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.

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Inventions

Stage: Exploratory

Path: Engineering science

Unit description

Did you know that the idea for the microwave oven was set in motion by a melted chocolate bar? While standing in front of a magnetron, inventor Percy Spencer noticed that his treat had begun melting in his pocket. To further test the potential of the magnetron, Spencer held a bag of corn kernels next to it and watched them pop. Whether it is this simple experiment that led to the microwave oven or the students' own creations, this unit is about inventors, inventions, and their impact on our world.

How does a toaster work, and what might make it work better? How can a package be designed to mail a potato chip so that it does not break? In this unit, students dismantle gadgets to figure out how things work and use ordinary household items to create new inventions. Students apply for mock patents, collaborate with their fellow inventors, keep an inventions journal, and work in teams to create hovercrafts or design more effective burglar alarms. In addition, students research the lives and innovative ideas of inventors past and present.

Throughout the process of inquiry, discover, and problem solving, students explore not only the how and why of various discoveries and inventions, but also their impact across the centuries. This integrated examination of inventions in our world offers young inventors a fuller understanding of the implications and promise of the creative imaginings.

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:

- Future vision.
- Logical thinking.
- Positive personal values and traits
- Take responsibility
- Self confidence
- Pursuit of excellence

Program components

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

How to implement the program

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Be a Scientist: Biology and Medical Science

Stage: Exploratory

Path: Medical, Biological and Chemical Sciences

Unit description

What is a biologist? What is a medical scientist? On what types of projects and experiments do different biologists and medical scientists work? In this unit, students learn about different types of biologists and medical scientists. They participate in hands-on activities like what biologists and medical scientists do in their jobs. To better complete experiments and engaging hands-on activities, students are exposed to basic biology and medical science concepts such as heredity, chemical reactions, human body systems, sterile technique, and forensic testing procedures.

Students examine strategies and techniques used by biologists and medical scientists and put them into practice. For example, students are guided in a real-life survey of their local ecosystem to determine the diversity, abundance, and behavior of the different organisms inhabiting the area. Role-playing the work of archaeologists, student teams develop the skills needed to survey a "dig site" using a variety of methods and tools. As toxicologists, students test, under controlled conditions, the effects of drugs on simple organisms. Students explore molecular biology as they use basic materials and methods to extract and describe a DNA sample. Students are trained to

perform a wide array of simple laboratory examinations and analyses that might be used by forensic scientists .

As they learn about different types of biologists and medical scientists, students also learn how to experiment and complete designs. By the end of the unit, students acquire a better understanding of the work done by biologists and medical scientists.

The skills that students will acquire

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Be a Scientist: Physics and Engineering

Stage: Exploratory

Path: Engineering science + Physics, Earth & Space Sciences

Unit description

What is a physicist? What is an engineer? On what types of projects and experiments do different physicists and engineers work? In this unit, students learn about different types of physicists and engineers. They participate in hands-on activities like what physicists and engineers do in their jobs. To better complete experiments and engineering design challenges, students are exposed to basic physics and engineering concepts such as kinematics, buoyancy, electricity, and forces.

Students examine strategies and techniques used by engineers and physicists and put them into practice. For example, as manufacturing engineers; students design, test, and improve an assembly line process. As experimental physicists they use the scientific method to verify Newton's Laws. As electrical engineers they design electrical communicators. Drawing upon the concepts they learn, students design and create a model amusement park ride.

As they learn about different types of physicists and engineers, students also learn how to experiment and complete designs. By the end of the unit, students acquire a better understanding of the work done by physicists and engineers.

The skills that students will acquire

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A journey in the world of numbers

Stage: Exploratory

Path: Computer Science & Applied Mathematics

Unit description

What does a subatomic particle measured in femtometers have in common with a galaxy measured in light years? Both are a part of the uniquely human effort to quantify the world around us. In this unit, students explore numbers, from the very small to the unimaginably large, and learn how numeric representations help to explain natural phenomena such as time, distance, and temperature.

Moving beyond traditional arithmetic, this unit centers on hands-on activities that develop understanding of the scope and scale of numbers. Students consider such questions as: does the camera add 10 pounds? They develop approximation and computational strategies for learning scientific notation and determine whether answers to problems are reasonable. In examining the diversity of measurement systems, students learn the origins of some familiar and unfamiliar methods of measurement and invent their own units of measurement. Additionally, students use dimensional analysis to investigate conversions between different scales or systems of

measurement. They apply concepts of ratio and proportion by constructing and analyzing scale models of our solar system, the human body, and other objects in our natural world.

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Chemistry in our life

Stage: Exploratory

Path: Medical, Biological and Chemical Sciences

Unit description

In this unit, students are introduced to the role played by chemistry in their everyday lives. Students learn about the states of matter, the changing states of matter, and colligative matter through ice melt, dry ice, and freezing point of ice laboratory investigations. They explore different types of mixtures and then make their own mixture—salad dressing. Students learn about subatomic particles and build models of atoms. They witness endothermic reactions in their bread-baking activity. During the focus on chemistry in the kitchen, students learn about enzymes, fermentation, and food preservation by doing hands-on activities. Additionally, students learn about the properties of water, chemical reactions and biological molecules, acids and bases, polymers, colors and pigments, and other concepts. Throughout the unit, laboratory investigations, hands-on activities, and discussions deepen students' understanding of the unit concepts.

The skills that students will acquire

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Discover your environment

Stage: Exploratory

Path: Physics, Earth & Space Sciences

Unit description

Why do animals adapt? What are the advantages of renewable energy? What do environmental scientists do? In this unit, students discuss these questions and more as they learn about the different types of scientists who work in the field of environmental science. They participate in hands-on activities like what environmental scientists do in their jobs. For example, as soil scientists they construct soil profiles. As topographers they learn about topographic maps and make clay landforms. As geologists they simulate core sampling. As environmental biologists they consider how the spread of disease can cause population decline. As environmental engineers they focus on green space and its benefits .

In a multi-day project, students act as meteorologists. First, they build barometers, thermometers, wind vanes, anemometers, and rain gauges. They assemble the devices into a weather station with which they collect and analyze weather-related data. As they learn about different types of environmental scientists, students also learn how to experiment and complete designs. By the end

of the unit, students acquire a better understanding of the work done by scientists working in the field of environmental science.

The skills that students will acquire

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Be a programmer

Stage: Exploratory

Path: Computer Science & Applied Mathematics

Unit description

At the start of the unit, you will learn about the impact of computer science and programming on the world. This will help you to appreciate the innovations that you will create during the program. Specifically, you will learn about how computers have evolved over the years and understand the physical and intangible components that make up computers. Your teacher will then take you through the theoretical concepts of programming which will lead to a practical introduction to Scratch. You will then have a hands-on experience and cover the main concepts in Scratch which include event listeners, sprites, motion, control, and variables. Be excited to create stories, games, and animations in Scratch.

After completing the tutorial son Scratch, you will learn how to design and develop websites. The first stage will involve learning about the basic concepts of designing and developing websites using HTML and CSS. This will help you to understand the basic HTML structure of every website and learn how to organize and style elements In HTML and CSS. Like Scratch, the classes will incorporate practical sessions which will help you style webpages by formatting background

colors, headings, fonts, images, etc. The final part of the unit will require you to create a final project which will involve designing a personal blog website that will highlight all the things you are passionate about.

Aside from having technical tutorials, the unit will also have some fun games that will help you interact with other members of your glass through the fun games.

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Water in life and energy

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.

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- Flexibility.
- Problem solving.
- Priorities management
- Critical thinking
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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.

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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.

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- 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).

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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

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

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Crystals and 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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Probability and Data 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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Physics between theory and application

Stage: Excellence

Path: Physics, Earth & Space Sciences

Unit description

This unit covers material ordinarily included in an algebra-based introductory physics unit. Topics covered include Newtonian mechanics, wave motion, optics, electricity and magnetism, and circuits. In labs, students learn to measure and analyze error; determine gravitational acceleration; and experiment with refraction and diffraction of light, waves, simple circuit analysis, and the magnetic deflection of electrons. The purpose of the unit is for students to learn physical laws, practice problem solving techniques, and acquire ability to communicate scientific results to a general audience.

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Chemistry applications

Stage: Excellence

Path: Medical, Biological and Chemical Sciences

Unit description

From artificial sweeteners in diet soft drinks to batteries in electric cars, applications of chemistry are integral to our everyday lives. In this unit, students investigate topics in chemistry as a means to solving simulated real-world problems.

Students begin the unit with an exploration of the importance of water in their everyday lives. This introduces them to the periodic table, atomic structure, and chemical bonding. In the laboratory, students investigate solubility and test water samples to identify potential toxins. They also create and maintain daily logs of their water usage.

Similarly, students examine other topics such as the biochemistry of food and pharmaceuticals using real-life scenarios simulated in the classroom. For instance, students may conduct calorimetric experiments and prepare biodiesel in their investigation of alternative fuels or prepare aspirin during their exploration of the healing and toxic properties of pharmaceuticals.

This unit emphasizes learning concepts in a laboratory setting to demonstrate how chemistry affects our everyday lives. Students leave the unit better prepared for high school chemistry and with a greater understanding of how chemistry is used to improve the world around them.

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Biomedical sciences

Stage: Excellence

Path: Medical, Biological and Chemical Sciences

Unit description

Why does our face turn red when we sweat? What does our appendix do? Is it true that your nose gets longer if you tell a lie? In the Introduction to the Biomedical Sciences, we will answer these questions and more. This unit is an introduction to human biology and the science of medicine. Drawing upon basic biological and chemical concepts, students explore the intricate anatomical and physiological mechanisms underlying normal human function. Students then investigate homeostatic imbalances that cause diseases. Lab work covers techniques in histology, anatomy and physiology (including dissections), and biochemistry. Additionally, students learn to read critically and respond to articles in scientific journals and the popular media.

Students learn how to ask scientific questions, hypothesize, and experiment in order to interpret biomedical phenomena. By the end of the unit, students acquire an understanding of major concepts in medicine and an enhanced ability to work in groups and individually to relate the structure of our bodies and their organs to their functions.

The skills that students will acquire

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Principles of Engineering Design

Stage: Excellence

Path: Engineering science

Unit description

Students in this unit work primarily in teams to solve real-world and simulated problems in the field of engineering. Case studies of actual engineering projects are used to demonstrate principles of design. For example, students may analyze the failure of the O-ring on the space shuttle Challenger to investigate how components in a system function together and the significance of manufacturing tolerances. Alternatively, they may review the Tacoma Narrows Bridge collapse to understand how inadequate knowledge of materials and insufficient testing can lead to failure.

Student teams construct and test their own working models and prototypes, such as green buildings, amphibious vehicles, electrical circuits, or gliders. They learn the physics behind their designs, covering aspects of mechanics, electricity and magnetism, and fluids.

As a part of the engineering design process, students weigh economic and ethical considerations along with technological ones. Students submit written reports for review. They leave the class with a broader view of the field of engineering and a deeper understanding of the day-to-day work

of engineers. Moreover, they leave with skills and knowledge they can apply to developing innovative solutions to real-world engineering challenges in their own lives and communities.

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Electrical engineering

Stage: excellence

Path: Engineering science

Unit description

The first transistor, created at Bell Laboratories in 1947, was about 4 cm in size. Today millions of transistors fit on a single computer processor chip about the size of a postage stamp. Innovations, such as the miniaturization of the transistor, are hallmarks of the exciting and challenging field of electrical engineering.

In this unit, students begin by learning the basics of current, voltage, resistance, energy, and magnetism. For instance, they map the electric field lines generated by an electric charge. They apply their conceptual understanding as they draw and construct series and parallel circuits, working with resistors, capacitors, inductors, diodes, and transistors.

Students study electromagnetism—one of the most important physical principles in modern electronics—and examine its applications to practical, everyday devices such as motors, lifting magnets, and stereo speakers. They construct breadboard models of similar devices using mathematical tools such as Ohm's Law and Kirchoff's Laws to guide their circuit designs.

Finally, students are exposed to cutting edge topics in the field, including the physics behind solar cells and solid-state electronics. Students leave the unit with a better understanding of electrical engineering and its many applications to everyday life.

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Cryptology

Stage: excellence

Path: Computer Science & Applied Mathematics

Unit description

Cryptology is the study of designing systems for encoding/decoding messages, as well as the study of cryptanalysis—the unauthorized decryption of a message. In this unit, students begin their journey with an introduction to many early manual techniques for creating and breaking ciphers such as cipher wheels, the Caesar shift, monoalphabetic substitution, and the Vigenère cipher. The students then move into more complicated manual encryption systems, such as the key grid systems of Playfair and ADFGVX, which conclude with the modular matrix-based system of the Hill cipher. They study the cipher machine Enigma and its historical significance before making their own paper Enigma machine simulators. They learn about modern digital encryption techniques, including RSA public key cryptography and El Gamal cryptosystems. Delving deeper into modern techniques, students explore how data stored and transmitted by computer can be secured with digital encryption. Discussions about the strengths and vulnerabilities of each encryption system enable students to attack and decrypt messages using techniques such as frequency analysis and cribbing. Students apply what they learn to encrypt and decrypt their own secret writing.

The historical context of cryptography and cryptographic devices is provided to further develop understanding of this branch of mathematics. By studying the inventors of ciphers systems, students are able to understand the context for which necessity mandated new cipher systems to emerge. For example, students examine the design and fallibility of the German Enigma Machine, one of the most important cryptographic devices in history. The historical study of the cryptosystems students explore also helps them to develop ideas for how to make the current systems they study as strong as possible.

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Mechanical Engineering

Stage: excellence

Path: Engineering science

Unit description

In this unit, students are introduced to the broad field of mechanical engineering and its focus on the principles of motion, energy, and force. Students review and extend their understanding of physics and engineering principles through activities and experiments. Students learn about the engineering design process and put that knowledge into practice as they construct and test their own working models and prototypes, such as a self-propelled projective vehicle. After learning about stress, strain, and gear usage, students are challenged to design and build a prototype for an amusement park ride. Students are introduced to fluid mechanics and use what they learn to design and build a working water fountain.

Students write design proposals, create free-body diagrams, craft engineering drawings by hand, and use computer-aided design to create models from drawings. Throughout the unit, the lessons and activities are designed with the goal of providing students with a broader view of mechanical engineering and a deeper understanding of the day-to-day work of mechanical engineers.

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Biotechnology

Stage: Excellence

Path: Medical, Biological and Chemical Sciences

Unit description

The Human Genome Project has already sequenced all of the approximately 20,000 genes in human DNA. How did scientists gather this information? What opportunities does it provide for curing congenital diseases or cancer? What ethical questions does it pose in terms of privacy rights or reproduction? This unit introduces students to the biology, technology, and the potential of genetics.

Students first learn or review fundamental principles of cell biology and genetics, including mitosis, meiosis, and Mendelian inheritance. Next, they turn to the structure and function of DNA and RNA, sources and types of mutations, genetic biotechnology, and biotechnology applications. Lab work includes isolating the DNA molecule from common bacteria and splitting DNA sequences using restriction enzymes. Students also explore biotechnology careers, model and perform polymerase chain reaction (PCR), and conduct gel electrophoresis.

Students explore current research in biotechnology and use their new knowledge to deliberate on the significance of genetics in society and the future of genetic inquiry and technology.

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Renewable Energy

Stage: Excellence

Path: Engineering science

Unit description

How can the world produce enough energy for a population predicted to hit nine billion people by 2040? Can we make a more efficient car without fossil fuels at the pump or the electricity source? Can we wean ourselves off fossil fuels and limit global warming? Are renewables the answers to all of these questions?

Renewable Energy is an introduction to renewable energy resources in a context of global energy production, consumption, and innovation. The unit draws from many fields of science (physics, engineering, earth and environmental science, biology, atmospheric science, and chemistry) as well as public policy, geopolitics, economics, and statistics. This unit examines the major types of renewable energy, including direct solar energy, indirect solar energy (wind energy, hydropower, wave energy, bioenergy, and tidal) and non-solar renewable energy (geothermal). It compares renewable energy to non-renewable energy sources (coal, oil, natural gas, and nuclear). Students study the energy system from cradle to grave to cradle, from inputs and source materials to generation, storage, distribution to consumption, waste, and broader impacts. Additional topics

include electricity and transportation, environmental and economic implications, world energy consumption and production, climate change, and the future of energy.

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Anatomy and Physiology

Stage: Excellence

Path: Medical, Biological and Chemical Sciences

Unit description

Anatomy and Physiology provides the foundations of the structure and function of the human body. The unit begins with an overview of regions of the human body. Students learn about each body system's structure and function. Each day focuses on one of the body systems including the skeletal, muscular, integumentary, circulatory, respiratory, immune, endocrine, reproductive, digestive, and excretory systems. Throughout each unit students perform lab experiments and hands on activities to have a strong understanding of the material.

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Flight Science

Stage: Excellence

Path: Engineering science

Unit description

From the sketches of Leonardo da Vinci to the expeditions of Amelia Earhart, humans have long struggled to unlock the mysteries of flight. In this unit, students study and explore the science, engineering, and design involved in the wonders of flight.

Students learn about the science behind the flight of gliders, balloons, airplanes, and rockets. Topics include buoyancy, kinematics, fluid flow, Newton's laws, and the four forces of aerodynamics: lift, weight, thrust, and drag. Students pay particular attention to the various lift theories and how the wing of an airplane generates lift. They design, construct, and test model aircraft. Students investigate the engineering process and how engineers make choices to meet the design goals for a particular aircraft, such as finding the best wing plan for a glider to fly the farthest distance or the best nose and wing design for a rocket to fly the highest height. They also explore orbital motion and rocket science. Students leave the unit with an understanding of the science that makes flight possible.

The skills that students will acquire

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Cyber Security

Stage: Excellence

Path: Computer Science & Applied Mathematics

Unit description

Students in this unit will introduce to the most important basic concepts in cybersecurity and cryptography, nature of the security threats facing computer systems and how to protect them from intrusions, and students shall be introduced to functions related to this field.

Furthermore, students will learn how to use digital evidence and solve their information security problems using programming languages. Moreover, the focus of the science module shall increase to include case studies in the field of cybersecurity and cryptography, and building on the same for developing projects for groups of students.

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Data Science & Artificial Intelligence

Stage: Excellence

Path: Computer Science & Applied Mathematics

Unit description

This unit focus on the relationship between artificial intelligence, data and computer science by studying basic concepts in programming, system implementation, machine learning and data processing on a large scale.

students shall learn how to design, manufacture, and evaluate smart systems through conducting scientific activities that train them to solve problems from experiments that occurred, and how to use computer science in dealing with data and understand the consequences that may result on society because of misuse. They will explore future jobs that suit them if they continue to study this field, they will explore concepts and algorithms through Python software.

At the end of the unit, students are expected to demonstrate experience in sources used in computer programs (Computer Library) associated with machine learning and knowledge of artificial intelligence principles, and that students shall be able to design their own simplified intelligent systems.

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Actuarial and Financial Mathematics

Stage: Excellence

Path: Computer Science & Applied Mathematics

Unit description

students shall learn the importance and origins of actuarial and financial mathematics, math operations on dates, periods, simple and compound interest, periodic payments, loans and depreciation of fixed assets, Evaluation of cash flow series, calculate probabilities using a life table, incorporation of uncertainty into the cash flow resulting from investment and death, simulation of uncertain cash flows, application of actuarial methods to life insurance and forecasting the expected average of human life, and how to use actuarial mathematics in financial resources, investments, banking and insurance.

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Mineral and Rock Resources

Stage: Excellence

Path: Physics, Earth & Space Sciences

Unit description

Students in this unit can review the mineral and rock resources in the Kingdom of Saudi Arabia in terms of knowing their types, uses, investing them and it impact in supporting the national economy and means of preserving and sustaining.

The skills that students will acquire

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