COURSE: Grade 12 Biology, University Preparation Level COURSE CODE: SBI4U

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| Unit of Study: Molecular Genetics | | |
| Curriculum: What will students learn? | Summary:  *The focus of this unit is on learning about the structure and function of DNA, determining its genetic code, understanding replication and base pairing, exploring the central dogma of genetics to understand protein synthesis, performing DNA extraction and fingerprinting and evaluating current applications of biotechnology.* | Overall Expectations:  D1. analyse some of the social, ethical, and legal issues associated with genetic research and biotechnology;  D2. investigate, through laboratory activities, the structures of cell components and their roles in processes that occur within the cell;  D3. demonstrate an understanding of concepts related to molecular genetics, and how genetic modification is applied in industry and agriculture  Key Questions:  - What is DNA and its structure?  - What is the genetic code and how does it relate to base pairing?  - How can we extract DNA and what application does it have to biotechnology?  - What is the central dogma of genetics and how does it work on the cellular level?  - How does protein synthesis work?  - How does molecular genetics and biotechnology impact human health, society and the environment? |

Unit Plan: Molecular Genetics

Important Notes: One Day is one 75 minute period. Major evaluations and due dates are in bold print.

Learning Skills (LS) Key: R = Responsibility, O = Organization, IW = Individual Work, C = Collaboration, I = Initiative, SR = Self-Regulation

Achievement Categories (AC) Key: K/U = Knowledge/Understanding, T/I = Thinking/Investigation, C = Communication, A = Application

Textbook pages referenced are from Biology 12, McGraw-Hill Ryerson, 2011 unless otherwise specified.

Since this is the third unit of the year, in-depth safety lessons are not specifically taught, just reviewed. If this plan is used as the first unit of the year, it is imperative that at least two safety lessons must be taught at the beginning of the unit.

| Topic | Day | Concept/Subtopic and Learning Goals | Teaching & Learning Strategies  Learning Skills | Assessment (A) and Evaluation (E) | Expectations |
| --- | --- | --- | --- | --- | --- |
| Genetics Introduction  DNA Structure Part 1 | 1-2 | Introduction to Genetics Unit.  Safety review  Inquiry investigation to extract DNA.  History of scientific research to determine DNA structure.  By the end of the lesson, students will be able to understand the molecular structure of DNA and RNA, and their purpose in genetics; understand the background of scientific research that went into isolating and identifying the DNA molecule. | Jigsaw safety review  Strawberry/Banana DNA investigation 5-A  p. 230-231 **(LS) C,I (AC) T/I**  Use think/pair/share to review genetic background knowledge and mitosis/meiosis from SBI3U**. (LC) C, SR (AC) K/U,C**  Brief lecture (powerpoint) explaining specific detail of DNA: significance and application.  Use Gizmos lesson “Building DNA” as an introduction to structure of DNA and to compare DNA to RNA  - <http://www.explorelearning.com/>  **(LS) IW,C (AC) K/U,T/I,A** | A: **Diagnostic:** review of diagrams and terms through discussion  A: **for learning:**  HW: Unit preparation p. 190-201  **Due next class** | A1.1, A1.2  A1.4, A1.6,  A1.8, D2.3  D3.2  D3.7  D2.1  D3.1 |
| DNA Structure and Replication  Part 2 | 3 | Students will use drawing materials to sketch and understand the DNA structure. The process of replication will also be introduced.  By the end of the lesson, students will be able to: identify and describe the DNA structure; be able to draw the structure of DNA.  Introduce Culminating Project and Ontario Science Centre trip. | Interactive online lesson with sketches, reading and using research to answer questions. Students work in pairs, sharing a computer. Use the following site:  <http://biologycorner.com/worksheets/DNAcoloring.html>  <http://www.biologycorner.com/bio1/DNA.html>  **(LS) O,C,SR**  **(AC) K/U,T/I,C,A**  Introduction of Genetics in the News Culminating Project  “Thumbs up” check for understanding of vocabulary on the handout explaining culminating project after going over expectations and due dates**. DUE: Day 13**  Introduction of DNA Fingerprinting Lab field trip to Ontario Science Centre. Pass out and explain information sheets and trip permission forms**. DUE: Day 6** | A**: as and of learning**:  Assess understanding as sketches are drawn, **E:evaluate** **Assessment of learning** when the sketches and questions are handed in with Marking Scheme  **A: assessment as learning** collaborative work as students work with each other to match base pairs.  **Assessment as learning**:  HW: read p. 204-218 | D2.1  D2.2  D3.1  A1.3, A1.7,  A1.8, A1.9, D1.1, D1.2,  D3.6 |
| DNA replication  Part 3 | 4-5 | Presentation of DNA structure and Replication with video and magnetic model  Describe processes involved in DNA replication visually, verbally, and physically.  By the end of the lesson students will be able to describe the DNA replication process with all the enzymes involved.  Introduce STSE | Video: The Replication Fork  <http://www.youtube.com/watch?v=OKBVDCpAipU&feature=related>  Demonstration with magnetic model of DNA Structure and Replication ([www.virtmac.com](http://www.virtmac.com)) DNA /RNA Protein kit  Students create a DNA replication sketches with explanation notes from demo on board: DNA Replication  **Sketches due: Day 9.**  **(LS) R,O,IW,SR**  **(AC) T/I,C,A**  Students will have 15 minutes in groups of 3 to read over the STSE assignment on pg 316-317 “Genetically Modified Animals”. In Jigsaw form each member of the group will take one of the three questions to research for homework.  **Due: Day 9** | A**: as and of learning**:  Assess understanding as sketches are drawn,  **E**: **evaluate** learning when the sketches are handed in with marking scheme.  Sketches  (due day 8)  **Assessment as learning**:  HW: read p.219-229, research STSE question | D2.1  D2.2  D3.1  A1.8, D1.1, |
| Protein Synthesis | 6-7 | DNA Structure and Replication Part 3  Central Dogma, Transcription, Translation.  By the end of the lesson students will be able to describe the processes of transcription and translation in detail visually and in written form.  Preparation for DNA Lab | DNA Structure and Replication Quiz (vocabulary and process)  Visual lecture of processes using overhead, video, powerpoint, etc.  <http://www.youtube.com/watch?v=PEDQoQuIhkg>  <http://www.youtube.com/watch?v=41_Ne5mS2ls&feature=related>  Students work together in pairs to complete Activity 6.2 “Transcription in Reverse”, pg. 261  (**LS) R,C,SR**  **(AC) K/U,T/I,A**  K-W-L chart to prepare for DNA Lab | E: written quiz with percentage correct out of 25 possible marks.  **Assessment as learning**: Day 5  HW: read p.242-256  **Assessment as learning**: Day 6  HW: read p.257-265  A: Formative: Activity 6.2 checklist | D3.3  D2.1  D2.4  D3.2 |
| DNA Finger-printing Lab | 8  9 | DNA Fingerprinting Lab  By the end of the activity students will experience first-hand the technology of PCR and Gel electrophoresis used to amplify DNA | Ontario Science Centre DNA Fingerprinting Lab  Work period in class to complete and work on formal lab report and meet in groups to finish STSE project. Students will hand in project for teacher suggestions/revisions.    **Lab report due day 11.**  **Sketches due today.**  **(LS) R,O,C,I,SR**  **(AC)K/U,T/I,C,A** | **Due: DNA sketches**  **Assessment as learning:** collaboration and investigative skills – teacher observation anecdotal notes  **Assessment of learning:**  Formal Lab report: rubric | D2.3  A1.1, A1.2, A1.4, A1.5, A1.6, A1.8  D1.1  D1.2  D3.5, D3.6, D3.7 |
| Lac Operon Mutations; Gene Expression | 10-11 | Explanation of lac operon  Magnetic model of operons  Single-gene and Chromosome Mutations  Gene expression and epigenetics  Learning goals: Students will understand and be able to communicate the process of lac operon, explain the various mutations and their effects, and discuss gene expression and its application. | Show video explaining lac operon  <http://www.youtube.com/watch?v=Y3dyxgSdKs4>  Presentation of Lac Operon with magnetic model kit  ([www.virtmac.com](http://www.virtmac.com)) DNA /RNA Protein kit  Students will fill out a mutation hand out using information from their textbook pgs. 262-266  Concept attainment exercise for gene expression and epigenetics. Written assignment after class exercise.  **(LS) R,C,IW,I,SR**  **(AC) K/U,C,A**  **DNA Fingerprinting Lab Due** | **Assessment as learning:**  Assessment of answers and results of concept attainment.  HW: read p.267-277  **Assessment of learning:**  Rubric for written assignment  Lab rubric | D2.1  D3.4 |
| Bio-technology | 11-12 | Students will choose from a list of biotechnology issues in current events and develop arguments for and against in pairs.  By the end of the lesson students will have an awareness of biotechnology in the modern world and analyse their implications. | **Vocabulary quiz on lac operon, mutations concepts**  **Fingerprinting lab due.**  Introduce and discuss current issues in biotechnology (i.e. GMO, patents, DNA fingerprinting, cloning, growth hormones, etc.)  Pairs of students choose a topic and develop arguments for and against the issue using research and citing from current sources (i.e. newspaper, magazines, journals, etc.)  Arguments can be presented as oral debates  **(LS) C,I, SR**  **(AC) K/U,C,A** | **Assessment of learning**: quiz and Fingerprinting Lab – rubric evaluation  **Assessment as learning**  HW: read p.294-310  E: Oral debate -rubric | D1.1  D1.2  D2.1  D3.5  D3.6 |
| Culminating Activity | 13-  14 | Summative: Students will fulfill expectations from strand A and D concerning researching and presenting scientific information | **Presentation of Poster project, “Genetics in the News”**  Students will evaluate and analyse classmates’ projects with summary sheet handout.  **(LS)R,IW,SR**  **(AC) K/U,C,A** | E: Culminating Project rubric  Assessment as learning: summary sheet - checklist | A1.3, A1.7, A1.8, A1.9, D3.6 |
| Review period | 15-16 | Students are to use the period to review and ensure they are prepared for the unit test. | Lesson could include jeopardy, trivia, group/teamwork, etc.  **LS: R, IW (students ensure they study)**  **I (students clarify concepts)**  **C (students work together to review)**  **(AC) K/U,A** | A: formative | All of strand D |
| Unit Test | 17  18 | Summative learning goals: students demonstrate knowledge, understanding and application of the unit materials. Students will apply thinking and communication skills as they write their unit test.  Feedback from their results | **Students write unit test**  **(AC) K/U,T/I,C,A**  Students will receive results from test performance | E: Unit Test  Assessment as learning: learn from mistakes made | All of strand D  Strand D |

**Considerations for Unit Plan Instruction:**

Differentiated instruction, Environmental Education as noted in “Shaping Our Schools, Shaping Our Future” with hands-on activities, sketching, online modules, laboratory investigations, cooperative learning, individual research and peer evaluations are some of the methods of teaching utilized in this unit. The STSE assignment provides a rich context for learning and gives an opportunity for internalizing information and producing an impact in the students’ world. Visual diagrams, videos, and interactive sketching activities have been incorporated into the lessons described above which will help all students to visualize the abstract structures and processes.

**Accommodations for Special Needs and English Language Learners (ELL):**

The differentiated instruction as outlined above with many kinaesthetic activities, technology and multimedia experiences integrated throughout will be conducive to students with special needs and English Language Learners. Cooperative learning groups will also be helpful. The performance tasks such as the STSE and Culminating Task can be accommodated for particular abilities. Individual Education Plans (IEP) documents will be reviewed for each student and accommodations and/or modifications may be made for homework assignments, projects and assignments.

Special Needs Students:

Examples of accommodations for special needs students are providing these students with extra time, computer options, strategic seating, assistive technology, etc. as outlined in their IEP. Also additional practice sheets as needed could be provided to allow students to practice naming and drawing the structure of DNA, DNA replication and protein synthesis. If the range of abilities in your class is appropriate, consider a heterogeneous group tutoring approach during individual work time and review periods.

English Language Learners:

Sensitivity to the level of English literacy is a very important component of this unit. Every time a new concept is introduced with vocabulary and term-specific assignments, the teacher should perform a diagnostic test for the ELL. It may be a simple oral check such as asking for a “thumbs up” from the students if they understand the concept (see example on day 3 of the unit overview) or the “1-2-3 strategy where the students can identify their level of understanding to the teacher. They may also write any explanations or words that would be of help to them on their flashcards in their own language. Posting a word wall with the names specific to the structure of DNA and the process of DNA replication and protein synthesis will be of help to the entire class. Vocabulary quizzes will be given as learning assessments at two different points in this unit. (See day 4 and 11 above) Peer tutoring can be easily implemented in the partner assignments and lab investigations.

Gifted students can be challenged to complete extensions on topics covered in class to their everyday lives, such as extending current research in biotechnology and its applications, further developments in decoding the human genome, public policy in CFIA and Health Canada, etc.

**Annotated References:**

Print resources used:

Gerards, Susan et al (2011). Biology 12. Toronto: McGraw-Hill Ryerson. Homework assignments are from this textbook.

MacLellan, John, VirtMac DNA/RNA Protein Kit. Ordered from www.virtmac.com.

Electronic resources used:

YouTube videos:

DNA Structure and Replication: - <http://www.explorelearning.com/>

DNA Replication: <http://www.youtube.com/watch?v=OKBVDCpAipU&feature=related>

Protein Synthesis: <http://www.youtube.com/watch?v=PEDQoQuIhkg>

Protein Synthesis: <http://www.youtube.com/watch?v=41_Ne5mS2ls&feature=related>

Lac operon demo: <http://www.youtube.com/watch?v=Y3dyxgSdKs4>

Websites:

DNA coloring worksheet: <http://biologycorner.com/worksheets/DNAcoloring.html>

DNA description and diagrams: <http://www.biologycorner.com/bio1/DNA.html>

Boulware, B J. (2008). [Using the Concept Attainment Strategy to Enhance Reading Comprehension](http://simplelink.library.utoronto.ca/url.cfm/111075). The Reading Teacher, 61(6), 491-495.