Internet of Things (IoT) at UCF

UNIVERSITY OF CENTRAL FLORIDA

UCF RET Site: Collaborative Multidisciplinary Engineering Design Experiences for Teachers

2000320: Biology 1 Honors

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2000320 and Biology 1 Honors

7/4/2018

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RET Site: CoMET Lesson/Unit Plan

Course(s): Biology 1 Honors
Grade Level: 9-12
Suggested Length of Lesson: 150 minutes

Materials/Technology Needed

- Lenovo/HP Laptop
- Compile Online
- Coding bat
- Raspberry Pi
- Breadboard with jumper wires
- RGB LED
- 3x 470 ohms resistors
- Transparent and frosted storage box

Where this Fits

- Heredity and Reproduction

Lesson Objective(s)/Learning Goal(s)

- Students will:
  - Understand that the DNA serves as the blueprint for life of all organisms on earth.
  - Understand that DNA stores the genetic information (genetic data) managed in molecular code form.
  - Understand that DNA bases match (pair) in specific ways: A→T; G→C.
  - Understand that DNA controls all life processes via protein synthesis ("The Central Dogma": DNA→RNA→Protein).

Standard(s)/Benchmark(s) Addressed

- *Standards:*
  - *SC.912.L.16.3 Describe the basic process of DNA replication and how it relates to the transmission and conservation of the genetic information.*
  - *SC.912.L.16.5 Explain the basic processes of transcription and translation, and how they result in the expression of genes.*
- *NGSS Standard(s):*
  - *HS-LS1-1: Construct an explanation based on evidence for how the structure of DNA determines the structure of proteins which carry out the essential functions of life through systems of specialized cells.*

Standards for Mathematical Practice

- MAFS.K12.MP.2.1—Reason abstractly and quantitatively
- MAFS.K12.MP.4.1—Model with mathematics.
- MAFS.6EE.2.6: Use variables to represent numbers and write expressions when solving a real world or mathematical problem; understand that a variable can represent an unknown number, or, depending on the purpose at hand, any number in a special set.
- MAFS.6.EE.3.9: Use variables to represent two quantities in a real-world problem that change in relationship to one another; write an equation to express one quantity, thought of as the dependent variable, in terms of the other quantity, thought of as the independent variable. Analyze the relationship between dependent and independent variables using

Instructional Strategies

- Guided Inquiry
- Gradual Release Strategy
- Discussion

graphs and tables, and relate these to the equation. ▪ MAFS.7.EE.1.2—Understand that rewriting an expression in different form in a problem context can shed light on the problem and how the quantities in it are related.	
Evidence of Learning (Assessment Plan) ▪ *Coding bat Formative Assessment (Practice Problems)* ▪ *Common Unit Test (Post-Test)*	

Description of Lesson Activity/Experiences

Days 1 and 2—Lesson Plan: *DNA is Binary!*
Daily Objective: Students will be able to use binary numbers to represent letters.
Lesson Activity: *Writing Binary Numbers.* ***(****20 minutes****)***
Teacher will describe binary numbers.
Teacher will and guide students practice session using gradual release instructional method.
Students will complete practice worksheet converting decimal numbers into binary and vice versa.

Teacher will explain how computers use binary numbers to represent letters and symbols.
Teacher will guide students into creating binary codes for each nucleotide (letter) used in DNA.
Students will complete practice activity matching DNA codons (3 letters) with their corresponding binary code.
Teacher will model how to write algorithm for DNA codons using C-programing language.

Formative Assessment/Wrap-Up Activity: Students will complete coding bat DNA codons practice problems. ***(****30 minutes****)***

Day 3—Lesson Plan:
Daily Objective: Students will be able to (1) describe the relationship between DNA base pairs, RNA, and proteins (2) model the process of protein synthesis using computer programming.
Lesson Activity: DNA Flashing LED Box ***(****15 minutes****)***
Teacher will briefly describe the activity's objective and materials to be used for the activity.
Teacher will model appropriate wiring and set up for the activity.
Teacher will guide students through connection of wires onto the breadboard.
Students will work in pair connecting wires and setting up for the activity.
Teacher will guide students to create, name and upload DNA files with pre-written programming instructions and flashing LED codes as follow:

- Adenine (A) = Purple;
- Thymine (T) = Blue;
- Cytosine (C) = Green;
- Guanine (G) = Cyan.

Student will used preloaded DNA files into a created folder on their Raspberry Pi and launch program.
Students will make necessary changes to program code designing their own sequence of order in which each color will flash.

Formative Assessment/Wrap-Up Activity ***(****35 minutes****)***: Students will determine DNA codes from other groups for which they will provide complementary DNA strand, corresponding mRNA and resulting polypeptide chain.
Recommended Assessment(s) and Steps ▪ Formative assessments are described above. ▪ Coding bat problems and daily discussions will be used to assess student's understanding of daily activities using technology to manipulate DNA as well as general concepts of DNA replication, transcription and translation. ▪ A common assessment will be designed by the Biology PLC at Edgewater High School as a post-test to this unit.
List of Materials/Resources Used ▪ Other than materials listed above, the OCPS approved Biology textbook and resources may be used as reference materials for content support. Students have online access to textbook and resources through their Biology Class Canvas.

You can create multiple lesson plans if you are developing a unit.

Important Vocabulary

Define unusual or probably unknown words. Write definitions in sentence format.

Term	Definition
Amino Acid	Biomolecular compound containing an amino group at one end and a carboxyl group at the other end of its chemical structure; monomer or subunit of polypeptide chains or proteins.
Base pairing	Matching rules for nitrogenous bases in DNA and RNA encoding the genetic information (DNA: A→T; G→C || RNA: A→U; G→C).
Binary	Base 2 digits.
DNA (Deoxyribonucleic acid)--	Genetic material found in all living organisms.
Genetic code	Set of mRNA codons that directs the assembly of amino acids into a particular polypeptide chain.
Genome	Information contained in an organism's DNA.
Nucleotide	Subunit or monomer of nucleic acids; composed of a sugar, a nitrogenous base and a phosphate group.
Replication	Process through which DNA makes an identical copy of itself.
RNA (Ribonucleic acid)--	Single-stranded nucleic acid containing a sugar ribose.
Transcription	Process through which a section of the DNA is encoded into an mRNA.
Translation	Process through which the mRNA message is decoded for the synthesis of proteins by aligning the correct sequence of amino acids.

Troubleshooting Tips

Add anything helpful here.

DNA sequences for any organism can be found using the following website: NCBI Gene.

Other Helpful Information

Add anything helpful here.

The intended purpose of this lesson is to introduce programming to students. Students will not be expected to write any codes but will be able to manipulate data and represent it in various ways. It would be also useful that the lessons and activities be presented to students as an extension to previously taught concepts of DNA replication and protein synthesis or as an introduction to genetic engineering and DNA technology units.

Attachments

List here any lesson or activity attachments not included within this document, such as the following:

- PowerPoints for lecture
- Handouts (Worksheets, Activities, Quizzes, Visual Aids, etc).
- Answer Keys
- Coding

Remember to send these as separate files along with your unit/lesson plan.

References

Miller, K. R., Levine, J, S. Biology—Elevate Science Florida, Boston, Mass. – Pearson -2010.
Nemzer, L. R. (2017). A binary representation of the genetic code. Biosystems 155, 10-19.
ACT: the Artemis Comparison Tool.

Acknowledgements

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Supporting Program

RET Site: COMET Program, College of Engineering and Computer Science, University of Central Florida. This content was developed under National Science Foundation grant #EEC-1611019.

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