**COURSE: Grade 12 Biology, University Preparation Level**

**COURSE CODE: SBI4U**

Written by Vega Lee, Christel Mokono, and Jocelyn Paas

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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 | 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** | E: Unit Test | All of strand D |
| Unit Test result review | 18 |  | Students will receive results from test performance | Assessment as learning: learn from mistakes made | 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.

**Submitted by V. Lee. C. Mokono and J. Paas**

# SBI4U Teacher Resource

**Discerning Truth from Fiction in the News**

**A Culminating Task within the SBI4U Molecular Genetics Unit**

by Vega Lee, Christel Mokono, Jocelyn Paas

Objective:

1. The students will gain discernment while evaluating the accuracy of mainstream news articles about Genetics topics.

2. The students will integrate and apply concepts learned in the Molecular Genetics Unit.

3. Students will learn about biotechnology from their research and from evaluating the research of their peers.

**Ministry Expectations Fulfilled**:

D1. analyse some of the social, ethical, and legal issues associated with genetic research and biotechnology;

D3. demonstrate an understanding of concepts related to molecular genetics, and how genetic modification is applied in industry and agriculture

D1.1 analyse, on the basis of research, some of the social, ethical, and legal implications of biotechnology (e.g., the bioengineering of animal species, especially those intended for human consumption; the cultivation of transgenic crops; the patenting of life forms; cloning) [IP, PR, AI, C]

D2.1 use appropriate terminology related to molecular genetics, including, but not limited to: polymerase I, II, and III, DNA ligase, helicase, Okazaki fragment, mRNA, rRNA, tRNA, codon, anticodon, translation, transcription, and ribosome subunits [C]

D3.5 describe some examples of genetic modification, and explain how it is applied in industry and agriculture (e.g., the processes involved in cloning, or in the sequencing of DNA bases; the processes involved in the manipulation of genetic material and protein synthesis; the development and mechanisms of the polymerization chain reaction)

D3.6 describe the functions of some of the cell components used in biotechnology (e.g., the roles of plasmids, restriction enzymes, recombinant DNA, and vectors in genetic engineering)

A1.3 identify and locate a variety of print and electronic sources that enable them to address research topics fully and appropriately

A1.7 select, organize, and record relevant information on research topics from a variety of appropriate sources, including electronic, print, and/or human sources, using suitable formats and an accepted form of academic documentation

A1.8 synthesize, analyse, interpret, and evaluate qualitative and/or quantitative data to determine whether the evidence supports or refutes the initial prediction or hypothesis and whether it is consistent with scientific theory; identify sources of bias and/or error; and suggest improvements to the inquiry to reduce the likelihood of error

A1.9 analyse the information gathered from research sources for logic, accuracy, reliability, adequacy, and bias

**Rationale**:

Several expectations of the Molecular Genetics Unit in SBI4U require students to be literate concerning current biotechnology discoveries and processes. One primary way to gain this knowledge is from current news reports. Yet how can students be sure that what they are reading is completely true, sensationalized, or worse yet, misrepresented for the author’s agenda?

This culminating project has three purposes:

1. Teach students to be discerning when reading Genetics news

2. Provide opportunities for students to gain knowledge of current Genetic technologies through research and reading their peers’ work

3. Equip students with inquiry and Investigation skills through implementing research techniques.

**The Content Strategy**

1. Students will find a mainstream article from a source available to all readers, i.e. magazine, newspaper, radio, television, documentary, electronic news, etc. that describes a recent advancement in Genetic biotechnology

2. Students will note science journals or articles that are mentioned in the mainstream article and try to locate them.

3. Students will look online or at the reference library for peer reviewed articles from science publications that discuss the Genetics topic in the mainstream article. **At least three peer reviewed articles must be located.**

4. Students will evaluate the accuracy and legitimacy of the mainstream article by comparing it to the scientific articles in the following criteria:

a) the general accuracy of the information portrayed in the mainstream news

b) common variables within the scientific research and the mainstream article

c) information within the research that is contradictory, problematic, and responsible for differences within the peer reviewed articles and the mainstream article.

d) important information that was not mentioned

e) required areas of further research or extensions of the Genetics topic

5. Display the analysed criteria clearly in a poster format in a way that is clear, easy to read, creative and attractive.

6. References must be properly made **within the text (author, year),** and the poster must be accompanied by a **List of References** in proper APA format.

7. Students will do a “scavenger hunt” on the day the posters are set up and look for specific information about biotechnology from the posters. See sample scavenger hunt activity attached.

**Research Criteria**:

Students must use peer reviewed articles published with in the last 10 years from a scientific journal, magazine or publication.

**Examples of articles and journals:** Students are not limited to these examples. If they find others, they must have them approved by the teacher.

Choose **one** article as your mainstream:

**1. Mainstream News Media:**

Macleans, Time Magazine, CBC, BBC, CNN, CTV, Toronto Star, National Post, Globe and Mail, Newsweek, television documentaries

Choose **three** from a combination of A and B. You must have one of each, and then a second from either category:

**2. Science Publication A (accessible to the general public)**

National Geographic Popular Science

Nature Scientific American

Discover eurekaalert.org

New Scientist

AAAS – American Association for the Advancement of Science

**3. Science Publication B (usually only accessed by researchers)**

See [www.pubmedcentral.nih.gov](http://www.pubmedcentral.nih.gov) for a comprehensive list of science publications

New England Journal of Medicine

Canadian Medical Association Journal

American Journal of Human Genetics

Journal of Genetics

JAMA – Journal of the American Medical Association

Genetics

American Scientist

**List of References**

Carter-Edwards, Trent et al., *Biology 12*, McGraw-Hill Ryerson, Toronto, ON, 2011

Lee, Meiah, Biology teacher, Peoples Christian Academy, Toronto, ON, 2007

*This is the peer analysis activity to be used when the posters are brought in to class and set up around the science lab. This will be given to the students at the same time as the student handout and assessment tool. All three should be given to the students when the task is introduced.*

Name\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ Date\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**Discerning Genetics News Scavenger Hunt**

As you read the posters that are displayed in the science lab, look for the following information and fill in your sheet. Make sure you identify the journal names when you explain the research. Ex: “ In the Journal of Orthopedic Medicine, the author claims…”

1. Find one discovery that discusses research on cancer. Explain what the research claims. A)\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

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2. Find a project that discusses new research about DNA. Explain what the research claims. \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

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3. Find a project where there is contradictory evidence for the issue discussed. Explain the contradiction. \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

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4. Find a project where the scientific evidence backs up the mainstream article’s claims.

Explain what the evidence claims. A)\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

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5. Find a project that gives information that may contribute to your health. Explain what the research claims.

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6. Find a project that taught you something you didn’t know before. Explain what you learned.

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7. Find a project that you might do further research on. Identify what you would research.

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8. Find a project that discusses a technology such as cloning, PCR, or Genetic manipulation.

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# SBI4U Student Handout

**Discerning Truth from Fiction in the News**

A Culminating Task within the Molecular Genetics Unit

Objective:

1. The students will gain discernment and analyse information gathered from research sources while evaluating the accuracy of mainstream news articles about Genetics topics.

2. The students will integrate and apply concepts learned in the Molecular Genetics Unit.

3. Students will learn about biotechnology from their research and from evaluating the research of their peers.

**The Content Strategy**

STEP 1.

Find a mainstream article from a source available to all readers, i.e. magazine, newspaper, radio, television, documentary, electronic news, etc. that describes a recent advancement in Genetic biotechnology

STEP 2.

Note science journals or articles that are mentioned in the mainstream article and locate them.

STEP 3

Look online or at the reference library for peer-reviewed articles from science publications that discuss the Genetics topic in the mainstream article (from #1). **At least three peer-reviewed articles must be located.**

STEP 4.

Evaluate the accuracy and legitimacy of the mainstream article by comparing it to the scientific articles in the following criteria:

a) the general accuracy of the information portrayed in the mainstream news compared to what was learned in class and what was found in peer-reviewed articles

b) common variables within the scientific research and between the research and the mainstream article

c) information within the research that is contradictory, problematic, and responsible for differences between the peer reviewed articles and the mainstream article

d) important information that was not mentioned in the mainstream article

e) required areas of further research or extensions of the Genetics topic

STEP 5.

Display the analysed criteria clearly in a poster format in a way that is clear, easy to read, creative and attractive. The five questions above should be arranged on your poster so that others can easily find your answer to them.

STEP 6.

References must be properly made **within the text (author, year),** and the poster must be accompanied by a List of References in proper APA format.

STEP 7.

Students will do a “scavenger hunt” on the day the posters are set up and look for specific information about biotechnology from the posters. See scavenger hunt activity attached.

See rating scale for assessment.

**Research Criteria:**

Peer-reviewed articles must be used that were published within the last 10 years from a scientific journal, magazine or publication.Examples: ( You are not limited to these examples. If you find others, have your examples approved by the teacher.)

Choose **one** article as your mainstream:

**1. Mainstream News Media:**

Macleans, Time Magazine, CBC, BBC, CNN, CTV, Toronto Star, National Post, Globe and Mail, Newsweek, television documentaries

Choose **three** from a combination of A and B. You must have one of each, and then a second from either category.

**2. Science Publication A (accessible to the general public)**

National Geographic Popular Science

Nature Scientific American

Discover eurekaalert.org

New Scientist

AAAS – American Association for the Advancement of Science

**3. Science Publication B (usually only accessed by researchers)**

See [www.pubmedcentral.nih.gov](http://www.pubmedcentral.nih.gov) for a comprehensive list of science publications

New England Journal of Medicine

Canadian Medical Association Journal

American Journal of Human Genetics

Journal of Genetics

JAMA – Journal of the American Medical Association

Genetics

American Scientist

# SBI4U Assessment Tool

# Discerning Truth from Fiction in the News

**Culminating Task Assessment Tool: Rating Scale**

**Ministry Expectations Fulfilled**:

D1. analyse some of the social, ethical, and legal issues associated with genetic research and biotechnology;

D3. demonstrate an understanding of concepts related to molecular genetics, and how genetic modification is applied in industry and agriculture

D1.1 analyse, on the basis of research, some of the social, ethical, and legal implications of biotechnology (e.g., the bioengineering of animal species, especially those intended for human consumption; the cultivation of transgenic crops; the patenting of life forms; cloning) [IP, PR, AI, C]

D2.1 use appropriate terminology related to molecular genetics, including, but not limited to: polymerase I, II, and III, DNA ligase, helicase, Okazaki fragment, mRNA, rRNA, tRNA, codon, anticodon, translation, transcription, and ribosome subunits [C]

D3.5 describe some examples of genetic modification, and explain how it is applied in industry and agriculture (e.g., the processes involved in cloning, or in the sequencing of DNA bases; the processes involved in the manipulation of genetic material and protein synthesis; the development and mechanisms of the polymerization chain reaction)

D3.6 describe the functions of some of the cell components used in biotechnology (e.g., the roles of plasmids, restriction enzymes, recombinant DNA, and vectors in genetic engineering)

A1.3 identify and locate a variety of print and electronic sources that enable them to address research topics fully and appropriately

A1.7 select, organize, and record relevant information on research topics from a variety of appropriate sources, including electronic, print, and/or human sources, using suitable formats and an accepted form of academic documentation

A1.8 synthesize, analyse, interpret, and evaluate qualitative and/or quantitative data to determine whether the evidence supports or refutes the initial prediction or hypothesis and whether it is consistent with scientific theory; identify sources of bias and/or error; and suggest improvements to the inquiry to reduce the likelihood of error

A1.9 analyse the information gathered from research sources for logic, accuracy, reliability, adequacy, and bias

**Criteria questions analysed:**

a) the general accuracy of the information portrayed in the mainstream news compared to what was learned in class and what was found in peer-reviewed articles

b) common variables between the scientific research and the mainstream article

c) information within the research that is contradictory, problematic, and responsible for differences between the peer reviewed articles and the mainstream article

d) important information that was not mentioned in the mainstream article

e) required areas of further research or extensions of the Genetics topic

Rating Scale **– Assessment as Learning** for the Preparation criteria (#’s 1-5)

This section can be submitted for revision and checked for progress along the way. Students will learn from their assessment and make corrections.

**Assessment of Learning** for the Poster criteria (A – F)

|  |  |  |
| --- | --- | --- |
| **Preparation Criteria** | **Comments/ Ministry expectations fulfilled** | **Possible Marks** |
| **Topic Commitment**  1. news article chosen on time,  relevant to genetics unit,  recent within 10 years  2. Three peer reviewed articles found from appropriate scientific sources, enough information recorded as notes to show that all 5 questions can be discussed.  DUE DATE: | **A1.3, A1.8, A1.9**  **D2.1, D3.5, D3.6** | **1. \_\_\_\_/3**  **2. \_\_\_\_\_/3** |
| **Progress Check**  3. Research journal is complete with dates and details.  4. References are cited within the text with proper APA format  5. Research covers all 5 questions  DUE DATE: | **A1.3, A1.7, A1.8, A1.9**  **D2.1, D3.5, D3.6** | **3. \_\_\_\_/2**  **4\_\_\_\_\_/2**  **5 \_\_\_\_\_/2**  **Total: \_\_\_\_/12** |
| **Poster Criteria** | **Comments/ministry expectations fulfilled** | **Possible Marks** |
| **A. Clarity:**  Social , ethical, or legal issues about the biotechnology researched is clearly organized and discussed. | **D1.1** | **1. \_\_\_\_/5** |
| **B. Language/Style:**  Use of appropriate terminology  Terms explained, grammar and spelling accurate  Creative and attractive arrangement of research on the board | **D2.1** | **2. \_\_\_\_\_/10** |
| **C. Content:**  Research is analysed for logic, accuracy, reliability, adequacy and bias. | **A1.9** | **3.\_\_\_\_\_/10** |
| **D. Thoroughness:** Each question is covered thoroughly. | **A1.3, A1.8**  **Question 1:**  **Question 2:**  **Question 3:**  **Question 4:**  **Question 5:** | **4. \_\_\_\_\_/20** |
| **E. References:** Sources are properly referenced both cited within the body of the discussion and I the List of References. | **A1.7** | **5. \_\_\_\_\_/10** |
| **F. Peer Analysis “Scavenger Hunt”:** Information gained from analysing classmates’ posters is accurate and thorough.  A good variety of topics were chosen to analyse. | **Overall Comments:** | **6. \_\_\_\_\_\_/16**  **Total: \_\_\_/71** |

**K/U\_\_\_\_\_\_\_/ 22 C\_\_\_\_\_\_\_/ 15 A\_\_\_\_\_\_\_\_/ 26 T/I\_\_\_\_\_\_\_\_/ 13 Total \_\_\_\_\_\_/76**

**SBI4U MOLECULAR GENETICS UNIT TEST** Name \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ Date \_\_\_\_\_\_\_

**Description of Test**

This summative assessment evaluates **knowledge and understanding** ofthe structure and function of DNA, determining its genetic code, replication and base pairing, the central dogma of genetics, protein synthesis, lac operon, mutations, gene expressions and biotechnology. This assessment evaluates **application** of concepts learned throughout the unit. It also requires clear, accurate **communication** in full sentences and paragraph format when specified. **Thinking and investigation** skills will be assessed from the problem solving question and creating diagrams*.*

**PART A: MULTIPLE CHOICE:** Circle the correct answer on the grid above.  **[10 K/U]**

1. a b c d 4. a b c d 7. a b c d 10. a b c d

2. a b c d 5. a b c d 8. a b c d

3. a b c d 6. a b c d 9. a b c d

**1.** The rules of base pairing of DNA are the following:

1. random base combination
2. T matches with C and A with G
3. A matches with T and C with G
4. C matches with A and T with G

**2.** The cell’s DNA is damaged:

1. millions of times per day.
2. by collision with other molecules or by chemical accidents and exposure to radiation.
3. not often and only by radiations.
4. a and b.

**3.** Which of the following transfers the code to the ribosome?

1. DNA
2. mRNA
3. tRNA
4. rRNA

**4.** Which of the following is generated as a result of the replication process?

1. mRNA
2. rRNA
3. tRNA
4. DNA

**5.** Which of the following is a DNA sequence not used for coding proteins?

1. the nucleotide
2. the intron
3. the exon
4. the gene
5. Which of the following is NOT found in DNA?
6. uracil
7. thymine
8. adenine
9. guanine
10. Which bond links the phosphate and sugar of nucleic acids together?
11. peptide
12. ester
13. phosphodiester
14. none of the above
15. Which of the following statements regarding replication is FALSE?
16. DNA Polymerase I excises primers.
17. Gyrase relieves tension.
18. DNA Polymerase III adds nucleotides to the new strand.
19. Primase unwinds the double helix.
20. Which of the following statements regarding transcription is FALSE?
21. It occurs in the nucleus. .
22. In elongation, the chosen DNA strand is called the template strand.
23. The mRNA can be found inside the nucleus.
24. The ribosome is the primary site of transcription.

1. Which of the following statements regarding translation is FALSE?
2. tRNA carry amino acids to the ribosome.
3. One codon codes for one amino acid.
4. It occurs in the nucleus.
5. The initiation codon codes for methionine.

**Part B: SHORT ANSWER** Answer these questions directly on the paper.

1. Fill in the following table.

|  |  |  |
| --- | --- | --- |
| **Molecule** | **Structure or description [5 K/U]** | **Function [5 C]** |
| tRNA |  |  |
| Ribosome |  |  |
| mRNA |  |  |
| Poly-A tail |  |  |
| Cap |  |  |

1. Fill in the table below that compares different amino acids. **[5 A]**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Amino Acids** | **tRNA** | **mRNA** | **DNA sense** | **Antisense DNA** |
|  | UGA |  |  |  |
|  |  |  |  | CCC |
|  |  | UGA |  |  |
| Histidine |  |  |  |  |
|  |  |  | CTA |  |

1. Name the process illustrated bellow: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ **[2 A]**

Where did the process start?(left or right) \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_



**Part C: WRITTEN ANSWER** Answer these questions on a separate piece of paper.

1. The following sequence ABCDEFGH represents a healthy DNA. Identify what type of mutations are involved in the following sequences: **[2 C]**
2. ABCCDEFGH
3. ABCDEGH
4. Explain how Griffith showed that DNA was the material of heredity. **[2 C]**
5. What does it mean that DNA replicates semi-conservatively? **[1 K/U]**

1. Name the two types of mutagens. Give an example for each of them and briefly describe how they generate mutations. **[4 K/U]**
2. Use the picture bellow to answer the following questions. **[7 A]**
3. What is the process illustrated here?
4. Associate each letter to an appropriate word.



**Resource:** Arms and Camp, Biology*, A journey into life, Saunders College Publishing*, **P.147**

1. Compare each of the following groups. Mention at least three points for each of them. **[9 A]**
2. cap and poly A tail
3. ligase and helicase
4. amino acid and nitrogen base
5. Why is it important for cells to fix mutations in their DNA sequences? Give an example of what might happen to a cell if mutations are too severe? **[3 A]**
6. Describe the purpose of lac operon**. [2 K/U]**
7. Since July 2000, there has been a DNA data base in Canada for people sentenced responsible for criminal acts. Many other countries intend to extend the concept to their all citizens. What are the advantages the risks related to that policy? Describe and explain including 2 risks and 2 advantages. **[6 C]**
8. Draw a structure of a DNA molecule containing at least 4 nucleotides using all nitrogen bases. **[4 T/I]**
9. Using the following sequence, write the amino acids involved. **[3 T/I]**

**AUGGGUCCAUGGCGUAGGCCAAAUGAUGAGGAAUGA**

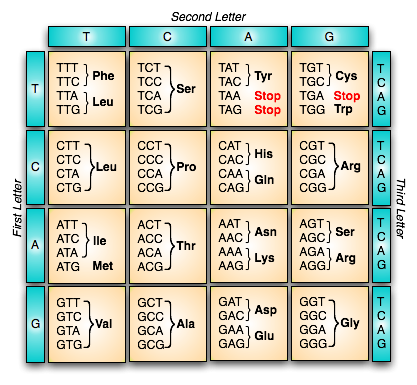
1. Which of the following strands has been used to generate the polypeptide below? Use the Genetic code table to help you. **(1 T/I)**

**Strand** 3’ ATGGAATGTTTACCCGTATTATACGGATAGACG 5’

**Strand** 5’ TACCTTACAAATGGGCATAATATGCCTATCTGC 3’

methionine - proline - isoleucine - cysteine - …

**The standard Genetic Code**



From: <http://plato.stanford.edu/entries/information-biological/>

1. Use your knowledge of genetic biotechnology to solve this problem. Write your answers in **full sentences. [5 T/I]**

You are assigned the task to help solve a bank robbery. In a small town where smoking is prohibited within 50 feet of all public places, a bank was robbed. No fingerprints or clothing were left behind. The only thing out of place was a cigarette butt right outside the door. How will you use biotechnology to find evidence related to the crime? Name and describe the process(es) you will use.

**SBI4U MOLECULAR GENETICS UNIT TEST ANSWER KEY**

**Description of Test**

This summative assessment evaluates **knowledge and understanding** ofthe structure and function of DNA, determining its genetic code, replication and base pairing, the central dogma of genetics, protein synthesis, lac operon, mutations, gene expressions and biotechnology.

This assessment evaluates **application** of concepts learned throughout the unit.

It also requires clear, accurate **communication** in full sentences and paragraph format when specified. **Thinking and investigation** skills will be assessed from the problem solving question and creating diagrams*.*

**Specific expectations fulfilled**

**D2.1** use appropriate terminology related to molecular genetics, including, but not limited to: polymerase I, II, and III, DNA ligase, helicase, Okazaki fragment, mRNA, rRNA, tRNA, codon, anticodon, translation, transcription, and ribosome subunits [C]

**D2.2** analyse a simulated strand of DNA to determine the genetic code and base pairing of DNA (e.g., determine base sequences of DNA for a protein; analyse base sequences in DNA to recognize an anomaly) [AI]

D3.1 explain the current model of DNA replication, and describe the different repair mechanisms that can correct mistakes in DNA sequencing

D3.2 compare the structures and functions of RNA and DNA, and explain their roles in the process of protein synthesis

D3.3 explain the steps involved in the process of protein synthesis and how genetic expression is controlled in prokaryotes and eukaryotes by regulatory proteins (e.g., the role of operons in prokaryotic cells; the mechanism of gene expression in eukaryotic cells)

D3.4 explain how mutagens, such as radiation and chemicals, can cause mutations by changing the genetic material in cells (e.g., the mechanisms and effects of point mutations and frameshift mutations)

D3.5 describe some examples of genetic modification, and explain how it is applied in industry and agriculture (e.g., the processes involved in cloning, or in the sequencing of DNA bases; the processes involved in the manipulation of genetic material and protein synthesis; the development and mechanisms of the polymerization chain reaction)

D3.6 describe the functions of some of the cell components used in biotechnology (e.g., the roles of plasmids, restriction enzymes, recombinant DNA, and vectors in genetic engineering)

D3.7 describe, on the basis of research, some of the historical scientific contributions that have advanced our understanding of molecular genetics (e.g., discoveries made by Frederick Griffith, Watson and Crick, Hershey and Chase)

**Multiple Choice [10 K/U]**

1. c
2. d
3. c
4. d
5. a
6. a
7. c
8. d

9. d

10. c

**Part B: Diagrams and Tables** Answer these questions directly on the paper.

1. Fill in the following table.

|  |  |  |
| --- | --- | --- |
| **Molecule** | **Structure or description**  **[5 K/U]** | **Function [5 C]** |
| tRNA |  | Links up a codon (located on the mRNA) to the appropriate amino acid |
| Ribosome | http://ridge.icu.ac.jp/biobk/ribosome_1.gif | Plays a role in proteins synthesis.  Binding site of the mRNA on the ribosome |
| mRNA |  | Carries the message from DNA down to the cytoplasm for proteins transcription |
| Poly-A tail | A-A-A-A-A-A-A | Stabilizes the mRNA |
| Cap | PolyGuanine | Allows the mRNA to get out of the nucleus. |

**Figures:** from <http://ridge.icu.ac.jp/biobk/BioBookPROTSYn.html>

1. Fill in the table below that compares different amino acids. **[5 A]**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Amino acids** | **tRNA** | **mRNA** | **DNA sense** | **Antisense DNA** |
| Threonine | UGA | ACU | TGA | ACT |
| Proline | GGG | CCC | GGG | CCC |
| Ending | ACU | UGA | ACT | TGA |
| Histidine | GUA  GUG | CAU  CAC | GTA  GTG | CAT  CAC |
| Aspartic acid | CUA | GAU | CTA | GAT |

1. Name the process illustrated below: Translation **[2 A]**

Where did the process start?(left or right) Left as the polypeptide size increases from the left to the right side.



**Part C: WRITTEN ANSWER** Answer these questions on a separate piece of paper.

1. The following sequence ABCDEFGH represents a healthy DNA. Identify what type of mutations are involved in the following sequences: **[2 C]**
2. ABCCDEFGH Insertion
3. ABCDEGH Deletion
4. Explain how Griffith showed that DNA was the material of heredity. **[2 C]**

The first series of experiments were performed by a British bacteriologist F. Griffith in 1928, using the bacterium Diplococcus pneumoniae which causes pneumonia in mammals.

Griffith noticed that this bacterium had two types of strains.

- S-type, which was capsulated and produced a smooth colony on a synthetic medium.

- R-type, which was non-capsulated and produced rough colony on a synthetic medium.

When S-type of bacteria was injected into healthy mice, the mice developed pneumonia and died. So S-type was named as virulent or pathogenic.

However, R-type of bacteria was non-pathogenic.

Source: [http://www.tutorvista.com](http://www.tutorvista.com/)

1. What does it mean that DNA replicates semi-conservatively? **[1 K/U]**

That means replication produces two copies that each contains one of the original strands and one new strand.

7. Name the two types of mutagens. Give an example for each of them and briefly describe how they generate mutations. **[4 K/U]**

|  |  |
| --- | --- |
| Physical mutagen | Chemical mutagen |
| UV | Benzen |
| DNA change due to an external cause | Chemical molecule inserted into the nucleus and linked up to DNA |

8. Use the picture below to answer the following questions. **[7 A]**

1. What is the process illustrated here?
2. Associate each letter to an appropriate word.

a. Replication

b. a. 3’ end

b. 5’ end

c. 3’ end

d. 5’ end

e. ligase

f. secondary strand

g. Okazaki fragment

h. primase

i. helicase

j. DNA primer

k. proteins

l. DNA

9. Compare each of the following groups. Mention at least three points for each of them. **[9 A]**

1. cap and poly A tail
2. ligase and helicase
3. amino acid and nitrogen base

a. cap and poly A tail

- They are additions to mRNA

- They are both made of nitrogen bases

- The tail is made of Adenine and the cap of Guanine

b. Ligase and helicase

- Ligase tightens while helicase separates

They are both:

- enzymes

- part of the replication process

c. They are both:

- monomers

- important for proteins synthesis

They contains Nitrogen in their structure

10. Why is it important for cells to repair mutations in their DNA sequences? Give an example of what might happen to a cell if mutations are too severe? **[3 A]**

It is important for the cell to repair damaged DNA for a proper protein synthesis. The damaged DNA can cause genetic diseases. If damages are too severe, the cell might generate suicide genes. That might also cause fatal tumors to the organism.

11. Describe the purpose of lac operon**. [2 K/U]**

Gene regulation

Carry the genes that encode lactase, the enzyme needed to break down lactose

12. Since July 2000, there has been a DNA data base in Canada for people sentenced responsible for criminal acts. Many other countries intend to extend the concept to their all citizens. What are the advantages the risks related to that policy? Describe and explain including 2 risks and 2 advantages. (6 A)

Advantages:

- Facilitates the crime offender investigation

- Helps to identify a child’s real parents

…

Risks :

- People’s confidentiality is compromised

- Discrimination from employers and Insurance business if the client’s profile states his or her vulnerability.

13. Draw a structure of a DNA molecule containing at least 4 nucleotides using all nitrogen bases. **[4 T/I]**

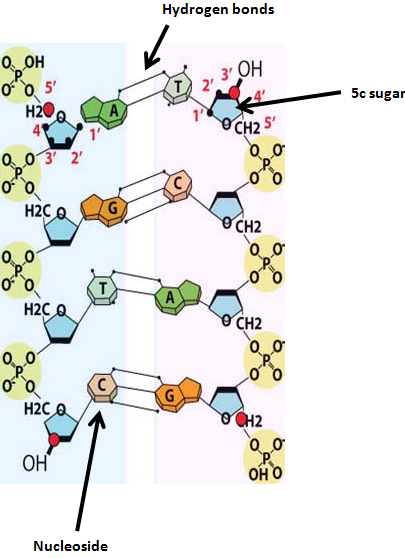


Figure 7.14 page 227 Biology 12 textbook

The student’s drawing will certainly be simpler. The most important aspect is to show the nucleotide, the hydrogen bonds and the sugars.

14. Using the following sequence, write the amino acids involved. You may use the genetic Code table below. **[3 T/I]**

**AUGGGUCCAUGGCGUAGGCCAAAUGAUGAGGAAUGA**

methionine - glycine- proline - tryptophane - arginine - arginine - proline - asparagine - aspartate -glutamine – glutamine-

15. Which of the following strands has been used to generate the polypeptide below? Use the Genetic code table to help you. **[1 T/I]**

**Strand A** 3’ ATGGAATGTTTACCCGTATTATACGGATAGACG 5’

**Strand** B 5’ TACCTTACAAATGGGCATAATATGCCTATCTGC 3’

Methionine- Proline- Isoleucine- Cysteine-

Strand A

16. Use your knowledge of genetic biotechnology to solve this problem. Write your answers in **full sentences. [5 T/I]**

You are assigned the task to help solve a bank robbery. In a small town where smoking is prohibited within 50 feet of all public places, a bank was robbed. No fingerprints or clothing were left behind. The only thing out of place was a cigarette butt right outside the door. How will you use biotechnology to find evidence ? Name and describe the process you will use.

The cigarette butt was probably from the robber since all the citizens of the town know the law. The process is DNA Fingerprinting that will be used. The steps are :

1. Collect the DNA from the part of the cigarette butt that was in the robber’s mouth through DNA isolation

2. Amplify the DNA through Polymerase Chain Reaction

3. Analyse the DNA through Gel electrophoresis

4. Match DNA fingerprint to previous police records.