Diploma Programme subject outline—Group 4: sciences

School name	Roald Amundsen High School	**School code**	1145
Name of the DP subject *(indicate language)*	Biology (*English*)		
Level *(indicate with X)*	Higher [ ] Standard completed in two years [X] Standard completed in one year * [ ]		
Name of the teacher who completed this outline	Peter Voss Todd Johnson	**Date of IB training**	August 2015 Chicago August 2015 Chicago
Date when outline was completed	2/23/2018	**Name of workshop** *(indicate name of subject and workshop category)*	DP BIology Cat 2 DP Biology Cat 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) *State the topics/units in the order you are planning to teach them.*	Contents	Allocated time One class is 50 minutes. In one week there are 5 classes.	Assessment instruments to be used	Resources *List the main resources to be used, including information technology if applicable.*
Year 1	6.5	Learning and Memory	4 days	Throughout the course, a basic structure exists in which students are asked to complete a note packet with syllabus statements and objectives. There is a unit quiz/test (modeled after IB exam structures), for each of the units outlined here.. Labs and other practical activities are distributed throughout, and listed below in the Practical Work section of this document. Mid-term and Final Exams are modeled after papers 1, 2 and 3 of the IB Biology Exam.	Computers/Internet (400x) Compound microscopes Vernier LabQuests with a variety of sensors Allott, A., & Mindorff, D. (2014). Biology Course Companion (2014 Ed.). Oxford, UK: Oxford University Press. IB Questionbank software (2nd and 3rd editions) Standard Lab Equipment (glassware/balances/etc.) Turnitin.com
	1.1 & 1.5	Cell Theory	7 days		
	1.1 & 1.2	Microscopy	5 days		
	1.2, 1.5, 3.2, 6.3	Prokaryotic Cells	5 days		
	1.2, 1.4, 1.5	Eukaryotic Cells	5 days		
	1.1, 3.5	Stem cells and differentiation	5 days		
	1.6, 3.2	Cell Division	6 days		
	1.6, 6.4, D.1	Cell Cycle and Cancer	6 days		
	1.3	Cell Membrane Structure	4 days		
	1.1, 1.4	Cell Membrane Transport	8 days		
	2.2	Water	4 days		
	2.1 and D.1	Intro to Molecular Biology	8 days		
	2.1, 2.3, D.1	Carbohydrates and Lipids	11 days		
	2.6, 3.5	Nucleic Acids	8 days		

	2.7, 3.5	DNA Replication	6 days		
	3.1, 3.2, 3.4	Genes and Genomes	8 days		
	3.2, 3.3, 3.4	Chromosomes	6 days		
	3.3, 3.4	Meiosis	8 days		
	3.4, D.1	Genetic Inheritance	8 days		
	5.1, 5.2	Natural Selection	8 days		
	5.1, 5.2, 6.3	Evidence for Evolution	5 days		
	4.1, 5.1	Speciation	5 days		
	5.3	Classification	3 days		
	5.3	Biodiversity	5 Days		
	5.3, 5.4 & D.1	Cladistics	8 Days		
	4.1	Communities and Ecosystems	4 Days		
	4.1 & 4.2	Energy Flow Through Ecosystems	5 Days		
	4.1 & 4.3	Nutrient Cycles	7 Days		
	4.4	Climate Change	5 Days		
Year 2	2.7	Gene Expression and Transcription	6 Days	Throughout the course, a basic structure exists in which students are asked to complete a note packet with	Computers/Internet (400x) Compound microscopes
	2.7	Translation	8 Days		

	2.7 & 3.5	Genetic Engineering	6 Days	syllabus statements and objectives. There is a unit quiz/test (modeled after IB exam structures), for each of the units outlined here.. Labs and other practical activities are distributed throughout, and listed below in the Practical Work section of this document. Mid-term and Final Exams are modeled after papers 1, 2 and 3 of the IB Biology Exam.	Vernier LabQuests with a variety of sensors Allott, A., & Mindorff, D. (2014). Biology Course Companion (2014 Ed.). Oxford, UK: Oxford University Press. IB Questionbank software (2nd and 3rd editions) Standard Lab Equipment (glassware/balances/etc.) Turnitin.com
	2.1, 2.4 & D.1	Protein Structure and Function	8 Days		
	2.1 & 2.5	Enzymes and Metabolism	9 Days		
	2.8	Respiration	11 Days		
	2.9	Photosynthesis	12 Days		
	6.1 & D.2	The Digestive System	11 Days		
	D.3	Liver Structure and Function	7 Days		
	1.4 & 6.5	Neural Structure and Function	5 Days		
	6.2, D.1 & D.4	The Heart	9 Days		
	6.2, 6.3, D.1 & D.4	The Circulatory System	7 Days		
	6.4	The Respiratory System	6 Days		
	6.3	Innate Immunity	3 Days		
	6.3	Acquired Immunity	4 Days		
	6.6 & D.1	Hormones and Homeostasis	9 Days		
	6.6	Reproductive Hormones	7 Days		

2. 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 duration of our school’s IB tenure, we have only offered Biology as a DP science course. The Group IV project, therefore, has only included students of Biology, and not of other subjects. Nevertheless, an effort is made to incorporate the other sciences as we investigate water quality in the Chicago River and its watershed. Students are divided into 3 groups: One group investigates water quality and assesses it using a benthic macroinvertebrate index. A second group investigates water quality and assesses it with chemical analysis. The third group investigates the watershed, and assesses the physical parameters of the river (flow rate, bank erosion, canopy cover, bottom profile, etc.).

Students then reconvene into “home groups” to share their findings and do a comprehensive assessment of the water quality. Data is contributed to a database maintained by the “Friends of the Chicago River - River Schools Network”, and students attend and present at the annual Chicago River Student Congress.

The 2019 test session will be the first time that our school is testing in both Chemistry and Biology, so the project will be re-evaluated for next year.

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

As you know, students should undergo practical work related to the syllabus.

- Physics, chemistry and biology: 40 hours (at standard level) or 60 hours (at higher level)
- Computer science: 40 hours (at standard level) or 40 hours (at higher level)
- Design technology: 60 hours (at standard level) or 96 hours (at higher level)
- Sport, exercise and health science: 40 hours (at standard level) or 60 hours (at higher level)

Use the table below to indicate the name of the experiment you would propose for the different topics in the syllabus.

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

Name of the topic	Experiment	Any ICT used? *Remember you must use all five within your programme.*
Acids and bases	Titration	Yes
Cell Biology	Microscopy Lab (Practical #1)	
Cell Biology	Mitotic Index Lab	
Cell Biology	Smoking and Lung Cancer Deaths Correlation Lab	Database mining
Cell Biology	Oreo Cookie Lab	
Cell Biology	Effect of Alcohol on Membranes	Vernier Colorimeter data logging
Cell Biology	Osmolarity lab (Practical #2)	Spreadsheet / Graphing
Molecular Biology	Properties of Water Lab	
Molecular Biology	Molecular modeling lab - physical models and computer models	J-mol, 3-D molecular modeling
Molecular Biology	Drawing and Identifying biochemicals	
Molecular Biology	Calorimetry Lab	Vernier Temperature probe data logging
Molecular Biology	Gel Electrophoresis Lab	
Genetics	DNA Sequencing and Gene Loci Lab	Database mining
Genetics	Student Time Lapse Videos of Meiosis	
Evolution	Natural Selection Simulation Lab from learn.concord.org and/or Peppered Moth Simulation	Computer model/simulation
Evolution	Classification of preserved specimen lab	

Evolution	Dichotomous Key Lab	
Evolution	DNA Blast / Cladogram construction and analysis	Database / computer modeling
Ecology	Quadrat Sampling Lab	Spreadsheet / Graphing / Chi-square
Ecology	Sealed Mesocosm Lab (Practical #5)	
Ecology	Calculating Carbon Footprints Lab	
Ecology	The Carbon Cycle and the Greenhouse Effect Data Lab	Database (mauna loa)
Molecular Biology	Modeling Transcription and Translation Simulation Lab	Computer model
Genetics	Mutations Simulation Lab	
Molecular Biology	Protein Structure modeling	
Molecular Biology	Modeling Enzyme Function	
Molecular Biology	Factors affecting Enzyme Reaction Rate (Practical # 3)	Data logging / spreadsheets / graphing
Molecular Biology	Cell respiration in Yeast	Data logging / spreadsheets / graphing
Molecular Biology	Plant pigment chromatography (Practical #4)	
Molecular Biology	Photosynthesis / waterweed simulation lab	Computer simulation / modeling
Molecular Biology	Photosynthesis design lab	
Human Physiology	Starch digestion lab	
Human Physiology	Modeling the small intestine lab	
Human Physiology	Heart sounds and blood pressure lab	Data logging

Human Physiology	Factors affecting heart rate design lab	Data logging / spreadsheet / graphing
Human Physiology	Measuring EKG Demonstration lab	Data logging
Human Physiology	Monitoring ventilation in humans lab (Practical #6)	Data logging / spreadsheet / graphing
Human Physiology	Reaction time lab	

4. 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.

Laboratory facilities are typical high school labs, equipped with running water, gas, ventilation system, eyewash station, etc., and stocked with typical safety equipment, balances, hot plates, glassware, etc. We have class sets of Vernier LabQuest data loggers with a variety of sensors and probes.

5. 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.

The school also has a state-of-the-art maker lab which is available to support the design and 3d printing of scientific models. While there are no immediate plans to utilize this lab, it is possible that this resource may be utilized in the future.

6. 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)
4.4 Climate change	The precautionary principle is meant to guide decision-making in conditions where a lack of certainty exists. Is certainty ever possible in the natural sciences? In jigsaw groups, students will examine a number of superseded scientific theories, and the evidence that was thought to support them and new evidence that was then later used to refute or revise them. Students will then be given a number of data sets and popular media sources about climate change. They will critically evaluate the validity of the source information (4.4.A3 - Evaluating claims that human activities are not causing climate change) and compose a written reflection in answer to the question "How certain are we that human activities are causing climate change?"

7. Approaches to learning

Every IB course should contribute to the development of students' approaches to learning skills. As an example of how you would do this, choose one topic from your outline that would allow your students to specifically develop one or more of these skill categories (thinking, communication, social, self-management or research).

Topic	Contribution to the development of students' approaches to learning skills (including one or more skill category)
1.1 Stem cells	As part of the study of stem cells, students will participate in a debate where they are asked to assume the role of a person with a personal interest in the issue surrounding the issues. This activity allows for the development of all five of the ATL skills as they research their assigned roles and then participate in an open forum setting using communication and social skills to drive the discussion around the topic of stems cells.

8. 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 analyse 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)

4.4 Climate change	Students will analyze potential changes due to climate change around the world. There will be a degree of student choice, but there will also be overall requirements that the class address locations around the globe (low lying coastal / island nations, agricultural nations where precipitation changes may occur, etc). In all cases, students will be instructed to consider effects on ecosystems, potential effects economic / trade / industrial production, potential effects on food production / distribution, potential effects on human population distribution, etc. Students will have access to internet and computers for gathering information on various countries topography, demographics, industry and etc., and will be guided to comprehensive and reputable data sources on effects of climate change, including - NASA - https://climate.nasa.gov/effects/ NOAA - https://www.climate.gov/maps-data IPCC - http://www.ipcc.ch/ipccreports/tar/wg2/index.php?idp=21 EPA - https://19january2017snapshot.epa.gov/climate-impacts/international-climate-impacts_.html (archived) Students will prepare summary posters of their findings for display in the school common areas to raise awareness of the international impacts of climate change.

9. 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
1.1 - Stem Cells	As part of the study of stem cells, students will participate in a debate where they are asked to assume the role of a person from all areas of the issue; political, social, professional, etc. In doing so, students will develop many of the attributes of the IB Learner Profile including becoming knowledgeable, thinkers, communicators, principled,

	open-minded, caring, and risk takers as they may assume roles that fall outside of their own views. Students are given time to research the opinions of their assigned person in the debate and then asked to act out their assigned position in an open discussion facilitated by the teacher.