STEM Learning Module Template

PISA Team:

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Strand(s): Genetics

Grade(s): 5

Key Science Terms: Heredity, dominant or recessive traits, pure or hybrid, genotype or phenotype, heterozygous or homozygous organisms, Punnett squares, genetic engineering.

Key Science Concepts:
- Genetics is the study of heredity, which relates to some specialty areas like Genetic Engineering.
- Heredity is the passing of traits from parents to offspring.
- The genes in the cells control the traits.
- Traits can be dominant or recessive which can be pure or hybrid.
- Gregor Mendel is the father of Genetics and formulated its principles.
- He cross-pollinated pure and hybrid pea plants that produce dominant and recessive traits.
- Traits have genotype and phenotype
- Resulting organisms can be heterozygous or homozygous.
- Punnett square and probability are tools to predict results in Mendelian Genetics.
- Genetic Engineering is the biological and chemical methods to change the arrangements of a gene's DNA.

NJCCC Standards: 5.5 (Characteristics of Life) All students will gain an understanding of structure, characteristics, and basic needs of organisms and will investigate the diversity of life.

5E's	Procedure	Assessment Attach all assessments	Materials/ Handouts Attach all handouts
Engage Week: Week 1	**Key Questions:** • What is genetics? • What is the history of genetics? **Key Concepts:** • Genetics is the study of heredity • Heredity is the passing of traits from parents to offspring. • The genes in the cells control the traits. • Traits can be dominant or recessive which can be pure or hybrid. • Gregor Mendel is the father of Genetics and formulated its principles. • He cross-pollinated pure and hybrid pea plants that produce dominant and recessive traits. **Procedure**: • Students observe and calculate the occurrence of various traits in dogs. Make a data table that lists each of the traits. • TECHNOLOGY: Record the data in the table and make a graph. • Compare the number of dogs that have one form of trait with those that have the other form. Ask students: What can you conclude about the variations you noticed in the dogs? • Lead students to understand that all of general physical traits are inherited. Discuss genetics and heredity. Recall the meaning of genes, chromosomes, and meiosis. Relate alleles to genes. Ask students to give a trait which they inherited from their parents. • Discuss the history of Mendelian Genetics. Emphasize that Mendel based his conclusions on the results of 30,000 pea plants over the period of 8 years. • Have the students visualize Mendel's experiments (See figure 3 in the textbook page 309). Using the example shown, have the students use Mendel's ratios to determine the number of yellow pea plants in the 2nd generation, if the 2nd generation of plants	• **MiniLab form and Performance Task Assessment for Graph** will be part of Science, Math, and Computer Subject grades. • **Reflective Journal** -What I did? -What I learned? -What questions do I have? -My overall response • **Self-Check questionnaire**	• Computers • Performance Task Assessment List for Graph • Textbook: Glencoe Science (level green)

contained the following: 100 plants and 300 plants.
- Have students relate the principles of heredity to genetic examples they have studied.
- TECHNOLOGY: Make a reflective journal (either in MS-Word or PowerPoint). Students identify activities and what they learned and record responses to the activities.

Explore

Week:
Week 2

Key Questions:
- What are some of your genetic traits?
- How similar are you and your parents for the same genetic traits?
- Is the most dominant trait the most prevalent?
- How often do certain easily-observable human traits occur in a population?
- Is there a relationship between the frequency of a trait in a population and whether the trait is dominant or recessive?
- Is red-green color blindness in humans an inherited trait? If so, do Mendel's Laws apply to its inheritance?

- Data tables and graphs
- Survey results and conclusions
- Performance Task Assessment

- Pencils and notebooks
- Worksheets
- Computers
- Performance Task Assessment list

Key Concepts:
- Some genetic traits
- Dominant and recessive traits.

Procedure:
- Ask the students to do laboratory activity 1 on genetic traits. Allow them to examine some of their genetic traits (refer to the hand-out). Also allow them to examine their parents for the same genetic traits. Let them compare how similar or different they are from their parents. Have them share results in class.
- Ask the students to do Human Genetics Activity (www.ciese.org/pisa). Let them conduct surveys.
- TECHNOLOGY: Tabulate results in MS-Excel. Submit project data to CIESE Collaborative Project.

| **Explain**

Week:
Week 3 | **Key Questions**:
• What are probability and Punnett Square and how are they used to predict?
• What is the relation of genotype and phenotype of traits to homozygous and heterozygous organisms?

Key Concepts:
• Probability is the branch of Math that helps to predict the chance that something will happen.
• Punnett square is a handy tool to make predictions.
• Genotype is the letter code for the genetic make-up of an organism.
• Phenotype is the way an organism looks or behaves.
• Homozygous are organisms with the same genes.
• Heterozygous are organisms with mixed genes.

Procedure:
• Ask students to guess the result of tossing a coin and let them express the results in ratio and percent. Have them define probability.
• Make a model of crossing pea plants. Provide students with 4 blocks of 2 different colors. Have them use the blocks to model cross involving pea plants seeds. Help them use these tools to discover the Punnett Square and to distinguish between genotype and phenotype, and homozygous and heterozygous.
• Use the Punnett Square to visualize Mendel's experiment (refer to fig. 3). Help them to give the genotype and phenotype of the resulting pea plants. Let them give the probability pf homozygous and heterozygous in each generation of pea plants.
• Ask students to work as a pair, form 2 varied genotypic traits and create a Punnett Square. Compare their results to those with the same genotypic traits and let them settle in case there are discrepancies. Share findings in class. | • **Reflective journal**
-What did I learn today?
-How did I learn it?
-What question do I have?
-What key terms did I learn?
-Define, draw pictures, and provide two examples.

• **Real-world application**: Have students choose a trait and determine its probability.

• **Note-taking worksheet**

• **Assessment sheet** | • Coins
• Blocks
• worksheets |

4

Elaborate	Key Questions:	• Genetic Journey	• Computer

Elaborate

Week:
Week 4

Key Questions:
- How will genetic investigations affect our future, from the medicine we take to the food we eat?
- What is "lethal" or deadly trait?
- What is genetic engineering?

Key Concepts:
- Genetic Investigations
- "Lethal" or deadly trait kills the baby organism before it is born.
- Genetic engineering is the biological and chemical methods to change the arrangement of gene's DNA.

Procedure:
- TECHNOLOGY: Go online (http://www.ology.amnh.org/genetics/index.html) and do the "Go on a Genetic Journey Activity.
- Ask students to read section 1: Enrichment (Double Trouble). Fill in the Punnett square for a case in which two mice each heterozygous for the dominant yellow trait, are mated. The, use the diagram to answer the questions.
- Research into genetic engineering, especially of crops, is taking place in other countries. Have students research to find out what countries could most benefit from agricultural advances involving genetic engineering. Have them research the staples of diet in those countries, and what if any, research is being done in engineering those crops. Students need to do these at home.

- Genetic Journey printouts.
- Completed enrichment form.
- One page research on genetic engineering

- Computer
- Blank Enrichment form

Evaluate	**Procedure**:	• Filled out gene stationery	• Computers
Week: Week 5	• Give test on Genetics • Complete the concept map and use the words in the concept map to complete some sentences. • Students share their reflective journal with some of their classmates. • TECHNOLOGY: Print stationery with gene decorations and write predictions about how advances in genetics might affect their life in the next 10 years • TECHNOLOGY (Optional): Write a newspaper article to announce a new, genetically engineered plant. Include all the methods of developing plant, the characteristics changed, and expected terms to see. Read the article in class. • Communicate: In their science journal, explain why offspring may or may not resemble their parents. • TECHNOLOGY: Go online (http://www.ology.amnh.org/genetics/index.html) and do the "What Do You Know?" Quiz. Retake the quiz and compare class averages. Express increase/decrease in percent.	• Test papers • Directed reading sheet for content mastery • Computed class average	• Science journal • Directed Reading Sheet

Timeline: Create a timeline for this project.

Engage
  Week 1   - Do MiniLab
                  - Define Genetics
                  - Give history of Genetics
                  - Recall previous lessons on cell division
                  - Computer Lab: Tabulate Data and create graphs

Explain
  Week 2   - Define dominant and recessive traits
                  - Do laboratory activity 1 and human genetics activitiy
                  - Computer Lab: Tabulate Data and create graphs
                  - Recall previous lessons on cell division

Explore
  Week 3   - Define probability
                  - Use Punnett Square
                  - Use Ratio and Percent
                  - Genotype and Phenotype
                  - Heterozygous and homozygous

Elaborate
  Week 4   - Go online (The Gene Space: Go on a Genetic Journey)
                  - Research on Genetic Engineering

Evaluate
  Week 5   - Test on Genetics
                  - Complete the Concept Map
                  - Sharing of the reflective journal
                  - Go online (The Gene Space: Stuff To Do") and make a Stationery
                  - Go Online (The Gene Space: "What Do You Know?")

Sources:

- **Visualizing Mendel's Experiments** – Glencoe Science (Level green) 2005 The McGraw-Hill Companies (www.green.msscience.com)

- **Performance Task Assessment List** – Performance Assessment in the Science Classroom – Glencoe/McGraw-Hill Companies (www.science.glencoe.com)

- **Chapter Resource: Heredity** - Glencoe Science (Level green) 2005 The McGraw-Hill Companies (www.green.msscience.com)
  - MiniLab: Comparing Common Traits
  - Laboratory Activity: Genetic Traits
  - Directed Reading for Content Mastery
  - Test on Genetics
  - Assessment Transparency Activity: Heredity
  - Note-taking Worksheet: Heredity
  - Enrichment: Double Trouble

- **The Gene Scene** - http://www.ology.amnh.org/genetics/index.html

- **Human Genetics Project** - http://www.k12science.org/curriculum/genproj/index.html