

Diploma Programme subject outline—Group 4: experimental sciences			
School name	La Costa Canyon High School	School code	924174
Name of the DP subject	Biology		
Level <i>(indicate with X)</i>	Higher <input type="checkbox"/>	Standard completed in two years <input type="checkbox"/>	Standard completed in one year * <input checked="" type="checkbox"/>
Name of the teacher who completed this outline	Cindi Schildhouse	Date of IB training	February 8-10, 2018
Date when outline was completed	12/1/2017	Name of workshop <i>(indicate name of subject and workshop category)</i>	Biology (Category 2)

* All Diploma Programme courses are designed as two-year learning experiences. However, up to two standard level subjects, excluding languages ab initio and pilot subjects, can be completed in one year, according to conditions established in the *Handbook of procedures for the Diploma Programme*

1. Course outline

- Use the following table to organize the topics to be taught in the course. If you need to include topics that cover other requirements you have to teach (for example, national syllabus), make sure that you do so in an integrated way, but also differentiate them using italics. Add as many rows as you need.
- This document should not be a day-by-day accounting of each unit. It is an outline showing how you will distribute the topics and the time to ensure that students are prepared to comply with the requirements of the subject.
- This outline should show how you will develop the teaching of the subject. It should reflect the individual nature of the course in your classroom and should not just be a “copy and paste” from the subject guide.
- If you will teach both higher and standard level, make sure that this is clearly identified in your outline.

	Topic/unit (as identified in the IB subject guide) <i>State the topics/units in the order you are planning to teach them.</i>	Contents	Allocated time			Assessment instruments to be used	Resources <i>List the main resources to be used, including information technology if applicable.</i>
			One class is	80-120	minutes.		
Year 1	Topic 1: Cell Biology	1.1 Introduction to Cells 1.2 Ultrastructure of Cells 1.3 Membrane Structure 1.4 Membrane Transport 1.5 The Origin of Cells 1.6 Cell Division	15 hrs.			Unit Test Quizzes Lab Activities Virtual Labs Lab reports Dissections Oral presentations	Biology for the IB DIPLOMA C.J. Clegg HODDER EDUCATION 2010 Advanced Biology Michael Kent OXFORD 2000
	Topic 2: Molecular Biology	2.1 Molecules to metabolism 2.2 Water 2.3 Carbohydrates and Lipids 2.4 Proteins 2.5 Enzymes 2.6 Structure of DNA and RNA 2.7 DNA replication, transcription and translation 2.8 Cell Respiration 2.9 Photosynthesis	21 hrs.			Class discussions Research papers Research projects Science Journals Worksheets Online assessments (all-in-learning, kahoot.it)	OpenStax Biology (Rice University)
	Topic 8: Metabolism, cellular respiration and photosynthesis	8.1 Metabolism 8.2 Cell Respiration 8.3 Photosynthesis	14 hrs.				
	Topic 7: Nucleic Acids	7.1 DNA Structure and replication 7.2 Transcription and gene expression 7.3 Translation	9 hrs.				
	Topic 3: Genetics	3.1 Genes 3.2 Chromosomes 3.3. Meiosis 3.4 Inheritance 3.5 Genetic Modification and Biotechnology	15 hrs.				

	Topic/unit (as identified in the IB subject guide) <i>State the topics/units in the order you are planning to teach them.</i>	Contents	Allocated time			Assessment instruments to be used	Resources <i>List the main resources to be used, including information technology if applicable.</i>
			One class is in one week there are	80- 120	minutes. classes.		
Year 1	Topic 4: Ecology	4.1 Species, Communities and ecosystems 4.2 Energy Flow 4.3 Carbon Cycling 4.4 Climate Change	12 hrs.			Unit Test Quizzes Lab Activities Virtual Labs Lab reports Dissections Oral presentations Class discussions Research papers Research projects Science Journals Worksheets Online assessments(all-in-learning, kahoot.it)	Textbooks Workbooks Guidebooks Lab books Review Books Vernier lab book
	Topic 5: Evolution and Biodiversity	5.1 Evidence for Evolution 5.2 Natural Selection 5.3 Classification of Biodiversity 5.4 Cladistics	12 hrs.				
	Topic 10: Genetics and Evolution	10.1 Meiosis 10.2 Inheritance 10.3 Gene pools and speciation	8 hrs.				
	Practical Activity		22 hrs.				
	Individual Investigation		7 hrs.				

	Topic/unit (as identified in the IB subject guide) <i>State the topics/units in the order you are planning to teach them.</i>	Contents	Allocated time			Assessment instruments to be used	Resources <i>List the main resources to be used, including information technology if applicable.</i>
			One class is in one week there are	80- 120	minutes. classes.		
Year 2	Topic 6: Human Physiology	6.1 Digestion and Absorption 6.2 The Blood system 6.3 Defense against infectious diseases 6.4 Gas exchange 6.5 Neurons and synapses 6.6 Hormones, homeostasis and reproduction	20 hrs.			Unit Test Quizzes Dissections Lab Activities Virtual Labs Lab reports Oral presentations Class discussions Research papers Research projects Science Journals Worksheets Online assessments(allinlearning, kahoot.it)	Textbooks Workbooks Guidebooks Lab books Review Books Vernier lab book
	Topic 11: Animal Physiology	11.1 Antibody production and vaccination 11.2 Movement 11.3 The Kidney and Osmoregulation 11.4 Sexual Reproduction	16 hrs.				
	Topic 9: Plant Biology	9.1 Transport in the xylem of plants 9.2 Transport in the phloem of plants 9.3 Growth of plants 9.4 Reproduction in plants	13 hrs.				
	Option A: Neurobiology and behavior	A.1 Neural Development A.2 The Human Brain A.3 Perception of stimuli A.4 Innate and learned behavior A.5 Neuropharmacology A.6 Ethology	25 hrs.				
	Option C: Ecology and Conservation	C.1 Species and Communities C.2 Communities and Ecosystems C.3 Impacts of Humans on ecosystems C.4 Conservation and Biodiversity C.5 Population Ecology C.6 Nitrogen and Phosphorus Cycles	25 hrs.				

Total Standard Level Core Content	155 hrs
Total Additional Higher Level Content	50 hrs

	Topic/unit (as identified in the IB subject guide) <i>State the topics/units in the order you are planning to teach them.</i>	Contents	Allocated time		Assessment instruments to be used	Resources <i>List the main resources to be used, including information technology if applicable.</i>
			One class is in one week there are	80-120 2-3		
Group 4 project/ Individual investigations/practical activity						80 hrs
TOTAL CONTENT AND OPTIONS TIME						285 hrs

1. The group 4 project

As the IB guides say, “The group 4 project is a collaborative activity where students from different group 4 subjects work together on a scientific or technological topic, allowing for concepts and perceptions from across the disciplines to be shared in line with aim 10—that is, to ‘encourage an understanding of the relationships between scientific disciplines and the overarching nature of the scientific method.’” Describe how you will organize this activity. Indicate the timeline and subjects involved, if applicable.

For the group 4 project we will investigate a school greenhouse project. Greenhouse projects can offer educational opportunities at various levels of education ranging from pre-school to university. Greenhouses can help teach basic botany concepts as well as concepts of solar power, heat, ecosystems and biodiversity. Advanced concepts such as community responsibility and both business and management concepts can also be taught using a greenhouse. Greenhouses can also be a good starting point to teach both about environmental stewardship and concepts related to global warming. Climate change and global warming is a great topic for students to study while working on the greenhouse because it integrates so many subjects: energy, environment, geography, politics, chemistry, biology, economics, and more. It requires students to use analytical tools and math skills, and to exercise their abilities to research, think and understand complex issues. The ability to grow food, farming and the agricultural industry are all affected by climate change, as well various countries around the world are affected.

Building the greenhouse will assist students with the content in the IB Biology course. Students will learn how to reduce waste and witness the impact of their conservation efforts on our local environment while applying their understanding of key scientific concepts in action. IB Biology students will analyze various aspects of genetics, photosynthesis, and biodiversity. Students will investigate inheritance trends by planting “Wisconsin Fast Plants” for a hands-on approach to genetics, conduct experiments to further understand the process of photosynthesis, and actually be able to cross pollinate plants in order to explore how traits are passed through generations. In addition students will learn about plants as whole systems. They can experiment with water movement, pollination, and nutrition, and explore relationships between plants and insects. Students can also simulate different habitats, and understand how physical factors and climate relate to plant type and growth.

We plan on building the greenhouse on available space behind the school facility. Approval will be secured through the Fulton County Facilities office and funding will be applied for from the Atlanta-based Captain Planet Foundation, which offers grants for garden/greenhouse-type projects in the K-12 Atlanta area. More information can be found at <http://captainplanetfoundation.org/apply-for-grants/>. Students would research all aspects of building a greenhouse and will decide what factors they would focus on. Building the greenhouse will provide a cross curricular opportunity where students can build solar panels in chemistry and physics courses. The greenhouse will be built and maintained throughout the second year of the IB HL Biology course. Students will be involved in building and planning all aspects of the greenhouse. We will first take a trip to a nearby greenhouse so that students can get firsthand knowledge and gather data for building the greenhouse. Students will work in groups and will be responsible for various aspects of building the greenhouse as well as collecting and organizing data. Integrating a greenhouse as a learning environment offers boundless opportunities for promoting student responsibility, and helps develop students' confidence and pride as they display and share the fruits and vegetables of their labors.

2. IB practical work and the internal assessment requirement to be completed during the course

As you know, students should undergo 40 hours (at standard level) or 60 hours (at higher level) of practical work related to the syllabus. Use the table below to indicate the name of the experiment you would propose for the different topics in the syllabus. Indicate which experiments you would use for assessing each of the internal assessment criteria—design (D), data collection and processing (DCP) and conclusion and evaluation (CE).

An example is given. Add as many rows as necessary.

Name of the topic	Experiment	Indicate the experiments you would use for assessing design (D), data collection and processing (DCP) and conclusion and evaluation (CE)	Any ICT used? <i>Remember you must use all five within your programme.</i>
Topic 1- Cell Biology	Activity- Building a three dimensional cell membrane with proteins embedded	D	The Vernier and PASCO interfaces and sensors will potentially be used for every experiment, so ICT will most likely be present in some shape or form in every laboratory exercise completed in this course. The majority of the activities will be used in conjunction with the Vernier lab book, sensors and probes which uses ICT's for their labs.
Topic 1- Cell Biology	Activity- Diffusion and Osmosis lab using dialysis tubing	DCP	
Topic 1- Cell Biology	Calculating cell size using the microscope-demonstrates the relationship between surface area, volume and diffusion time.	CE	
Topic 1- Cell Biology	Lab- Mitosis and Cancer: In this lab, students will be viewing sections of tissue containing mitotic cells and determining what stages each of the cells is in and estimating how long each stage lasts. They will also be comparing normal cells and cancer cells to see how mitosis is altered in cancer cells.	DCP	
Topic 1- Cell Biology	Modeling meiosis using pop beads	D	
Topic 2: Molecular Biology	Enzyme Catalysis- Pineapple enzymes and Jell-O molds	CE	
Topic 2: Molecular Biology	Toothpickase and/or Paperase Activity	D	
Topic 2: Molecular Biology	Building Macromolecules A paper-scissors-tape activity used to help students envision the process of synthesis building macromolecules out of smaller subunits	D	

Name of the topic	Experiment	Indicate the experiments you would use for assessing design (D), data collection and processing (DCP) and conclusion and evaluation (CE)	Any ICT used? <i>Remember you must use all five within your programme.</i>
Topic 2: Molecular Biology	Food Test lab- Using and understanding how different indicators are used to identify proteins, lipids, carbohydrates (incl. reducing sugars analysis) using Biuret, Benedict's, Sudan etc.	DCP,CE	<p>The Vernier and PASCO interfaces and sensors will potentially be used for every experiment, so ICT will most likely be present in some shape or form in every laboratory exercise completed in this course.</p> <p>The majority of the activities will be used in conjunction with the Vernier lab book, sensors and probes which uses ICT's for their labs.</p>
Topic 8: Metabolism, cellular respiration and photosynthesis	Yeast Fermentation lab	CE	
Topic 8: Metabolism, cellular respiration and photosynthesis	Photosynthesis in Leaf Disc	CE	
Topic 8: Metabolism, cellular respiration and photosynthesis	Plant pigment and photosynthesis	CE	
Topic 7: Nucleic Acids	DNA extraction techniques using strawberries	DCP	
Topic 7: Nucleic Acids	Building 3 dimensional models of Nucleic Acids	D	
Topic 7: Nucleic Acids	Mapping plasmids lab	DCP	
Topic 3: Genetics	Genetics lab- Identifying the phenotype- and genotype for a certain characteristic (like tongue rolling) for a family tree	DCP	
Topic 3: Genetics	Chi Square test lab using corn	CE	
Topic 3: Genetics	Drosophila Fruit Fly Lab	DCP	
Topic 4: Ecology	Lincoln Index simulation- Jumping beans lab	DCP	
Topic 4: Ecology	Mark and Recapture Lab	DCP	
Topic 4: Ecology	Predator Prey Simulation with notecards	DCP	
Topic 4: Ecology	Building an ecosystem	D	
Topic 5: Evolution and Biodiversity	Endangered Species or Vanishing species lab	CE	
Topic 5: Evolution and Biodiversity	Biodiversity Calculation Lab	DCP	
Topic 10: Genetics and Evolution	Hardy – Weinberg Lab	DCP	
Topic 10: Genetics and Evolution	Dichotomous Key Activity	CE	
Topic 10: Genetics and Evolution	Cladograms Activity	CE	
Topic 6: Human Physiology	Digestion: McMush Lab	DCP	
Topic 6: Human Physiology	Lights, camera, action potential	DCP	
Topic 6: Human Physiology	Physiology of the circulatory system Lab	CE	
Topic 11: Animal Physiology	Urinary System lab	CE	

Name of the topic	Experiment	Indicate the experiments you would use for assessing design (D), data collection and processing (DCP) and conclusion and evaluation (CE)	Any ICT used? <i>Remember you must use all five within your programme.</i>
Topic 11: Animal Physiology	Elasticity of arteries and veins (using weights to determine how far they stretched)	DCP	<p>The Vernier and PASCO interfaces and sensors will potentially be used for every experiment, so ICT will most likely be present in some shape or form in every laboratory exercise completed in this course.</p> <p>The majority of the activities will be used in conjunction with the Vernier lab book, sensors and probes which uses ICT's for their labs.</p>
Topic 9: Plant Biology	Classifying plants according to the kingdom, phylum	CE	
Topic 9: Plant Biology	Botany Lab- The effect of environmental factors on seed germination	DCP	
Topic 9: Plant Biology	Root and Stem Anatomy Lab	CE	
Option A: Neurobiology and behavior	Brain Cap Lab	D	
Option A: Neurobiology and behavior	Aggressive behavior in beta fish	CE	
Option C: Ecology and Conservation	Kaibab Deer population lab	CE	

3. Laboratory facilities

Describe the laboratory and indicate whether it is presently equipped to facilitate the practical work that you have indicated in the chart above. If it is not, indicate the timeline to achieve this objective and describe the safety measures that are applicable.

The IB HL Biology class will be taught in a combined classroom/laboratory facility with an attached stockroom. Dissectible are kept in the stockroom along with large equipment like spectrophotometers. The laboratory class has sixteen tables and thirty two chairs and a fume hood inside the lab. The Biology lab is equipped with a fire extinguisher, a fire blanket, and a first aid kit. Both a safety shower and an eyewash station are located in the attached stockroom. The stockroom is well stocked with chemicals, glassware and other lab equipment which includes hot plates, water bath, colony counter, microscopes, convection lab oven, lab coats, balances and electronic scales. There is also a locked cabinet for holds additional lab equipment including dissecting equipment and goggles. The lab is equipped with four lab sinks and teacher demonstration table. There are also numerous outlets in the room to plug microscopes and other electronic lab equipment. There are a total of twelve fully equipped laboratory rooms with six stockrooms.

We currently have ten PASCO devices, a charging station, and sets of probes. The probes include: Water Quality Sensors, Water Quality Colorimeters, Turbidity Sensors, Thermocline Sensors, Flow Rate and Water Temperature Sensors, ph sensors, Carbon Dioxide Gas Sensors and Oxygen Gas.

Additionally our school has secured \$10,000 in additional lab supplies from SPLOST funding. The science department is also allocated a yearly budget of \$12,000. Each year the budget is spent on replacing and purchasing new lab equipment.

4. Other resources

Indicate what other resources the school has to support the implementation of the subject and what plans there are to improve them, if needed.

There are eight computer labs throughout the school to conduct investigations. My classroom is also equipped with an LCD projector, document cameras, all-in-learning devices/ clickers, a moveable laptop cart, models of all body system and organs including skeleton model, lung model, brain model, heart model and kidney model.

All classrooms in our school will also be equipped with smart board technology by May of 2015. The science department currently has two fully equipped mobile laptop carts, two mobile promethean boards and has access to an iPad cart.

5. Links to TOK

You are expected to explore links between the topics of your subject and TOK. As an example of how you would do this, choose one topic from your course outline that would allow your students to make links with TOK. Describe how you would plan the lesson.

Topic	Link with TOK (including description of lesson plan)
Topic 5: Evolution and Biodiversity	<p>5.1 Evidence for Evolution 5.3 Classification of Biodiversity 5.4 Cladistics</p> <p>The evidence of evolution topic is closely linked with TOK. TOK explains that natural science is a system of the natural world largely based on observation and constructed using reason and imagination. TOK also explains that prediction and scientific inquiry are important features of scientific knowledge. In the same way when studying the evolution and biodiversity unit students will have to provide evidence for evolution using cladograms and fossils. By using evidence of fossils students are able to predict that evolution took place. Fossils prove evolution existed as it shows the varying remains of both species of animals or plants. Due to the science of investigating how old the fossil is, it can show how species and biodiversity can change over the course of time. In the same way studying cladistics would show how organisms are related and how they evolved over time, acquiring various adaptations in order to survive in their new environment. Collecting fossils and data from cladograms can also show how the environment or ecosystem changes over time causing both animal and plants to adapt to its environment. TOK encourages students to analyze scientific data and ask deeper questions and in the process creating hypotheses from evidence provided.</p>

6. International mindedness

Every IB course should contribute to the development of international mindedness in students. As an example of how you would do this, choose one topic from your outline that would allow your students to analyze it from different cultural perspectives. Briefly explain the reason for your choice and what resources you will use to achieve this goal.

Topic	Contribution to the development of international mindedness (including resources you will use)
The Group 4 project	For group 4 project students will be building a greenhouse which will seek to expand the understanding of how students can make greener choices. Building the greenhouse will assist students in learning the value of gardening for their own nourishment. Educating students about the importance of creating an environmentally clean and safe ecosystem is essential in today's world. It is not just about telling students what can be done to make greener choices; it is about designing experiences to allow the students to actually make them. A greenhouse will provide a cross curricular opportunity where students can build solar panels in chemistry and physics courses, investigate scientific concepts, and grow food that they can proudly share with the school community. Students will also learn about what conditions are best for agriculture and farming as well as the effects of climatic conditions around the world on limiting food supply and resources. By undertaking this new challenge of building a greenhouse students will be able to increase their awareness of their own strengths and areas for growth and make informed decisions about resources in their environment which will in turn globally benefit us all. By working collaboratively with others, students are also able to develop new skills, consider the ethical implications of their actions, engage with issues of global importance, and show perseverance and commitment in their activities.

7. Development of the IB learner profile

Through the course it is also expected that students will develop the attributes of the IB learner profile. As an example of how you would do this, choose one topic from your course outline and explain how the contents and related skills would pursue the development of any attribute(s) of the IB learner profile that you will identify.

Topic	Contribution to the development of the attribute(s) of the IB learner profile
Laboratory Activities	Inquiry: When students conduct hands on inquiry labs they are able to remember the material better, feel a sense of accomplishment when the task is completed, and be able to transfer that experience easier to other learning situations. When more than one method of learning is accessed as in hands-on learning, the information has a better chance of being stored in the memory for useful retrieval. Students who have difficulty in the learning arena for reasons of auditory deficiencies, or behavioral interference can be found to be on task more often because they are part of the learning process and not just spectators.

Topic	Contribution to the development of the attribute(s) of the IB learner profile
<p>Option C: Ecology and Conservation</p> <p>C.1 Species and Communities</p> <p>C.2 Communities and Ecosystems</p> <p>C.3 Impacts of Humans on ecosystems</p> <p>C.4 Conservation and Biodiversity</p>	<p>Knowledgeable: Whether it be the food we eat or the air or water we consume, human beings, like all other things that are alive, interact and depend upon the living and non-living components of the biosphere for survival. Yet in the general activity of daily life, it is easy to miss our dependency on the Earth's ecology. Food purchased from a grocery store, water retrieved from a tap, and air breathed as a matter of course, allow people to live without considering the rest of the world on which we rely. At the same time that people are living apparently separate from the environment, our impact on the Earth is increasing. As science teachers we provide the students with knowledge on said topics to bridge this persistent disconnect of daily life between ecology and human environmental impact on our ecosystems. For example deforestation and its impact on ecosystems or the increase use of automobiles which creates even more air pollution. In this unit we discuss ways to conserve and decrease our carbon footprint.</p>