading, and analyzing scientific literature, demonstrating understanding through oral and written communication, in addition to several targeted skills, which are provided through training packages appropriate to the age group, provided by Specialized and trained staff, including:

- Digital security
- Flexibility.
- Problem solving.
- Priorities management
- Critical thinking
- Communication skills

Program components

- A specialized enrichment scientific unit.
- Practical activities and scientific projects.
- Skill activities.

How to implement the program

The program, with its scientific and skill components will be implemented in attendance (face to face) or in virtual classes (distance learning).

Computer programming

Stage: Empowerment
Path: Computer Science & Applied Mathematics

Unit description

In this unit, students are introduced to the full breadth of computer science and gain an understanding of all the different places the field might take them. Students learn about algorithms, the most fundamental topic in computer science. They study the basics of programming in Python and write and test many Python procedures while learning the language. Students investigate the inner working of a computer, generate truth tables, and simulate logic gates. Using their knowledge of digital multiplexors and decoders, they apply the two concepts to truth tables and logic gates. They become familiar with current computer components. Students are introduced to the basics of networking and operating systems, learning the structure and function of both. Additional activities cover content such as cryptography, graphical programming, steganography, intellectual property law, and computer ethics as it relates to intellectual property law.

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From a Molecule to a Living Organism

Stage: Empowerment
Path: Medical, Biological and Chemical Sciences

Unit description

This unit covers the material ordinarily included in a year-long introductory course in high school biology (a usual prerequisite for AP or IB Biology). Students begin with the smallest unit, the atom, and build towards the final discussions of ecology and the environment. Along the way they sample biochemistry, move through genetics and cellular processes, and then integrate these concepts into their studies of evolution and systems of living things, such as respiration and reproduction.

Through readings, lectures, and lab work (including dissections), students finish the unit with a sound foundation in biological concepts.

The skills that students will acquire

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Future doctor

Stage: Empowerment
Path: Medical, Biological and Chemical Sciences

Unit description

You may know that our skin helps us decide whether the bath water is too hot and that our nose helps us tell fresh from spoiled milk. But do you know how? In this unit, students are introduced to the science behind these everyday observations. In the laboratory, students dissect sensory organs and investigate sensory perceptions. They learn what cell types make up a sensory system, how those cells communicate with the brain, and how the brain can be fooled by illusions and expectations.

Students employ the scientific method by creating hypotheses, collecting data from their classmates, and formulating their own answers to questions about sensation, perception, and the brain. By the end of the unit, students acquire an understanding of major concepts in the biological sciences and an enhanced ability to work in groups and individually to investigate the biological sciences.

The skills that students will acquire

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Robotics

Stage: Empowerment
Path: Computer Science & Applied Mathematics

Unit description

In the field of robotics, computer science and engineering come together to create machines that can perform a variety of tasks from manufacturing microchips to exploring Mars.

In this unit, students develop familiarity with computer science concepts. For example, they explore topics such as control structures, flowcharts, and path planning. Students also survey basic principles of mechanical engineering, such as torque, leverage, and traction. Using LEGO® robotics equipment, they work together to construct, program, and test their robots.

For their culminating project, students design, build, and program robots to complete a complex task. The project demonstrates the basic computer science and engineering principles that underlie everything from the space shuttle to the average home toaster. Students gain a foundation in computer programming and engineering that will become increasingly important in the highly technical twenty-first century.

The skills that students will acquire

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Future engineer

Stage: Empowerment
Path: Engineering science

Unit description

How do simple machines work? How can a concrete boat float? How do you build the strongest bridge with the lightest building materials? Physics, the science of matter and its motion, helps answer these questions and more. In this unit, students explore basic physics and engineering concepts such as principles of mechanics; electricity and magnetism; waves and optics; and thermodynamics. They learn through hands-on activities and projects reinforced by lectures, class discussions, and practice exercises.

Students might participate in a catapult design challenge to learn about projectile motion or take part in an egg-drop container contest to investigate impulse. To study potential and kinetic energy, they might design and build roller coasters, and they could learn about current and voltage by using a lemon to light a bulb. Students carefully analyze data they collect and write reports about the projects.

Students learn how to ask scientific questions, hypothesize, and experiment to interpret physical phenomena. By the end of the unit, students acquire an understanding of major concepts in physics and an enhanced ability to work in groups and individually to solve problems in the physical sciences.

The skills that students will acquire

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Fun Chemistry: From Metals to Polymers

Stage: Empowerment
Path: Medical, Biological and Chemical Sciences

Unit description

How are minerals and crystals different? What, exactly, is a polymer? Why is shape important to a protein's function? What does food science have to do with polymers? What is Oobleck and how can you make it dance? Paper or plastic? In this unit, these questions, and many more, are answered as students explore crystals and polymers.

The unit begins with the basics of matter and chemistry. Students are introduced to atomic structure and participate in a simulation to further their understanding. Students then turn their attention to minerals and crystals. For example, they investigate the shape of crystals by making models. They learn about the science of candy making before growing their own rock candy. Students identify minerals by using tests for their properties such as color, hardness, streak, heft, cleavage versus fracture, and luster. They prepare saturated solutions of different mineral salts to grow crystals .

Students next turn their attention to polymers. They read about and discuss the history of plastics and their practical uses. Students learn about crosslinking in polymers and then see the concept in action by making slime balls. They evaluate plastic and paper bags, brainstorming methods of comparison, such as weight to space occupied, and later debate the merits of using paper bags versus plastic bags. Students take part in a recycling engineering activity; the challenge is to arrive at an idea for an innovation that improves the plastic bag recycling process and to build a model of their design.

Students learn the connection between polymers and food science. For instance, they make alginate gels to learn about complex carbohydrate polymers. Students conduct research to learn about polysaccharides and then share what they have learned in presentations. A cooking demonstration illustrates a real-life implication of denaturing proteins. Students learn about the chemistry of the elastic protein gluten by preparing bread dough from different kinds of flour.

Throughout the unit, students engage in laboratory investigations, hands-on activities, demonstrations, and discussions to further their understanding of crystals and polymers.

The skills that students will acquire

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3D modelling

Stage: Empowerment
Path: Engineering science

Unit description

The unit starts with an introduction to 3D modelling covering the history of it and how it is used in different fields including CGI in architecture, gaming, VR experiences, travel, cars and satellite navigation, movies and animations, medicine, and shopping, to name a few. Students will be exposed to understanding scale in the real world and the digital interfaces to develop an understanding of its purpose in design.

Students will be given the opportunity to explore basic shapes and modelling techniques. These will be expanded onto model manipulation by extruding, modifying, and sweeping basic objects. The common geometric shapes will be applied alongside more complex geometry and modelling structures such as NURBS, curves and meshes. Throughout the program, students will have opportunities to engage in peer-to-peer learning as well as having opportunities to revert their knowledge and comprehension of the unit through presenting their own modelling work individually and in groups.

As the unit progresses, more complex modelling techniques will be introduced. Students will be able to apply them to their own personal models and their group project. Once students have a working model, they will be able to cut sections to extract orthographic 2D drawings which will support the expression of their design and concepts. They will learn to manage and modify views and create motion paths which can be used to develop animations and renders along with applying materiality and textures. The unit will also cover the various types of 3D printing and materials and machinery that can be used.

Overall, the unit provides a comprehensive overview and introduction to 3D modelling. It covers the various techniques required and gives the students an understanding of the various career paths available with the knowledge they will have learnt.

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The World of Data: From Probability to Interpretation

Stage: Empowerment
Path: Computer Science & Applied Mathematics

Unit description

How do we reason in uncertain conditions? How do Probability theorists model the world? How do data scientists make sense of the world using data? Students will be introduced to some of the fundamental concepts of probability, such as Independence, Conditional Probability, and Expectation. They will also learn about some of the fundamentals of data interpretation, such as measures of center, measures of spread, sampling, and hypothesis testing, and how to use experiments to test their hypothesis, or to back up their abstract reasoning. There will also be focus on communicating and explaining their ideas; including ways in a manner specific to the unit, such as learning about different methods of data presentation, and how to do write-ups of experiments, and including ways that can be applied to all their academic careers, such as explaining solutions to problems they have solved, and giving presentations on things they have researched. There will also be the chance for students to see how probability can form the basis of study for other topics of interest, such as machine learning, or modelling infectious diseases .

Students will also be encouraged to apply new knowledge and skills to studying real- world examples. Opportunities will be included throughout the unit, such as using Bayesian reasoning to study medical tests, as well as having 2 days devoted at the end to deep dives on topics where probability and data interpretation are key players.

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The Space Sciences

Stage: Empowerment
Path: Physics, Earth & Space Sciences

Unit description

How big is the solar system? How do we observe stars? What are black holes? In this unit, students learn about the principles of Astronomy, its history, its operation, and the scientific theories within it. The students participate in hands-on, creative activities, experiments, research along with mathematical and scientific exercises to study the nature of the Universe.

Students will learn about the foundations of Astronomy and the key figures throughout its development. They will also explore instruments, observatories, and theories from the past. They will learn about the current outstanding questions in this science as well as modern day advancements in space technologies both international and in the KSA. The students will be familiarized with the night sky, for example recognizing constellations and moon sighting. The science topics that will be covered include the Solar System, radiation and spectra, distances, the life of stars, galaxies, black holes, dark matter, and life in the Universe.

Throughout the program, they will be presented with role models, both living and in the past, to inspire those who are interested in pursuing the Space Sciences.

In summary, by the end of the program, students should acquire a better understanding of the work done by space scientists and broad knowledge of many fields in Astronomy.

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