B. Algarin
5E Lesson Plan
SCED 548

Genigames: Inheritance through Game-based Learning

Topic: Inheritance of traits	**Grade Level: Middle School**	**Time: 15 - 20 class periods[1]**
Standards		
NYS Science Learning Standards	*CCSS - ELA*	*CCSS – Math*
MS-LS3-1. Develop and use a model to describe why structural changes to genes (mutations) located on chromosomes may affect proteins and may result in harmful, beneficial, or neutral effects to the structure and function of the organism. 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 (partially address – focus is on sexual reproduction).	RST.6-8.1 Cite specific textual evidence to support analysis of science and technical texts. RST.6-8.4 Determine the meaning of symbols, key terms, and other domain-specific words and phrases as they are used in a specific scientific or technical context relevant to grades 6-8 texts and topics. RST.6-8.7 Integrate quantitative or technical information expressed in words in a text with a version of that information expressed visually (e.g., in a flowchart, diagram, model, graph, or table). 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.	MP.4 Model with mathematics. 6.SP.B.5 Summarize numerical data sets in relation to their context.
Objectives		
● Collect and analyze class data about human traits. ● Cite evidence to support the idea that parents pass down half of their genetic material to each offspring. ● Identify patterns to show that genes determine the physical traits that are expressed in an organism. ● Infer that alleles are different forms of a gene; they can be dominant or recessive. ● Construct models (punnett square) as visual representations to show the probability of traits passed down from parent to offspring.		

1 A class period is defined as 40-45 minutes. This is what I currently have as part of my schedule.

- Analyze and interpret the outcomes represented in a model (punnett square) and use as evidence to support or deny a claim regarding inheritance of traits.
- Identify patterns for the different inheritance mechanisms.
- Predict possible outcomes in dragon breeding using the patterns identified in inheritance mechanisms.
- Use context clues, inheritance patterns and models (punnett squares) to virtually breed dragons with specific traits.
- Conduct research on human traits; assess patterns of inheritance in dragons to compare to human trait.
- Compare and contrast inheritance mechanisms between humans and dragons.
- Use a digital tool to design a digital poster that synthesizes inheritance concepts inferred through evidence from the game and student survey.

Justification

Game-based learning allows for students to immediately engage in the learning experience in a low-stakes manner because they can continuously attempt the tasks if they do not succeed right away. Genigames allows students to learn about inheritance of traits through the breeding a dragons. Each level reinforces the basic concepts and challenge students by adding new traits and different modes of inheritance. The game provides a virtual world where students have to make decisions based on evidence and strategy. To provide a visual representation of how traits are inherited, models, such as Punnett squares, are included in formative assessments to how traits are inherited and to use probability as evidence of what traits might be expressed. Punnett squares allow students to use probability to infer possible outcomes. They can also use the punnett square to justify breeding choices. The use of models and the strategic decisions made during the game integrate the use of technology and the engineering practices. A comparison between dragon traits and human traits is used as a culminating task to reinforce the idea that organisms use similar patterns of inheritance to pass traits from parents to offspring. Digital tools are used for game-based learning and as a creative tool to show understanding of concepts, which shows integration of technology, engineering and science.

(LINKS)	5E Lesson Plan
Engage (1 period) (Survey) (Analysis)	Students are asked to take a survey of traits on a google form. Once the class has completed the survey, students are asked to analyze the results. The survey serves two purposes: to introduce the topic of inheritance and identify students' ideas (or misconceptions) regarding inheritance.
Explore (2 periods) (Game) (Tracker)	Students explore the basic ideas of inheritance through game-based learning. Genigames allows students to study inheritance through breeding dragons. The first half of the first level (Lullen world) provides an introduction to genetics. Students will learn how to play the game while they breed their first drake. Students need to keep track of the traits of the dragons and must start to identify some of the principles of inheritance. The following are principles addressed during the exploration: 1. traits are passed down from parents to offspring; 2. each

	parent provides half of their genetic material to the offspring; 3. observable traits (phenotype) depend on the genes passed down from the parents (genotype); 4. some traits are dominant (only one allele is needed for the observable trait to be expressed) while others may be recessive (two identical recessive alleles are needed for the observable trait to be expressed); 5. traits can be identified as dominant or recessive depending on the observable trait. Students MUST attempt to breed the first 5 drakes and maintain a trait tracker. Students can play the game in pairs or individually, however, each student must log into their own account to be able to show independent progress.
Explain (1 or 2 periods) (Check-in 1)	At the half point of level 1 (Lullen world), students complete CHECK-IN 1 as a formative assessment to ensure students are understanding the basic principles of inheritance mentioned above. It's also a great moment to answer clarifying questions and to make sure everyone knows the basic information to continue playing the game. This assessment asks students to provide evidence directly from the game to support their new ideas regarding inheritance. It also introduces the use of a model (punnett square) to allow them to connect the outcomes in a punnett square (symbols, diagram, model) to the dragon traits expressed in the game.
Elaborate (2 periods) (Game) (Tracker)	Students complete the second part of level 1 (Lullen world) and continue onto level 2 (Angeral world). The goal is for students to complete level 1 and breed 4 drakes in level 2. Students must continue to keep track of traits with more details and with the addition of specific vocabulary words (phenotype, genotype, chromosome, allele). The following concepts are addressed: females have two X chromosomes; males have one X and one Y chromosome; recessive traits are only expressed when both copies of the chromosome have the recessive alleles; dominant traits only need one copy of the dominant allele to be expressed. More dragon traits appear at this point to reinforce the concepts of dominant/recessive traits as well as to reinforce how the XX/XY chromosomes determine gender.
Explain (1 or 2 periods) (Check-in 2)	Students complete CHECK-IN 2 to solidify the understanding of the basic principles of inheritance, complete Punnett squares, interpret the results of a Punnett square and to assess vocabulary comprehension/acquisition (phenotype, genotype, chromosome, allele, etc). This assessment allows students to start making connections between symbols (genes) and the meaning of those symbols in words (physical traits). This assessment also allows students to start making connection between the genetic material found in the cell and how this material is connected to parents and offspring. Students are expected to use mathematical representations (probability), models (punnett square) to support a their claim as to which set of genes they would use to produce a set of desired traits.

Extend (2 or 3 periods) (Game) (Tracker)	Students complete the second part of level 2 (Angeral world) and the entire level 3 (Tarrin's Crag). The following are concepts addressed: X-linked traits is another form of inheritance in which traits are linked to the X chromosome, which means males will most likely have the trait expressed because they have only one X chromosome; during cell division of sex cells homologous chromosomes cross over genes, which allows for diversification of the genes; incomplete dominance is another form of inheritance in which the heterozygous pair of genes express another phenotype.
Explain (1 or 2 periods) (Check-in 3)	Students complete CHECK-IN 3 to solidify the understanding of the basic principles of inheritance, complete Punnett square (X-linked and incomplete dominance), interpret the results of a Punnett square (X-linked and incomplete dominance), and assess vocabulary comprehension/acquisition. This assessment allows students to extend their understanding of inheritance by using mathematical representations (probability), models (punnett square) to support a their claim as to which set of genes they would use to produce a set of desired traits with different inheritance patterns (X-linked and incomplete dominance).
Evaluate (3 or 4 periods) (Rubric) Digital poster platforms: google slides, easel.ly, canva, smore, infogram	Students choose between 3 human traits (cleft chin, colorblindness, and blood types). They research the trait and choose one of the dragon traits to compare it to. Students create a digital poster using the platform of their choice. The purpose of the digital poster is to show how organisms inherit traits through similar mechanisms. The digital poster must include: the name of the trait, the inheritance pattern, the possible allele combinations (genotype) with the physical trait that is expressed (phenotype), an explanation of the reason why we see these possible combinations, and at least two Punnett squares showing different crosses between different parents. The digital poster must include the information for both humans and dragons. This assessment allows them to incorporate the science of inheritance, use mathematical models (punnett squares and probability), and instructional technology (digital poster platforms) to provide the necessary evidence that compares and contrast human and dragon traits.