In the Blood

5e Lesson Plan

Topic: Blood Genetics
Title: In the Blood: The Case of the Baby Swap
Grade Level: 7th Grade Life Science
Lesson Timeline: Roughly 1 week (Six 40-minute class periods)

Standards Addressed:
NGSS:
MS-LS1-3: **Use argument supported by evidence for how the body is a system of interacting subsystems composed of groups of cells.** [Clarification Statement: Emphasis is on the conceptual understanding that cells form tissues and tissues form organs specialized for particular body functions. Examples could include the interaction of subsystems within a system and the normal functioning of those systems.] [*Assessment Boundary: Assessment does not include the mechanism of one body system independent of others. Assessment is limited to the circulatory, excretory, digestive, respiratory, muscular, and nervous systems.*]
MS-LS3-2: **Develop and use a model to describe why asexual reproduction results in offspring with identical genetic information and sexual reproduction results in offspring with genetic variation.** [Clarification Statement: Emphasis is on using models such as Punnett squares, diagrams, and simulations to describe the cause and effect relationship of gene transmission from parent(s) to offspring and resulting genetic variation.]

Science and Engineering Practices:
Asking Questions and Defining Problems:
Asking questions and defining problems in grades 6–8 builds on grades K–5 experiences and progresses to specifying relationships between variables, and clarifying arguments and models.

- Define a design problem that can be solved through the development of an object, tool, process or system and includes multiple criteria and

constraints, including scientific knowledge that may limit possible solutions. (MS-ETS1-1)

Analyzing and Interpreting Data:

Analyzing data in 6–8 builds on K–5 experiences and progresses to extending quantitative analysis to investigations, distinguishing between correlation and causation, and basic statistical techniques of data and error analysis.

- Analyze and interpret data to determine similarities and differences in findings. (MS-ETS1-3)

Engaging in Argument from Evidence:

Engaging in argument from evidence in 6–8 builds on K–5 experiences and progresses to constructing a convincing argument that supports or refutes claims for either explanations or solutions about the natural and designed world.

- Evaluate competing design solutions based on jointly developed and agreed-upon design criteria. (MS-ETS1-2)

CCSS:

CCSS.MATH.CONTENT.7.SP.C.5: Understand that the probability of a chance event is a number between 0 and 1 that expresses the likelihood of the event occurring. Larger numbers indicate greater likelihood. A probability near 0 indicates an unlikely event, a probability around 1/2 indicates an event that is neither unlikely nor likely, and a probability near 1 indicates a likely event.

CCSS.MATH.CONTENT.7.SP.C.6: Approximate the probability of a chance event by collecting data on the chance process that produces it and observing its long-run relative frequency, and predict the approximate relative frequency given the probability. *For example, when rolling a number cube 600 times, predict that a 3 or 6 would be rolled roughly 200 times, but probably not exactly 200 times*.

CCSS.MATH.CONTENT.7.SP.C.7: Develop a probability model and use it to find probabilities of events. Compare probabilities from a model to observed frequencies; if the agreement is not good, explain possible sources of the discrepancy.

CCSS.ELA-LITERACY.WHST.6-8.1.B

Support claim(s) with logical reasoning and relevant, accurate data and evidence that demonstrate an understanding of the topic or text, using credible sources.

CCSS.ELA-LITERACY.WHST.6-8.1.C

Use words, phrases, and clauses to create cohesion and clarify the relationships among claim(s), counterclaims, reasons, and evidence.

ISTE Standards:

Knowledge Constructor: 3a: Students plan and employ effective research strategies to locate information and other resources for their intellectual or creative pursuits.

Creative Communicator: 6a: Students choose the appropriate platforms and tools for meeting the desired objectives of their creation or communication.

NJ Technology Standards:

8.1 Educational Technology: All students will use digital tools to access, manage, evaluate, and synthesize information in order to solve problems individually and collaborate and to create and communicate knowledge.

E: Research and Information Fluency: Students apply digital tools to gather, evaluate, and use information.

Lesson Background:

Sexual reproduction to can lead to a wide variation of traits within the human population. Blood is a tissue capable of genetic variation due to inherited antigen combinations located on the red blood cells. There are four major types of blood (A, B, AB and O), each of which can be positive or negative based on the inherited Rh factor. Within these blood groups, there are dominant and recessive alleles. Blood typing is an important practice when dealing with medical concerns such as blood transfusions and pregnancy, and can be used in detection techniques of forensic analysis and paternity testing.

Justification:

This integrated STEM lesson (mini-unit) is designed as an extension within the standard Genetics unit for the Life Science classroom. Prior to engaging in this lesson sequence, students should have a basic foundation in microscope use, Mendelian genetics and the use of punnett squares. The lessons designed provide students with hands-on, authentic problem solving activities while allowing students the opportunity to synthesize concepts within body systems and Mendelian genetics. Within these lessons, students will gain scientific knowledge of body tissue and genetics, will strengthen mathematics concepts of probability and statistics, can engage in written practice of claim-evidence-reasoning, and can use technology for research, simulations, virtual lab activities and a platform to submit final case reports.

Learning Objectives:

- Students will be able to investigate and magnify blood in order to determine the components of blood (red blood cells, white blood cells, plasma and platelets)
- Students will be able to draw and define each component of blood within the circulatory system.
- Students will be able to identify and sketch each of the four major types of blood.

- Students will be able to determine genotype and phenotype of each type of blood in the human system.
- Students will be able to explore the statistics of blood types within the human population.
- Students will be able to solve a variety of blood genetics punnett squares in order to determine probability of inheritance patterns of blood.
- Students will be able to utilize all blood typing equipment to properly test and identify a variety of patient blood samples.
- Students will be able to apply their knowledge of blood testing and blood inheritance patterns to solve a baby swap case, and return each baby to the correct set of parents.
- Students will analyze data and draw conclusions based on evidence.
- Students will be able to use technology to effectively create and submit a "medical report" written as a claim, evidence, reasoning report in order to express their baby swap blood testing results.
- Students will be able to share and evaluate medical testing results with their peers.

Essential Vocabulary:

- Red Blood Cell
- White Blood Cell
- Plasma
- Platelet
- Antigen
- Antibody
- Tissue
- Circulatory System
- Dominant Allele
- Recessive Allele
- Codominance
- Genotype
- Phenotype
- Probability
- Claim
- Evidence
- Reasoning

Required Materials:

- Compound Light Microscope (1 microscope per student team)
- Glass coverslips and slides (1 slide/coverslip per student team)
- ABO Blood Typing Kit (available from Carolina Biological or other science supply companies)
    - Synthetic Blood Samples

    - Anti-A Serum
    - Anti-B Serum
    - Color Coded Toothpicks (yellow and blue)
    - Blood Typing Trays
- Computer with Internet Access
- Student Activity Sheets and Resource Links (listed below)

Engage: (1 class period)

1. Students will enter the classroom, with microscope stations set up at each table (student teams of 2). Projected, will be an image of a blood drop with the title, "In the Blood". Students at each lab table will be provided with a pack of sticky notes and will first be asked to answer the following on a sticky note:
    a. What do you know about blood?
    b. Why is it important to know the genetics of blood?

Students will be given 5 minutes to answer these questions on a sticky note and then these notes will be collected and added to a class "brainstorm" paper. Selected brainstorm notes will then be shared with the class (by the teacher) in order to share and determine what the class already knows about blood and the genetics of blood.

2. Next, students will be asked if they have ever had the opportunity to examine blood under a microscope? Students will next be introduced to synthetic blood samples and safety and use of the synthetic blood will be reviewed with the class. *Note: When discussing safety, it is imperative to discuss the fact that student blood should note be used for this laboratory activity. Bloodborne pathogens, infection and disease transmission should be discussed and reviewed with the class as reasons to not expose student blood in the classroom.* Following this safety discussion, students should be issued a lab paper called, "Examining Blood" for the next portion of the activity. In this activity:
    a. Student teams will be asked to place a drop of synthetic blood onto a glass slide and cover it with a cover slip.
    b. Students will be asked to magnify the blood under low power, medium and then finally high power. *Note: teacher may need to help student teams magnify the blood and check microscope magnification for accuracy.*
    c. Students should sketch the blood on high power and make observations.

3. Once all students have successfully created blood magnification sketches, a diagram should be projected for all students to see and compare to. As a class, discuss, label and define each portion of blood observed under high power magnification. Students should have observed red spheres (red blood cells), blue spheres (white blood cells), platelets (yellow, irregularly shaped particles), and plasma (orange liquid) in their sample.

Following this activity, students should read and review the suggested article(s), to strengthen their vocabulary and understanding of blood components. **When utilizing either online program, a reading comprehension quiz or "Blood Practice" questions can be issued to assess student knowledge.**

a. Rocket Lit Science: In the Blood: https://www.rocketlit.com/articles/article.php?id=204
b. CK-12.org: Blood: https://www.ck12.org/biology/blood/lesson/Blood-BIO/

Explore: (Three 40-minute class periods; each lesson utilizes one class period) During the "Explore" phase, students will be completing a series of three lessons in order to gain essential skills, laboratory techniques, and content on blood genetics. Each lesson with supporting documentation and links is described below.

Lesson A (Investigating Blood Genetics):

This lesson is designed as a "discovery lesson" using an online resource, complemented by a student guided note sheet. This purpose of this lesson is to provide scientific information by having students review informational content on the genetics of blood in order to learn the different blood types and the antigens that determine those blood types. Additionally, students will learn dominant, recessive and codominant blood alleles and will work through sample Punnett Square problems in order to determine the probability of blood inheritance patterns. Please see all attached resources below. **It is recommended that all content is collected and reviewed by the teacher at the completion of this class session in order to determine if student comprehension is achieved.** Additionally, teachers may choose to review and model all Blood Genetics practice problems with the class at the completion of the activity and/or assign additional practice problems as homework for further practice.

a. Amoeba Sisters Multiple Alleles (ABO Blood Types) Video: https://www.youtube.com/watch?v=9O5JQqlngFY
b. Amoeba Sisters Video Recap Notes: https://www.amoebasisters.com/uploads/2/1/9/0/21902384/video_recap_of_multiple_alleles_by_amoeba_sisters.pdf
c. Biology Corner Additional Blood Genetics Practice Problems: https://www.biologycorner.com/worksheets/blood_type_problems.html

*Note: Please see **Additional Resource** links below for additional articles and videos to reinforce blood types, genetics and blood typing.*

Lesson B (Virtual Blood Typing):

In this lesson, students will learn the necessary techniques and equipment used to test and type blood. Students will complete the virtual lab assignment in order to prepare for the "Case of the Baby Swap" activity the following day. This virtual activity also helps each student independently practice and review blood typing and ensure success for the next day without consuming extra simulated blood and serums, which can be expensive to order. **This activity can be collected and scored by the teacher or reviewed/corrected as a class activity in order to assess student comprehension.** Two virtual lab activities have been included for teacher/student lesson choice with supplemental materials. Please use the provided links below to access the virtual lab activities and supporting documentation.

Option A: Glencoe Virtual Lab

a. Glencoe Virtual Blood Typing Lab: http://www.glencoe.com/sites/common_assets/science/virtual_labs/LS27/LS27.html
b. Virtual Blood Typing Lab Worksheet: https://docs.google.com/document/d/1pPmx15Zo-G3kZIBnLgGIWr1vDgKo_g5Tkgom0qCGz0E/edit?usp=sharing

Option B: WOW Biolab Activity

a. WOW Biolab: https://www.classzone.com/books/hs/ca/sc/bio_07/virtual_labs/virtualLabs.html
b. WOW Biolab Student Activity Sheet: https://docs.google.com/document/d/1tT1yd2U6M2O6WrJuTA3WftQjXQdfoMwOMKyK9TdpXJ8/edit?usp=sharing

Lesson C (Case of the Baby Swap):

This lesson completes the "Explore" phase for students. In this culminating lesson, student teams are challenged to solve " The Case of the Baby Swap" in order to return each baby to the correct set of parents. In this activity, students must obtain synthetic labeled blood samples (note: teacher pre-labels samples as Mr. Smith, Mrs. Smith, Baby Sally and Baby Julie) and must test blood in order to determine proper blood type. After typing each individual in the case, students must then use Punnett Squares and probability in order to determine which child biologically belongs to each set of parents. *Note: For simplicity of Punnett Squares, Rh factor testing was removed from this lab activity. Students will simply test the blood in order to determine if it is type A, B, AB or O.* Please see supporting documentation below.

a. The Case of the Baby Swap Laboratory Document: https://docs.google.com/document/d/1tBEvbmlTba08NZnPScENxdVCECxi-KH2Kgkv8mkCtmU/edit?usp=sharing

b. Medical Blood Typing Procedures (to be laminated and handed to each student team along with proper supplies): https://drive.google.com/file/d/0B-A312hLHLb0a2txWFpGQWlIQVk/view?usp=sharing
c. The Case of the Baby Swap Medical Report Template and Rubric: https://docs.google.com/document/d/1vHPQIy-J-zfIUXUg9NJUHPfJjHeqjAhXGKD94kX2xpE/edit?usp=sharing

Explain: (1 class period)
Student teams will create a "Medical Report" in order to share their findings after completing "The Case of the Baby Swap" activity. Students will present their claim (which baby belongs to which set of parents) and must present their evidence and reasoning to support their claim. Within this report, evidence should consist of data supporting each patient's blood type as well as Punnett Square genetic results supporting inheritance of blood types from parents to child. All final team reports will be "shared" with the teacher and links to each final medical report will be shared in Google Classroom for further class comparison and evaluation. Student teams will design their final medical report in accordance with a rubric provided to student groups.

Evaluate: (1 class period)
Students will complete a "Medical Report Evaluation" consisting of two parts. In part 1, students will be asked to independently review two class team medical reports by accessing links provided on their Google Classroom page. In part 2 of the reflection, students will reflect on their team medical report, teamwork dynamic, gained knowledge, comfort and effort applied to the project.

The teacher will evaluate final student team performance by reviewing each team "Medial Report" according to the rubric initially provided to students.

a. The Case of the Baby Swap Medical Report Rubric: https://docs.google.com/document/d/13pd_iC2tqlPtZ9sD1lAseFgGTE45-DqR5ecTXDXQ6dA/edit?usp=sharing

Elaborate/Extend:
As an extension to the blood genetics content covered in class, students may extend their learning in a variety of ways as listed below.
a. Forensic Science: Student can apply medical blood testing and blood genetics to solve a forensic science case. Many forensic science kits are available and

use blood typing and genetics to solve the case. Example forensic activity kit - Carolina Biological: Crash in the Night Case

b. "Who's Your Daddy Genetics" online baby swap case. Due to an earthquake, nurses in a California hospital need your help to return babies to the correct set of parents! In this activity, students can choose their challenge level and must apply blood genetics and their knowledge of other Mendelian traits to solve the case. Activity link: https://www.cccoe.net/genetics/daddyhome.html
c. Student Created Case: Students can create their own medical blood typing genetics case for future classroom use based on their knowledge of blood genetics. Instead of a "baby swap" case, students can explore other uses of blood genetics and write their own mystery case with an answer key.

Additional Resources and References:

a. Newsela Article: What are Blood Groups and Why Do They Matter? https://drive.google.com/file/d/1YSUVjY4Orkfe-wRfXqaDynNtxROm3v5o/view?usp=sharing
b. Brainpop Blood Types Video: https://www.brainpop.com/health/personalhealth/bloodtypes/
c. Nobel Prize Blood Typing Game: https://educationalgames.nobelprize.org/educational/medicine/bloodtypinggame/
d. American Red Cross Facts About Blood Types: https://www.redcrossblood.org/donate-blood/blood-types.html
e. Eloncard for Blood Typing: https://www.eldoncard.com/
f. What are Blood Types? (Sci Show Video): https://www.youtube.com/watch?v=ttjn1jVACk8
g. Why do Blood Types Matter? (TED ED Video): https://www.youtube.com/watch?v=xfZhb6lmxjk&t=173s
h. Blood Types are a 20-Million-Year-Mystery (Video): https://www.youtube.com/watch?v=XGrxY0nlMgs&t=151s