IB Biology Y2: Cell Development Unit

Teacher(s)	IB Biology PLC	**Subject group and course**	Group 4/IB Biology Y2 SL		
Course part and topic	Unit 3: Genetics Y1 Review Topics 1.1,1.2,2.6,2.7 Y2 Focus 3.1-3.3, 5.2	**SL or HL/Year 1 or 2**	SL Y2	**Dates**	7 weeks
Unit description and texts		**DP assessment(s) for unit**			
Pearson IB Biology Textbook: Review Y1 Units 1-4 Phenomenon: Stem cell research offers great promise for understanding basic mechanisms of human development and differentiation, as well as the hope for new treatments for diseases. Design Lab: Plant Propagation Debate Topic: Genetic Modification of Organisms Discussion: Ethical Considerations for Stem Cell Research		• Unit Summative assessment • Projects/Practicals • Formative/Summative assessment quizzes per subtopic to check for understanding			

INQUIRY: Establishing the purpose of the unit

Unit Statement of Inquiry: Advancements in biotechnology supports complex research into the inheritance patterns and genetics of all living things.

Essential Ideas/Inquiry Statements per Subtopic: See Units 1-4 from Y1 for the Review Topic info.
Every living organism inherits a blueprint for life from its parents.
Chromosomes carry genes in a linear sequence that is shared by members of a species.
Alleles segregate during meiosis allowing new combinations to be formed by the fusion of gametes.
The diversity of life has evolved and continues to evolve by natural selection.

Core Ideas: Cell Cycle/DNA Replication/Meiosis/Asexual vs. Sexual Reproduction/Viruses and Prokaryotes/Mitosis/Binary Fission/Stem Cells and Treatment (Revisit)

Phenomenon: Stem cell research offers great promise for understanding basic mechanisms of human development and differentiation, as well as the hope for new treatments for diseases.

Crosscutting Concepts- Structure and Function/Systems and Systems Models/Patterns

ACTION: teaching and learning through inquiry

Content/skills/concepts—essential understandings **U = Understandings** **NOS = Nature of Science** **A = Applications** **S = Skills**	**Learning process** Pedagogical approaches used during the unit. Aim for a variety of approaches to help facilitate learning.
Students will know the following content/Students will grasp the following concepts: 3.1 Genes Understandings: • A gene is a heritable factor that consists of a length of DNA and influences a specific characteristic. • A gene occupies a specific position on a chromosome. • The various specific forms of a gene are alleles. • Alleles differ from each other by one or only a few bases. • New alleles are formed by mutation. • The genome is the whole of the genetic information of an organism. • The entire base sequence of human genes was sequenced in the Human Genome Project. Applications and skills: • Application: The causes of sickle cell anemia, including a base substitution mutation, a change to the base sequence of mRNA transcribed from it and a change to the sequence of a polypeptide in hemoglobin. • Application: Comparison of the number of genes in humans with other species. • Skill: Use of a database to determine differences in the base sequence of a gene in two species. 3.2 Chromosomes Understandings: • Prokaryotes have one chromosome consisting of a circular DNA molecule. • Some prokaryotes also have plasmids but eukaryotes do not. • Eukaryotic chromosomes are linear DNA molecules associated with histone proteins. • In a eukaryotic species there are different chromosomes that carry different genes. • Homologous chromosomes carry the same sequence of genes but not necessarily the same alleles of those genes. • Diploid nuclei have pairs of homologous chromosomes.	Learning experiences and strategies/planning for self-supporting learning: ❑ Socratic Seminar ✓ Small Group/Pair Work ✓ PowerPoint Lecture Notes ❑ Individual Presentations ✓ Group Presentations ❑ Student Lecture/Leading the class ✓ Interdisciplinary Learning ✓ Student designed investigations ✓ Using lab protocols for biotechnology techniques Details: Modeling, Think/Pair/Share, CER, Writing Prompts, Videos, etc. Accommodations: SWD/504 – Accommodations Provided ELL – Reading & Vocabulary Support Intervention Support Extensions – Enrichment Tasks and Project

• Haploid nuclei have one chromosome of each pair. • The number of chromosomes is a characteristic feature of members of a species. • A karyogram shows the chromosomes of an organism in homologous pairs of decreasing length. • Sex is determined by sex chromosomes and autosomes are chromosomes that do not determine sex. Applications and skills: • Application: Cairns' technique for measuring the length of DNA molecules by autoradiography. • Application: Comparison of genome size in T2 phage, Escherichia coli, Drosophila melanogaster, Homo sapiens and Paris japonica. • Application: Comparison of diploid chromosome numbers of Homo sapiens, Pan troglodytes, Canis familiaris, Oryza sativa, Parascaris equorum. • Application: Use of karyograms to deduce sex and diagnose Down syndrome in humans. • Skill: Use of databases to identify the locus of a human gene and its polypeptide product. 3.3 Meiosis Understandings: • One diploid nucleus divides by meiosis to produce four haploid nuclei. • The halving of the chromosome number allows a sexual life cycle with fusion of gametes. • DNA is replicated before meiosis so that all chromosomes consist of two sister chromatids. • The early stages of meiosis involve pairing of homologous chromosomes and crossing over followed by condensation. • Orientation of pairs of homologous chromosomes prior to separation is random. • Separation of pairs of homologous chromosomes in the first division of meiosis halves the chromosome number. • Crossing over and random orientation promotes genetic variation. • Fusion of gametes from different parents promotes genetic variation. Applications and skills: • Application: Non-disjunction can cause Down syndrome and other chromosome abnormalities.	Guidance: Students should be able to recall one specific base substitution that causes glutamic acid to be substituted by valine as the sixth amino acid in the hemoglobin polypeptide. The number of genes in a species should not be referred to as genome size as this term is used for the total amount of DNA. At least one plant and one bacterium should be included in the comparison and at least one species with more genes and one with fewer genes than a human. The Genbank® database can be used to search for DNA base sequences. The cytochrome C gene sequence is available for many different organisms and is of particular interest because of its use in reclassifying organisms into three domains. Deletions, insertions and frameshift mutations do not need to be included. The terms karyotype and karyogram have different meanings. Karyotype is a property of a cell—the number and type of chromosomes present in the nucleus, not a photograph or diagram of them. Genome size is the total length of DNA in an organism. The examples of genome and chromosome number have been selected to allow points of interest to be raised. The two DNA molecules formed by DNA replication prior to cell division are considered

• Application: Studies showing age of parents influences chances of nondisjunction. • Application: Description of methods used to obtain cells for karyotype analysis e.g. chorionic villus sampling and amniocentesis and the associated risks. • Skill: Drawing diagrams to show the stages of meiosis resulting in the formation of four haploid cells. NOS Developments in scientific research follow improvements in technology—gene sequencers are used for the sequencing of genes. (1.8) Developments in research follow improvements in techniques—autoradiography was used to establish the length of DNA molecules in chromosomes. (1.8) Making careful observations—meiosis was discovered by microscope examination of dividing germ-line cells. (1.8) Use theories to explain natural phenomena—the theory of evolution by natural selection can explain the development of antibiotic resistance in bacteria. (2.1)	to be sister chromatids until the splitting of the centromere at the start of anaphase. After this, they are individual chromosomes. Preparation of microscope slides showing meiosis is challenging and permanent slides should be available in case no cells in meiosis are visible in temporary mounts. Drawings of the stages of meiosis do not need to include chiasmata. The process of chiasmata formation need not be explained. Students should be clear that characteristics acquired during the lifetime of an individual are not heritable. The term Lamarckism is not required.
Students will be assessed with classwork, discussions, group work, and reflections using a variety of formats with a focus on the applications and skills provided in the syllabus.	**Formative assessment:** ✓ Quiz/Test ✓ Project/Model ✓ Lab Report ✓ Data Analysis ✓ CER/Reflection ✓ Essay/Writing Assignment

Students will be assessed per subtopic and then at the end of the unit (Topic) to ensure understanding using IB exam style questions, modeling, reflection, lab reports, and writing prompts	**Summative assessment:** ✓ Quiz/Test ✓ Project/Model ✓ CER/Reflection ✓ Essay/Writing Assignment ✓ Lab Report ✓ Data Analysis
Students may be aware of many of the concepts within this unit, so building on prior knowledge using scaffolding techniques to aid students in a deeper understanding and extending learning to ensure that students can meet the goals set by the unit.	Differentiation: Affirm Identity - build self-esteem Value Prior Knowledge Scaffold Learning Extend Learning Details: Many concepts may be familiar to the students and others will need more scaffolding and extension.

Approaches to learning (ATL)

Check the boxes for any explicit approaches to learning connections made during the unit. For more information on ATL, please see the guide.

- ✓ Thinking - Asking questions and defining problems
- ✓ Social Communication- Constructing Explanations/Engaging in Argument from Evidence
- ✓ Self-management - Carrying out Investigations
- ❏ Research- Developing and using models

Language and learning	**TOK connections**	**CAS connections**
Check the boxes for any explicit language and learning	Check the boxes for any explicit TOK connections	Check the boxes for any explicit CAS connections. If

connections made during the unit. For more information on the IB's approach to language and learning, please see the guide.	made during the unit	you check any of the boxes, provide a brief note in the "details" section explaining how students engaged in CAS for this unit.
✓ Activating Background Knowledge ✓ Scaffolding for new learning ✓ Acquisition of new learning through practice ✓ Demonstrating proficiency Students rely on previous vocabulary in order to set a basis for understanding. New terminology and use of language will be scaffolded throughout the unit, as students work to be able to utilize new vocabulary clearly and in correct context in written assignments.	✓ Personal and Shared Knowledge ❑ Ways of Knowing ✓ Areas of Knowledge ❑ The Knowledge Framework Details: There is a link between sickle cell anemia and prevalence of malaria. How can we know whether there is a causal link in such cases or simply a correlation? Sequencing of the rice genome involved cooperation between biologists in 10 countries. In 1922 the number of chromosomes counted in a human cell was 48. This remained the established number for 30 years, even though a review of photographic evidence from the time clearly showed that there were 46. For what reasons do existing beliefs carry a certain inertia? Natural Selection is a theory. How much evidence is required to support a theory and what sort of counter evidence is required to refute it?	❑ Creativity ❑ Activity ❑ Service Details: Modeling and active participation in the learning process. Creating materials to aid their fellow classmates in understanding a particular concept through peer interaction and team/group activities.

International Mindedness/Aims:

International Mindedness: (Research/Reflections/Writing)
Sequencing of the human genome shows that all humans share the vast majority of their base sequences but also that there are many single nucleotide polymorphisms that contribute to human diversity

Sequencing of the rice genome involved cooperation between biologists in 10 countries.
Aims: (Practicals/Activities/Student Reflections/CER Activities)

Aim 7: The use of a database to compare DNA base sequences. Aim 8: Ethics of patenting human genes. Aim 6: Staining root tip squashes and microscope examination of chromosomes is recommended but not obligatory. • Aim 7: Use of databases to identify gene loci and protein products of genes. Aim 8: Pre-natal screening for chromosome abnormalities gives an indication of the sex of the fetus and raises ethical issues over selective abortion of female fetuses in some countries.

Resources
Damon, A.; McGonegal, R.; Tosto, P.; Ward, W. Standard level biology; Pearson Education Limited: Harlow, Essex, 2014. Greenwood, T.; Pryor, K.; Bainbridge-Smith, L.; Allan, R. Environmental science: student workbook; Biozone International: Hamilton, New Zealand, 2013. Van de Lagemaat, R. www.inthinking.net: Andorra la Vella, Andorra, 2019. IB Biology Schoology Course

Stage 3: Reflection—considering the planning, process and impact of the inquiry

What worked well List the portions of the unit (content, assessment, planning) that were successful	**What didn't work well** List the portions of the unit (content, assessment, planning) that were not as successful as hoped	**Notes/changes/suggestions:** List any notes, suggestions, or considerations for the future teaching of this unit