Block Coding Lesson

Lesson Title:	**Cell Division and Genetics**
Grade Level:	**High School**
Subject:	**Biology**
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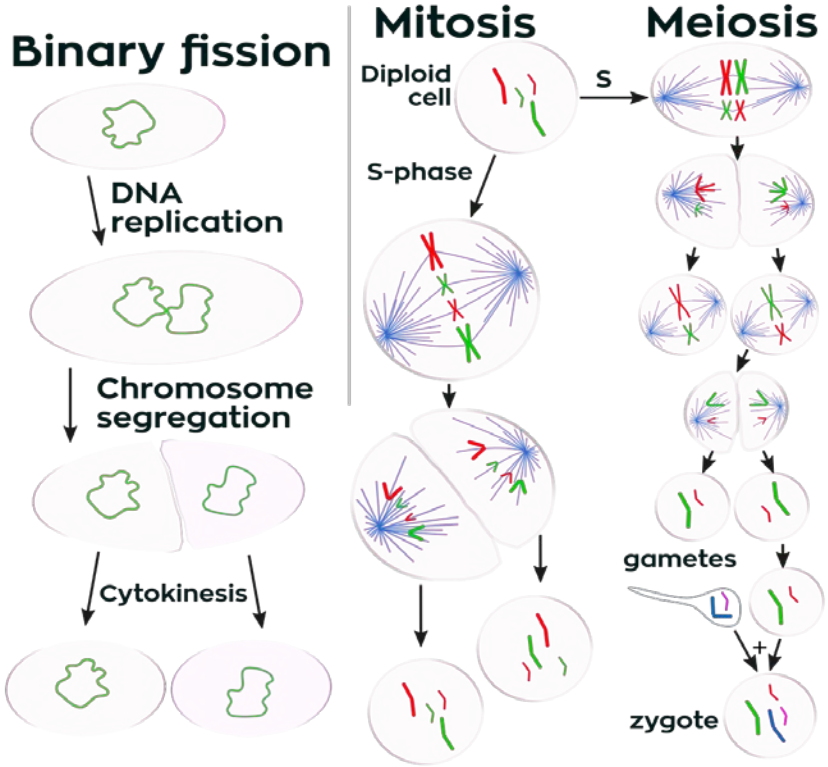
Engagement:

- Begin by playing the video: https://www.youtube.com/watch?v=AhgRhXl7w_g
- To introduce the concept of cell division.
- Ask students, "How do cells know how to divide themselves? Have they always had these instructions inside of them? If not, where did they come from?" ----> Lead students towards "Genetic Code"
- Ask students, "How are we able to use the Copy and Paste function on computer? Is this function built into computer parts? If not, where does it come from? Do you think that this function is a product of some written code?"
- -----> Lead students towards: It is a built in code written by computer programmers.



Source: https://en.wikipedia.org/wiki/Cell_division

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- Question, “Do you think that these two forms of coding (computer and biological) are similar in any way? Do they serve the same function in the larger systems that they compose?”
- Instruct students to take a minute to think about the question and discuss with nearby students.
- Gain attention and bring focus to the front of the room by using a call-response technique.
- Explain to students, “Just as computers have a copy and paste function, cells also contain a method for replicating themselves to make identical copies, just like the computer does with information. Much like computers, the code to do these functions didn’t just appear spontaneously. The genetic code that helps organisms replicate their cells was written by the greatest programmer of all time: Evolution.”
- Conclude, “Today, we will be acting as Mother Nature’s programmer, and we will write a code to instruct a cell to grow and divide when it has met the required parameters.”

Exploration:

- Big Idea #5: Programming enables problem solving, human expression, and creation of knowledge. It results in the creation of software, and it facilitates the creation of computational artifacts, including music, images, and visualizations. You will create programs, translating human intention into computational artifacts.
- (Source:https://apstudent.collegeboard.org/apcourse/ap-computer-science-principles/course-details)
- Instruct students to open their computers and go to the website https://scratch.mit.edu/.
- Have students start coding by clicking on the “Start Creating” button.
- Optional: Have students create a new sprite that looks like a plant or animal cell.
- Instruct them to make a program that will make their sprite divide when it reaches a certain size. For this activity, do not use the actual size quantity for the size of the cell.
- Instead, set a variable named “size” and have the variable increase after various intervals. Set this variable to any number between 50 and 250.
- If the sprite does not have a value for their variable that is the specified size required for replication then program the sprite to say or think “I am not big enough yet.” and to keep increasing in size.

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- Once the sprite's variable of "size" reaches the specified number, have the sprite say, "I am finally big enough to divide!", followed by the cloning function
- Set a final message of , " Hello, my identical twin!". And move the original sprite out of the way to reveal the newly copied sprite.
- While students are working on their block coding program, prompt them for the following questions and have them write down their answers on a separate sheet of paper for discussion later in the class period.
- "Where is programming present in the field of biology? Can you think of any other subjects where there is programming involved?" -------> Within genetic code. In the field of psychology, people can have their brains programmed to react to certain triggers (ex. Pavlov's Dog)
- "Why is it important for us to be able to replicate our cells? What is the greater evolutionary importance of cell replication? Why is it important for us to be able to program things such as this? What use does programming play in our everyday lives?" ---------> Passing genetic information. Evolution of species for survival. Accessibility and ease of access. The ability to sort information, create programs to simplify tasks, and save time cutting out repetitive tasks

Explanation:

- Ask students, "What was the requirement that had to be met for the cell to be able to replicate?"
- "Do cells have to meet certain criteria in order to divide in nature? Can anyone think of what any of these conditions might be?" ------> Size must be above the specified number. Yes. Some criteria might be: size, the right amount of nutrients, the right amount of time, etc."
- Ask students, "Think back to the big idea, what does this program enable us to do?"
- -------> "Create a autonomous pathway for cells to divide based on certain criteria"
- Prompt for higher order thinking, "What other things could this program enable us to do if we made it more complex? Do you think there is any upper limit to how many things can be accomplished with programming in nature?
- -------> Cause the cell to divide even more, cause the cell to differentiate between different stages of division, and have the program differentiate between the cell stages in which it would be able to stop at, or continue on based on the desired outcome. In nature, there does not seem to be an upper limit, as we look at life it seems to be almost infinitely complex with its intricate programming."

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Elaboration:

- **Ask, "**What kind of programming terms can we connect to the block program that we just created? Are there any terms that you noticed while you were creating your program?"
- ------> If-Else statements: Explain and provide definition
- ------>Variables: Explain their purpose and show the example in the created programs.
- Further explain the usage of variables and conditional statements in relation to the program that was created.
- "Were there any examples of operations that were used in your programs?"
- ------> Yes, we used greater than / less than operators in order to specify whether growth (and thus the program) would continue.
- Prompt the students to connect this program to another example in real life.
- "For what other subjects / topics could we use this same type of programming? Is there any task that you can think of that we could design a program to complete?"
- Instruct students to talk in groups for a few minutes and then convene focus to the front of the room again to elaborate.
- -------> Chemistry - determining what element is what, Math - determining which letter bracket your numerical grade would fall under, etc.
- State," In conclusion, do you think that programming is a useful tool for scientists and other academics alike?"
- Have students respond for a little while and instruct them to keep the question in mind as they proceed through their academic trials.

Evaluation:

- Students will be evaluated based on their programs as well as an exit ticket.
- Do the programs follow the instructions? Is the cell able to divide after it reaches a certain size? Did the students include statements throughout the cells increase in size as the program runs?
- Lastly, have students complete the "Exit Ticket" worksheet and hand in before they leave class.

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