NORTHERN ILLINOIS UNIVERSITY

Making Middle School Science Curriculum Lesson Plans More Culturally Relevant to Early Adolescent Ethnic Minorities

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University Honors Program
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With Honors
Department Of
Curriculum and Instruction

By
Ashley Grazutis
DeKalb, Illinois
December 2018
University Honors Program
Capstone Approval Page

Capstone Title (print or type)
Making Middle School Science Curriculum Lesson Plans More Culturally Relevant to Early Adolescent Ethnic Minorities.

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Department of (print or type) Curriculum and Instruction
Date of Approval (print or type) 12/03/18

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MAKING MIDDLE SCHOOL SCIENCE LESSON PLANS MORE CULTURALLY RELEVANT TO EARLY ADOLESCENT ETHNIC MINORITIES

Making Middle School Science Curriculum Lesson Plans More Culturally Relevant to Early Adolescent Ethnic Minorities

Ashley M. Grazutis

Northern Illinois University

TLCI 497H

Honors Capstone

Dr. Blake

Fall 2018
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HONORS CAPSTONE ABSTRACT

Guidelines

The changing needs of our students, such as an increased knowledge of social justice and equity issues, are gaining importance in teacher training programs as world views of social norms are broadened to address the changing demographics in schools. This is important as education needs to be relevant to all students so they can all become informed and engaged citizens. The purpose of this study was to analyze a sample of state recommended science lessons through the lens of cultural relevance (student voice, use of differentiation, language and literacy development opportunities, student access to information, connection/contextualization to students, degree of challenge in lessons, social justice examination, and student equity/decolonization) and to adapt lesson plans found deficient in the areas stated to support new expectations of differentiated instruction. The lessons were analyzed for deficiencies in cultural relevancy using a rubric adapted from the CREDE standards for Culturally Relevant activities and Jean Aguilar-Valdez’s rubric for Culturally Responsive Lessons/Assignments and then annotated with adaptations that could be made to the lesson plans in the areas that were rated Not Observed. Deficiency was determined by percentage of inter-rater agreement using a rubric with the ratings of Not Observed, Minimal, Emerging, Effective and Highly Effective. The rubric was separated into eight (8) categories, as identified earlier and inter-rater agreement was calculated. It was calculated taking the amount of people who agreed and dividing that number by the total people who agreed. If 2 out of the 3 people said an area was not observed in a lesson plan, adaptations were annotated onto the lesson plans. Further research could look into the extent to which the adaptations suggested are effective at addressing cultural relevancy in the classroom.
Lesson Plan Analysis

As the education system is always changing, so are the needs of students. These changing needs, such as an increased knowledge of social justice issues, are some of the changes that students need in their education as society changes. There has been research done that has examined the extent to which the current science curriculum is culturally relevant to the needs of students. It has shown that while there are strides being made to make the current science curriculum more culturally relevant, still more can be done. Paul Hurd (2000) supports this idea when he states the following:

The traditional fragmented discipline bound courses are seen as meaningless for dealing with human and social affairs, with the result that forgetting becomes a major outcome of science courses...we are graduating high school students as foreigners in their own culture. Linking science/technology as a knowledge-producing system with society as a knowledge-using system is the challenge now confronting education in the sciences. The socialization and humanization of research in today's sciences provides a base for modernizing school and college science curricula. Overall, the information of science curricula is to move students from passive learning to a more proactive role emphasizing the personal and social use of knowledge...So far, most actions for the reform of science education have been simply a matter of degree; they are not a reinvention of curricula containing goals that are consistent with changes taking place in the practice of today's society, a global economy, a knowledge-intensive society, and advances in information technology (p. 48-49).
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In my future classroom, I will work towards making the curriculum I have to teach in my science classroom as relevant to the social and cultural needs of ALL of my students as possible. I will work to celebrate my students as individuals when facilitating their development of knowledge on the topics I will need to teach in my curriculum in my classroom.

In working to make the science curriculum more relevant to the social and cultural needs of ALL my students, I have analyzed the curriculum relevancy of 4 lessons that are aligned to the NGSS Life Science standards MS-LS4: Biological Evolution: Unity and Diversity. These lessons were analyzed using a rubric that was adapted from the Center of Research on Education, Diversity and Excellence (CREDE) Rubric for Observing Classroom Enactments of CREDE’s Standards for Effective Pedagogy and Jean Aguilar-Valdez’s rubric for Culturally Responsive Lessons and Assignments. In creating my rubric, I analyzed a set of lesson plans and identified deficiency by percentage of inter-rater agreement in 8 areas: student voice, use of differentiation, language and literacy development opportunities, student access to information, connection/contextualization to students, degree of challenge in lessons, social justice examination, and student equity/decolonization. Student voice is defined as when students get the opportunity to work together cooperatively and share their knowledge, experience, strengths, backgrounds, interests and needs in order to facilitate knowledge construction with their instructor and each other. Differentiation is defined as students getting the opportunity to express their learning in multiple ways. Language and Literacy development is defined as students getting the opportunity to develop their reading and speaking skills as they learn new content. Access is defined as ways in which the teacher communicates ideas in order for all students to be able to learn the information. Connection/contextualization is defined as the real life connections that are made between the content and students’ lives. Challenge is defined as allowing for

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opportunities for complex thinking to occur. Social Justice is defined as how the lesson addresses social, political and environmental concerns that impact students' lives and possible ways to act upon these concerns. Equity/Decolonization is defined as dominant discourses, deficit perspectives and possible biases in expectations being minimized so students from non-dominant backgrounds can have equitable access and ability to participate as well as those from dominant backgrounds. Each of these 8 criteria was seen as being not observed, minimal, emerging, effective or highly effective. Criteria for each of these 5 levels of cultural relevancy is defined per category in the rubric created for this analysis.

The lesson plans were chosen based on how well they aligned with the NGSS set of content domain MS-LS4 and how developmentally appropriate they are to be taught to early adolescents. MS-LS4 was the content domain chosen for this lesson analysis because biological evolution is a controversial topic that is taught in schools because of its theories going against certain religious beliefs. In choosing the lessons that would be analyzed, the decision was made to use general lesson plans that could be found on websites such as teacher-pay-teachers and CPalms (Florida State Department of Education state standard lesson resource site). This decision was made because lesson plans are increasingly being made available to teachers online. The internet is now a resource that many teachers use to get lesson plan ideas. With the internet now being a resource to gain lesson plans, I wondered how credible these lesson plans are in terms of their cultural relevancy. In searching for these lesson plans, I went into Google and typed in a science topic that goes along with the theme of biological evolution.

In finding the Genetics Goes to the Dogs Lesson Plan, I typed in “Genetics lesson plan” to Google. For the 5E on Natural Selection Module, I typed in “Natural Selection lesson plan” to Google. For the Genetically Engineering Athletes lesson plan, I typed in “Genetic Engineering
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lesson plan” to Google. For the Adaptations: Will You Survive lesson plan, I typed in

“Adaptations lesson plan” to Google. I made sure that all of them were lesson plans taken from
websites that teachers commonly use to get lesson plans in choosing the lesson plans. All of the
lesson plans chosen for this project ended up being CPalms lesson plans. In choosing these
lesson plans, I also took into consideration the instructional methods used, the context(s) chosen
to address the topic and the objectives the lesson was trying to hit on. All of these factors are
important as they help determine the cultural relevancy of the lesson plan.

In analyzing the lesson plans, I had to think about how each lesson was incorporating
student voice, use of differentiation, language and literacy development opportunities, student
access to information, connection/contextualization to students, degree of challenge in lessons,
social justice examination, and student equity/decolonization. In doing so, I read through all
portions of the lesson plans and looked for representations of each of the categories in them.

What I found was pretty surprising.

Table 1: Genetics Has Gone to the Dogs Cultural Relevancy Analysis

<table>
<thead>
<tr>
<th>Criteria for Culturally Relevant Lessons</th>
<th>Effectiveness Rater 1: Grazutis</th>
<th>Effectiveness Rater 2: Blake</th>
<th>Effectiveness Rater 3: Eads</th>
<th>Percentage of Total Agreement Among Raters</th>
</tr>
</thead>
<tbody>
<tr>
<td>Voice</td>
<td>Minimal</td>
<td>Minimal</td>
<td>Minimal</td>
<td>100% (3/3 people)</td>
</tr>
<tr>
<td>Differentiation</td>
<td>Emerging</td>
<td>Emerging</td>
<td>Not Observed</td>
<td>66% (2/3 people)</td>
</tr>
<tr>
<td>Language and Literacy</td>
<td>Minimal</td>
<td>Emerging</td>
<td>Not Observed</td>
<td>0% (0/3 people)</td>
</tr>
<tr>
<td>Access</td>
<td>Effective</td>
<td>Effective</td>
<td>Minimal</td>
<td>66% (2/3 people)</td>
</tr>
<tr>
<td>Connections/Contextualization</td>
<td>Effective</td>
<td>Emerging</td>
<td>Emerging</td>
<td>66% (2/3 people)</td>
</tr>
<tr>
<td>Challenge</td>
<td>Emerging</td>
<td>Effective</td>
<td>Emerging</td>
<td>66% (2/3 people)</td>
</tr>
<tr>
<td>Social Justice</td>
<td>Emerging</td>
<td>Not Observed</td>
<td>Not Observed</td>
<td>66% (2/3 people)</td>
</tr>
<tr>
<td>Equity/Decolonization</td>
<td>Minimal</td>
<td>Not Observed</td>
<td>Not Observed</td>
<td>66% (2/3 people)</td>
</tr>
</tbody>
</table>

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<td>0% (0/3 people)</td>
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<td>Effective</td>
<td>Emerging</td>
<td>0% (0/3 people)</td>
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<td>Highly Effective</td>
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<th>Challenge</th>
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<th>Emerging</th>
<th>0% (0/3 people)</th>
</tr>
</thead>
<tbody>
<tr>
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<td>Not Observed</td>
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</tr>
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<td>Equity/Decolonization</td>
<td>Minimal</td>
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<td>0% (0/3 people)</td>
</tr>
</tbody>
</table>

Table 4: Genetically Engineering Athletes Cultural Relevancy Analysis

<table>
<thead>
<tr>
<th>Criteria for Culturally Relevant Lessons</th>
<th>Effectiveness Rater 1: Grazutis</th>
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<td>Highly Effective</td>
<td>0% (0/3 people)</td>
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<td>Language and Literacy</td>
<td>Not Observed</td>
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<td>Emerging</td>
<td>66% (2/3 people)</td>
</tr>
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</tr>
<tr>
<td>Social Justice</td>
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<td>Not Observed</td>
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<tr>
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<td>Not Observed</td>
<td>Not Observed</td>
<td>Minimal</td>
<td>66% (0/3 people)</td>
</tr>
</tbody>
</table>

In the Genetics Has Gone to The Dogs Lesson Plan, I found that that there was minimal student voice, minimal language and literacy development and minimal equity/decolonization. In this lesson plan, I found an emerging level of differentiation, access to the content, challenge and social justice application. Connections/contextualization was the only criteria that I found this lesson plan was effective on.

I found that the 5E on Natural Selection Module had minimal connections/contextualization to students and minimal equity/decolonization. This lesson plan

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also showed no social justice application. It was emerging in the areas of differentiation and access to content. I found the lesson plan as effective in student voice and language and literacy development and highly effective in challenge.

I found that the Adaptations: Will You Survive lesson plan as only being minimal in the area of equity/decolonization. It was emerging to me in the areas of student voice, language and literacy development, connection/contextualization and social justice. I found it effective in differentiation, access and challenge.

I found from the Genetically Engineering Athletes lesson plan that it was minimal in access. I found it to have no language and literacy development. I found it as emerging in the areas of student voice, differentiation and connection/contextualization.

In order to have more reliance in the data, I also had two other professionals analyze the lesson plans for cultural relevancy. One of the people was the Curriculum and Instruction Department Chair, Dr. Sally Blake. The other person was an Assistant professor in the Physics Department, Dr. Michael Eads.

For the Genetics Has Gone to the Dogs Lesson Plan, Dr. Blake found that the lesson showed no social justice applications or equity decolonization. She found the lesson plan showing minimal student voice. She saw the lesson as emerging in differentiation, language and literacy development and connection/contextualization.

For the 5E Natural Selection Module Lesson Plan, Dr. Blake found that the lesson plan showed minimal evidence in social justice application. She found the lesson was emerging in student voice and equity decolonization. She found the lesson plan as effective in differentiation, connections/contextualization, language and literacy development, access and challenge.
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For the Adaptations: Will You Survive Lesson Plan, she found the lesson plan as having no evidence for social justice. However, she saw emerging evidence differentiation and equity/decolonization. For all the other categories, she saw the lesson plan as being effective.

For the Genetically Engineering Athletes lesson plan, she saw the lesson plan as having no evidence of social justice or equity. She saw the lesson plan as being minimal in student voice, emerging in language and literacy development, connections/contextualization and challenge, and as effective in differentiation and access.

Dr. Eads was the other professional that analyzed the lesson plans.

For the Genetics Has Gone to the Dogs Lesson Plan, he saw no evidence of differentiation, language and literacy development, social justice or equity/decolonization. He saw minimal evidence in student voice and access. He saw the lesson plan as emerging in connection/contextualization and challenge.

For the 5E Natural Selection Module Lesson Plan, he saw no evidence of language and literacy development and social justice. He saw minimal evidence of differentiation and equity. He thought the lesson plan was effective in challenge and highly effective in student voice.

For the Adaptations: Will You Survive lesson plan, he saw no evidence of social justice and equity/decolonization. He saw minimal evidence of student voice and differentiation. He saw emerging evidence of language and literacy development and connections/contextualization. The only area he saw the lesson plan was effective at was access.

Finally, for the Genetically Engineering Athletes Lesson Plan, he saw the lesson plan as having no evidence of language and literacy development and social justice application. He saw the lesson as showing minimal evidence of equity and as emerging in differentiation, access,
connections/contextualization and challenge. He found this lesson plan to be highly effective in student voice.

In these three analyses of the lesson plans, there are discrepancies in the interpretations of the evidence in the lesson plans for each category used in assessing cultural relevancy. For the Genetics Has Gone to the Dogs Lesson Plan, none of us agreed on how effective the lesson was in language and literacy development. All of us agreed that student voice in this lesson plan was only minimal. For the rest of the categories assessed, two out of three of us agreed the effectiveness of the lesson plan in the given category. For the 5E Natural Selection Module lesson plan, none of us agreed on the effectiveness of the student voice, differentiation and connections/contextualization used in the lesson plan. Two out of three of us agreed on the effectiveness of the lesson plan in addressing the remaining categories. For the Adaptations: Will You Survive lesson plan, none of us agreed on the effectiveness of the differentiation, challenge and equity/decolonization used in the lesson plan. However, all of us agreed that the access was effective in the lesson plan. Two out of three of us agreed on the effectiveness of the remaining categories in the lesson plan. For the Genetically Engineering Athletes lesson plan, none of us agreed on the effectiveness of student voice and access used in the lesson plan. However, all of us agreed that the challenge used in the lesson plan was emerging. Two of out three of us agreed on the effectiveness of the lesson plan in the remaining five areas analyzed.

For the Genetics Has Gone to the Dogs lesson plan, most of us found voice to be minimal, differentiation to be emerging, language and literacy to be mixed between not observed and emerging, access to be effective, connections/contextualization to be emerging, challenge to be emerging, social justice to be not observed and equity/decolonization to be not observed. The
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lesson plan was the weakest in social justice and equity/decolonization and the strongest in access.

For the 5E Natural Selection Model lesson plan, voice was seen as a mix between emergent and highly effective, differentiation to be mixed between minimal and effective, language and literacy to be effective, access to be emerging, connections/contextualization to be mixed between minimal and effective, challenge being effective, social justice to be not observed and equity/decolonization to be minimal. The lesson plan was the weakest in social justice and the strongest in voice, language and literacy and challenge.

For the Adaptations: Will You Survive lesson plan, voice was seen as effective, differentiation was seen as mixed between minimal and effective, language and literacy to be emerging, access to be effective, connections/contextualization to be emerging, challenge to be effective, social justice to be not observed and equity/decolonization to be mixed between not observed and emerging. The lesson plan was the weakest in social justice and the strongest in voice, access and challenge.

For the Genetically Engineering Athletes lesson plan, voice was seen as mixed between minimal and highly effective, differentiation to be emerging, language and literacy to be not observed, access to be mixed between minimal and effective, connections and contextualization to be emerging, challenge to be emerging, social justice to be not observed and equity/decolonization to be not observed. The lesson plan was the weakest in language and literacy, social justice and equity/decolonization and strongest in voice, differentiation, access, connections/contextualization and challenge.

Overall, social justice was not observed in any of the lesson plans. Voice was seen to be more effective in the natural selection lesson plan and the adaptations lesson plan and less

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effective in the genetic engineering lesson plan and even less effective in the genetics lesson plan. Differentiation was seen as emerging in all of the lesson plans. Language and literacy was seen as the most effective in the natural selection lesson plan, second most effective in the adaptations lesson plan, third most effective in the genetics lesson plan and the least effective in the genetic engineering lesson plan. Access was seen as the most effective in the genetics and adaptations lesson plans and least effective in the natural selection and genetic engineering lesson plans. For connections/contextualization all the lesson plans were seen as emerging. For challenge, the natural selection lesson plan and the adaptations lesson plans were seen as the most effective and the genetics and genetic engineering lesson plans as the least effective. Equity was seen as not observed in the genetics and genetic engineering lesson plans and minimal for the natural selection and the adaptations lesson plan. Looking at all the lesson plans together, the weakest areas are in social justice and equity/decolonization and the strongest area are voice, access and challenge.

With this data, there are many limitations to it. The biggest limitation to this data is the sample size. Our sample size is not big enough in order to make an overall conclusion on the effectiveness of the lesson plans presented in the eight categories that were assessed. However, with the data that has been collected and presented, we can see some agreements in the lesson plans needing changes so they are more culturally relevant. Disagreements between the three of us in the effectiveness in the given categories could be for many reasons. Some of these reasons could be for our variations in academic backgrounds and experiences, variations in interpretations of the criteria descriptions for each level of effectiveness on the rubric, variations in interpretations of the lesson plans themselves and the variations of the interpretations of the criteria being represented in the lesson plans.

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Lesson Plan Modifications

I. Genetics Has Gone to the Dogs

As we have seen, the Genetics has gone to the Dogs lesson plan is the weakest in the social justice and equity/decolonization areas. In addressing the social justice area, Wayne Au, Bill Bigelow and Stan Karp write that “classrooms can be places of hope, where students and teachers gain glimpses of the kind of society we could live in and where students learn the academic and critical skills needed to make it a reality” (2015, p.1). Blake also mentions that, “In order to foster classroom social justice, teachers must first build a safe, encouraging place where students can speak about their experiences and beliefs” (2015, p.1). From these ideas, we can see where the lesson plan lacks in allowing the students to speak about their experiences and beliefs, gain a glimpse of the society we live in and gain critical skills to make social justice a reality. In the lesson plan, two areas in particular where social justice can be addressed are in the explore section of the lesson and the elaborate section of the lesson. A major area that stood out in the explore section of the lesson is when the lesson plan says “The Explore section encompasses a short period of direct instruction about how to read a pedigree” (Genetics Has Gone to the Dogs, 2015, p. 2). This area can be improved in being more academically rigorous. “A social justice classroom equips children not only to change the world but also to maneuver in the one that exists. Far from devaluing the vital academic skills young people need, a critical and activist curriculum speaks directly to the deeply rooted alienation that currently discourages millions of students from acquiring those skills” (Introduction: Creating Classrooms for equity and social Justice, n.d, p.1). In directly instructing these students, students are missing out on the opportunity to gain critical thinking skills. In giving the students an opportunity to think critically in addressing social justice, the students could instead start out by simply being given
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the pedigree and then looking at the information the pedigree gives and patterns in the information the pedigree gives in order to look at what a pedigree could be used for in addressing a social justice issue having to do with dogs, such as how can we achieve the traits we would like to have in dogs safely? The students could then use the pedigree in order to determine what types of dogs could be bred together to produce the traits we want in dogs, while still keeping them healthy. In looking at social justice as working together to determine how our resources can be used to solve problems, we are also addressing social justice in “learning about the problems that dramatically impact quality of life for certain populations, and how people have worked to solve those problems” (Gonzalez, 2016, p.1). In having the students discover what pedigrees can be used for to solve problems, they will be practicing social justice through advocacy and critical thinking.

Another major area that stood out in the elaborate section in the lesson is the part where the students “will form teams for pro and con for artificial selection and the teacher will facilitate a friendly debate” (Genetics Has Gone to the Dogs, 2015, p. 2). In having groups of pro and con for debating about being for or against dog breeding, the teacher can take it a step further having the students think about ways in which dog breeding can be done more safely. In this way, the students will be working to solve a problem. Social justice works to “…approach the learning process as a path to solving problems…” (Blake, 2015, p. 1). In this point in the lesson, the students are working to think through their thoughts in doing a debate on pros and cons in dog breeding, but the lesson never addresses how to make the dog breeding process safer and more effective. Students could work together to address this issue in this lesson in order to address social justice in this lesson more effectively. Social justice also connects very closely to equity/decolonization, which is the other area of this lesson plan that is the weakest.
write to explain the impact of selective breeding on dog breeds

- Prior Knowledge: What prior knowledge should students have for this lesson?

Students should know that parents pass traits to their offspring. They should also know that some diseases and disorders are passed from parent to offspring.

This lesson should take place after the lesson on Punnett squares.

- Guiding Questions: What are the guiding questions for this lesson?

How do doctors determine the risk of genetic disease in an individual?

If humans can use our knowledge of inheritance to obtain desired traits in an individual, should we? Why or why not?

How are Chihuahuas and Great Danes both members of the same species, domesticated dogs (*Canis familiaris*)? How do humans impact the look and temperament of dog breeds?

- Engage: What object, event, or questions will the teacher use to trigger the students' curiosity and engage them in the concepts?

Begin with the pre-test. Students should take no more than about 15 minutes to complete the test. Remind them that this is an assessment to see what they already know about what you are going to teach, so if they don't know, they should do their best but not take too much time on any one question. (Note that the answer key is included in the attached document beginning on the third page.)

Once the pre-test has been collected, begin with the PowerPoint.

The teacher will introduce the standards and learning goals.

The teacher will ask the essential questions. This can be followed by a brief discussion about things students already know about genetics and genetic engineering.

Advance to the slide of the Great Dane and Chihuahua. Prompt students to turn and talk to their shoulder or face partner about the questions. Students can write any questions that they have on sticky notes; if the teacher does not answer them during the course of the lesson, they can ask later.

Pairs share what they discussed with the whole class. This should take no more than about 5 minutes.

- Explore: What will the students do to explore the concepts and skills being developed through the lesson?

The Explore section encompasses a short period of direct instruction about how to read a pedigree (PowerPoint slides 6-13). The teacher answers questions as he/she moves along. The teacher should have the Pedigree Checklist Template (attached) in front of her/him during the PowerPoint to record student misconceptions.

During the lecture, students practice reading pedigrees and interpreting them using their white boards. (Each student arrives at his or her own answer, but they can correct misconceptions after everyone has shared.)

- Explain: What will the students and teacher do so students have opportunities to clarify their ideas, reach a conclusion or generalization, and communicate what they know to others?

Once you get to "Real World Implications" (slide 14), the teacher will give students their sample pedigree about German Shepherds and hip dysplasia (Hip Dysplasia attachment). Students will determine the probability that each individual in Generation III will be affected by hip dysplasia.

The teacher hands out articles I and II (Dog Articles attachment), and the rubric (Pedigree Rubric attachment). Students will complete a 2-3 paragraph opinion response in which they discuss whether humans should continue to selectively breed dogs for desirable traits (like sense of smell, size, etc.) knowing that this selective breeding can reduce genetic variability in the population and increase the incidence of genetic disorders.

Elaborate: What will the students do to apply their conceptual understanding and skills to solve a problem, make a decision, perform a task, or make sense of new knowledge?

Once complete, students will form teams for "pro" and "con" for artificial selection, and the teacher will facilitate a friendly debate. Each side will have 5 minutes to go around the group once. Each group will have a recorder (to write down ideas) and a speaker (to share ideas with the whole class). The teacher will facilitate group discussion as students talk back and forth about artificial selection.
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An area where there is a great opportunity in this lesson plan for equity/decolonization can be improved is in the extensions part of the lesson where students are to “research examples where limited gene pools in humans caused an increase in undesirable traits in offspring. Examples include the Fugate family in Kentucky, the Hapsburg Jaw and other deformaties in the Hapsburg family that resulted from generations of inbreeding, and the rapid spread of hemophilia in European royalty during the late 19th/early 20th century” (Genetics has Gone to the Dogs, 2015, p. 3). Notice how all of the examples given come from those of European descent or American descent. In only giving these examples, only the dominant cultures are being addressed. This is a disservice in equity/decolonization because with only the dominant culture being addressed, it is expected that those from the non-dominant backgrounds will be able to know the connections behind the diseases and the family as well as the kids from non-dominant backgrounds.

Equity/decolonization can be improved in this way by giving students resources from families that are not from European or American descent. “Understanding the impact of culture, adopting a student-first mindset, and creating multiple points of engagement with the same content will help teachers move towards academic equity in their classroom” (Berry-Jones, 2018, p.1). In giving students resources on families who are not from a European descent, it will help students to more effectively connect the funds of knowledge they gain from their culture to the content they are learning, which will then give multiple points of view in which the content can be seen. From there, students will be able to connect what they have from their culture to what they are learning in a more effective way and apply the content in a more effective way to be able to address the social justice theme of finding a way to breed dogs more safely and effectively as given in the previous section.
Potential "Pros" and "Cons" for artificial selection:

(These will either be sample student responses or you can suggest these to students to spark further discussion before groups begin to debate.)

Pros:

- Artificial selection doesn't just pass along faulty genes; it helps us select for desirable ones, too.
- It helps us understand the impact of genetic pre-disposition in research on human diseases, like cancer.

Cons:

- It hurts the animal, who will have no choice but to suffer through painful and debilitating illness if affected.
- It hurts the population because of decreased genetic variability.

• **Summative Assessment**

The pre-test can be given again to show growth with regard to the learning goal, however, the primary assessment of this lesson is the written assignment, which asks, "Should people continue to breed and/or purchase purebred dogs that have desirable traits if the artificial selection of these dogs leads to an increase in genetic disorders?"

• **Formative Assessment**

The teacher will use a pre-test to determine existing knowledge (as well as understanding of prior lessons on Punnet squares).

The teacher may use a checklist during the PowerPoint/Explore session to ensure that students are able to correctly use a pedigree and are ready to move on to the analytical portion of the lesson.

• **Feedback to Students**

Students will get immediate feedback during formative assessment as well as feedback on their summative assessment via the rubric.

**ACCOMMODATIONS & RECOMMENDATIONS**

• **Accommodations:**

Students who need accommodations can have a leveled passage according to their Lexile. The whole group will be using various Kagan structures. Gifted students will use the "Elaborate" section of the lesson to further pursue the impact of artificial selection on a species.

• **Extensions:**

Students will research the requirements of the American Kennel Club for pure-bred animals and write about how dog shows, pop culture (think 101 Dalmatians), and puppy mills impact species and how our knowledge and documentation of the artificial selection might apply to other species (think endangered species).

Students can also research examples where limited gene pools in humans caused an increase in undesirable traits in offspring. Examples include the Fugate family in Kentucky (the "blue people"), the Habsburg law and other deformities in the Habsburg family that resulted from generations of inbreeding, and the rapid spread of hemophilia in European royalty during the late 19th/early 20th centuries.

Sample articles:

- "Why the Fugate Family Has Blue Skin" by Stacy Conradt (Mental Floss)
- "Inbreeding caused demise of the Spanish Habsburg dynasty, new study reveals" by Fiona Govan (The Telegraph)
- "Hemophilia: The Royal Disease" by Yelena Aronova-Tuntseva and Clyde Freeman Herreid (from the National Center for Case Study Teaching in Science)

• **Suggested Technology:** Computer for Presenter, Microsoft Office

**Special Materials Needed:**

- Class sets of the Pre-Test (pp. 1-2 only), Dog Articles, Hip Dysplasia, and Rubric attachments should be printed in advance.
- Whiteboards/dry erase boards and dry erase markers - a class set
- The teacher should have a copy of the Pre-Test key (pp. 3-4) and Pedigree Checklist.
II. 5E Natural Selection Module

For this lesson, social justice was once again the weakest area. In addressing this area, environmental concerns were evident in this lesson plan in on the factors leading to natural selection being environmental change and how the peppered moth population changed because of the increase in pollution in the area. However, this lesson plan could go even more in depth on human impact in natural selection outside of artificial selection by addressing how we can lessen our impact on the environment in order to have natural selection happen more naturally. Climate change is a very controversial issue that is not even being addressed so much outside of the classroom. “…Until we treat climate change as a social issue that is not a separate issue for environmentalists-only or as separate from social justice work, we are not addressing the full issue” (Xiao, 2016, p. 1). In educating our students about the content we teach in the classroom, we need to not be afraid of integrate the topics that are more controversial to talk about. If we don’t address these issues in the future, they could have devastating consequences.

Because social justice and environmentalism don’t always align in their objectives, lower-income communities often face the decision of choosing industrial development and jobs over their health, a trade-off that ends up nefariously ruining a community’s potential for prosperity in the long-run as the attractiveness of the neighborhood degrades and property values decrease… Climate change requires our immediate attention. If we don’t incorporate climate change into our social justice work, there will be no society for us to even fight for in as little as twenty-five years (Xiao, 2016, p.1).
Materials needed: Student laptops with shockwave installed, lab sheet

Students will explore the weblab simulation created by the Education Development Center, Inc. and programmed by MathResources, Inc. as part of Enlivening Genetics Education Project. They will complete the included worksheet that follows along with the simulations.

http://www2.edc.org/weblabs/NaturalSelection/NaturalSelectionMenu.html

The questions go in order. It usually takes my advanced students about 30 minutes to complete. I let them work with partners.

The weblab uses Shockwave, and has been around a while. It can sometimes be problematic to get the permissions to install Shockwave on student computers. However, the simulation does a very nice job of going through natural selection and letting them play around with the different scenarios. If tech is a problem in terms of student access, I've done this as a whole group with a projector, still making them answer the questions on the worksheet to hold them accountable for the activity. If it won't work at all, the main ideas are covered in the other components of this lesson plan.

- **Explain:** What will the students and teacher do so students have opportunities to clarify their ideas, reach a conclusion or generalization, and communicate what they know to others?

Materials needed: PowerPoint presentation, 11x17 paper for posters, art materials, animal reference pictures

1. Using the "Factors Leading to Natural Selection" section of the powerpoint provided teacher will explain the four factors that contribute to natural selection, overproduction, variation, competition, and environmental change. Students should take down notes for the basic explanations, and go through how sea turtles illustrate how the factors might work on a population.

Overproduction is the hardest for the kids to understand. They confuse it with overpopulation. Overproduction means far more offspring are produced that can survive due to competition and limiting factors. Overpopulation occurs when a limiting factor is removed and more of those offspring survive than the system can support. If there is no variation, no selection can occur and it is simply a matter of luck who survives to pass on their identical trait. Without competition, everyone survives so no selection. Students should be clear about what organisms are competing for — often they are competing not to be eaten by someone else. In an evolutionary context, competition occurs within the species to force selection. Competition with other species in a similar niche is part of ecology, and usually leads to the extinction of one of the species. Environmental change does not have to be, and in terms of evolution has rarely been, related to human impact on the environment.

2. Students will create posters in groups illustrating the four factors acting on a population of their choice, and will be assessed according to the rubric below. Students will evaluate posters and will vote on which to hang in the room as a reference during the unit.

I only give the kids the class period for their posters. They always want more time, but on task groups do have enough time to create a good idea. I give them one tabloid size (11x17) piece of white paper, and provide art boxes. I also have field guides and books on animals to give them references for their illustrations, and ideas for populations. I don't let them use computers or phones because it eats up too much time, and I want them to think creatively. I also have them lay their finished work out (names on back) with a sticky note on the front, so that all of my students can vote on which posters they want to hang up on the wall. Then I post them and leave them up through the test. This makes them selective and critical about how well the poster reminds them of the factors, and is a good way for students to assess the relative quality of their work.

**Poster Rubric (26 points)**

1. The population illustrates each of the four factors leading to natural selection realistically. (12 points possible)
   - Explanation clearly shows how the factor is working on the population, makes sense, and is realistic. (3 points)
   - Explanation shows how the factor works, but the scenario is not entirely clear or thoroughly explained. (2 points)
   - Factor is included, but the explanation doesn't make sense. (1 point)
   - Factor is not represented on poster (0 points)

2. Text on the poster explains the factor appropriately (4 points possible)
   - 1 point for each factor for at least a complete sentence explaining how the scenario relates to the factor.

3. Pictures illustrate the factors at work (8 points possible)
   - 1 point for each factor for at least some illustration in color representing the factor.
   - 1 point for each factor if the illustrations drawn relate to scenario

4. Each factor is written on the poster as a clear heading, large enough to read. (1/2 point each factor)

**Make-up Assignment:**

Make sure that you write with clarity of expression and show depth of thought, as you are not making the poster portion of the original assignment.

1. Give a description of each factor (overproduction, variation, competition, and environmental change) and how it affects selection.
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In teaching students about how to combat social justice issues in teaching them our content, we will be helping our students to live happier and healthier lives and having them be the advocates for the changes they want to see in the world.

III. Adaptations: Will You Survive

For this lesson plan, social justice was also the weakest area. In addressing this area for this lesson plan, it focuses very much so on the Florida ecosystems. At the end of the lesson plan in the extensions section of the lesson plan, it mentions that the teacher could include a current event. "Include current events such as python hunting in the Everglades on the controversial 2015 Florida black bear hunting to create a classroom debate. Students would be assigned either the pro or the con of the controversy" (Adaptations: Will You Survive, 2015, p. 3). In looking at this extension in the lesson plan and the idea that it is talking about adaptations, students could address the social justice issue of overhunting and the extent to which humans should be able to hunt animals. Some may think that social justice is only applicable to humans. However, it does apply to animals as well. It is also our responsibility to protect the rights of animals in addressing social justice issues. "...those committed to social justice – to minimizing violence, exploitation, domination, objectification, and oppression – are equally obligated to consider the interests of all sentient beings, not only those of human beings" (Jones, 2015, p.1). In exploring social justice, we are exploring what is moral and ethically correct for all beings.

Interestingly, what we find time and time again in the classroom is that students not only enjoy engaging with these voices, but doing so opens their eyes to the significance of social justice and human rights in their own lives and communities. It awakens in them an intuitive knowing that justice for one is justice for all, and reminds them that in our global political

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Extensions:
Include current events such as python hunting in the Everglades or the controversial 2015 Florida black bear hunting to create a classroom debate. Students would be assigned either the pro or con of the controversy.

Students may write a paragraph summarizing the cloze activity.

- Suggested Technology: Computers for Students, Microphones

Further Recommendations:
Print out the PowerPoint presentation slides for any students who may be absent.

SOURCE AND ACCESS INFORMATION

Contributed by: Patricia Goss
Name of Author/Source: Patricia Goss
District/Organization of Contributor(s): Orange
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Related Standards

<table>
<thead>
<tr>
<th>Name</th>
<th>Description</th>
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</thead>
<tbody>
<tr>
<td>SC.5.L.15.1:</td>
<td>Describe how, when the environment changes, differences between individuals allow some plants and animals to survive and reproduce while others die or move to new locations. Compare and contrast adaptations displayed by animals and plants that enable them to survive in different environments such as life cycles variations, animal behaviors and physical characteristics.</td>
</tr>
<tr>
<td>SC.5.L.17.1:</td>
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</tbody>
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climate it is up to individuals to ensure that institutions are held accountable to moral and
ethical standards (Johnston, 2015, p. 5).

In teaching students social justice, we also need to make sure that we have students think
about how their actions will affect them in the long run. We need to make sure in our lessons that
we are teaching in a way where students can minimize harm to others and do what is morally and
ethically right not only for themselves, but for others. As students in middle school are in the
concrete operational stage of cognitive development and moving into the formal operational
stage of cognitive development, these students will develop the skills in thinking more critically
about how to best serve themselves and others. However, it will take some students more time
than others to empathize with others and put their needs at best interest as well.

IV. Genetically Engineering Athletes

The weakest areas of this lesson plan were social justice, equity/decolonization and language
and literacy development. Once again, this lesson plan has students form a position on the role of
biotechnology in society when in the lesson, the teacher is deciding which groups will be pro and
which groups will be con in whether we should be able to genetically engineer humans to give
them certain traits. To end the debate, “The teacher will lead a final conversation reminding the
students that this science fiction is not so fictional anymore. In fact, their generation will be
making a lot of decisions about this topic as they get older” (Genetically Engineering Athletes,
2015, p. 3). Students once again are making decision based on information they find, but there is
nowhere in this lesson where students are doing anything to address the controversy they
encounter. In this lesson, students could explore the social justice issue of genetic engineering by
making the decisions about when it is ok to genetically engineer and when it is not ok to
genetically engineer as given at the end of the lesson. This simple activity will get the students
The teacher will lead a final conversation reminding the students that this "science fiction" is not so fictional any more. In fact, their generation will be making a lot of decisions about this topic as they get older.

**Summative Assessment**

- The final assignment will be a debate between teams over the ethical dilemma of genetically engineering people to be better athletes. A rubric can be found at Rubistar Rubric. If the teachers need to do a site search for the rubric on RubiStar, the number is 2449663.
- There are two attached documents that will help students as they prepare for the assessment. The teacher will find "How to Debate as a Team" and "Sources for Research" attached to the lesson plan (both documents are for the students to use).

**Formative Assessment**

The teacher will be circulating to ensure that students are completing the assignment accurately and thoughtfully. While they are working in their groups, the teacher may ask:

- What are the characteristics of good ______? (soccer players, swimmers, figure skaters, gymnasts)
- Why would one person be better at playing football while another is better at basketball?
- What makes it difficult for a long distance runner to win in a sprinting event?
- Just because we CAN do something (like cloning) does that mean we should?

Student answers to these questions will inform teacher about how well the student is grasping this information.

**Feedback to Students**

- While the teacher is circulating and asking questions such as those listed above in Formative Assessment, the teacher will listen for any misconceptions in student responses and provide verbal feedback.
- Feedback will also be given for the final Summative Assessment using the rubric provided (see Summative Assessment).

**ACCOMMODATIONS & RECOMMENDATIONS**

**Accommodations:**

- The first part of the lesson will be to research the traits of athletes and how they can make an athlete more successful. This is probably best done in pairs if students need additional assistance. They are to use textbook, outside sources, or computer sources to assist in this assignment.
- As the second part of the lesson is a larger group assignment, the structure will be helpful for students who need additional assistance through the student-student interactions. The teacher may wish to form teams such that weaker students are grouped with stronger students.
- The nature of the activity will help to meet the different strengths of class members while teaching the concepts.

**Extensions:**

Students may write "newsprint" articles or create news reports to explain the influence of genetics on sports. Another option would be for students to try to design the perfect athlete, emphasizing which type(s) of biotechnology they would plan to use.

**Suggested Technology:** Computer for Presenter, Computers for Students, Internet Connection, LCD Projector, Microsoft Office, Computer Media Player

**Special Materials Needed:**

Materials for research – computers, textbooks, etc.

**Further Recommendations:**

The lesson may be challenging for those students who are not the best at working together, as it requires a lot of give and take. Therefore, some extra teacher guidance may be required, as well as paying special attention to student personalities when assigning students to groups.

Some students may struggle with the idea of "better" or "worse" genetically. The teacher should try to encourage students to think scientifically, not judgmentally.

**SOURCE AND ACCESS INFORMATION**

Name of Author/Source: Anonymously Submitted
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thinking about how to address equality as it will have students look at the ways in which their lives are equal and unequal from those around them and think about how students will address inequalities in the future.

Enabling conversations about these issues empowers students to voice their concern and question unjust situations in their lives or in the lives of those around them. To help students examine systemic inequality, teachers can have them consider questions such as: Who makes decisions and who is left out? Who benefits and who suffers? Why is a given practice fair or unfair? What is required to create change? What alternatives can we imagine? Through answering these questions, students can start to recognize injustice existing at the micro and macro levels (Blake, 2015, p.1)

Students can learn through discussions on social justice issues, such as genetic engineering, how to make decisions on what is best for all the people in a community. In students being able to do this, we can work to decrease the amount of inequalities among people in our society in the future.

This lesson was also the weakest in language and literacy development and equity/decolonization. In addressing both of these issues at once, the materials the students are reading for this activity could be matched to the students’ lexile levels and their interest. This activity can also be expanded to not just talk about sports, but to also talk about any activities the students are involved in. Also, the teacher should frame this activity so students are not being judged because of traits they cannot control. This asks students to point out what traits make others better at some sports than others. However, this can be degrading to students. Instead, this lesson needs to be structured in a way where students have more freedom in exploring their own interests and reading materials that are appropriate for their lexile levels. In this way, the teacher

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4. Students will debate their positions on genetic engineering in athletics.
5. Students will understand that science can stir up ethical debates among scientists and in the general population.

- **Prior Knowledge: What prior knowledge should students have for this lesson?**
  - Students should have knowledge of basic genetic concepts and heredity.
  - They should understand that selective breeding is considered biotechnology; it is just a simpler form that has been around for many, many years.
  - They should understand what biotechnology is.
  - They should understand what ethics are and why they are important.

**Students may sometimes find it difficult to understand how genetics contribute to success in various areas. They are also often confused about the types of biotechnology and how they are used. Many students may be confused by why ethics should be considered in cases like that covered in the lesson plan ("after all, it is making something better"). Exposure to many examples will help students understand how "beneficial" biotechnology can be controversial ethically, although many adults struggle with these concepts, as well.**

- **Guiding Questions: What are the guiding questions for this lesson?**
  1. What are some of the physical characteristics of good athletes?
  2. Why are some athletes better at some sports and not others?
  3. Is it okay to genetically engineer a better human?

- **Teaching Phase: How will the teacher present the concept or skill to students?**
  - The lesson will begin with a review of biotechnology as a field; biotechnology dates back to the days when people figured out how to selectively breed animals and plants to obtain desired traits. Selective breeding proceeded to the actual manipulation of genetic material in organisms. Use the attached PowerPoint.
  - As a hook to pull students in, two YouTube video clips will help students to begin to grasp these concepts. First, show the clip YouTube - Genetic Engineering for Human Enhancement (show from 3:30-6:14). Follow the first video with this clip from the film Gattaca depicting a futuristic society in which genetic engineering of zygotes has become common practice. The Gattaca clip will expose students to the idea of custom choosing the traits of one's offspring.
  - Ask students what fields they think would benefit from genetic engineering of humans. Hopefully, someone will suggest sports, but if not, they need to be led to that. This clip, Race, Science, and Athletics, provides an interesting look at characteristics for success in some sports.

- **Guided Practice: What activities or exercises will the students complete with teacher guidance?**
  The students will complete the worksheet - Traits of Athletes (attached). To do this students will use internet and/or library research. Often, students will already have insight into some sports. The teacher will remind the students that when traits are discussed in this lesson plan, the traits will be those relevant to success in the sport, not trivial traits.

  The teacher will be circulating to ensure that students are completing the assignment accurately and thoughtfully. While they are working in their groups, the teacher may ask:
  - What are the characteristics of good _____? (soccer players, swimmers, figure skaters, gymnasts)
  - Why would one person be better at playing football, while another is better at basketball?
  - What makes it difficult for a long distance runner to win in a sprinting event?
  - Just because we CAN do something (like cloning), does that mean we should?

  Once the assignment is completed, the teacher will lead a brief, free-form, class discussion addressing a few of these traits.

- **Independent Practice: What activities or exercises will students complete to reinforce the concepts and skills developed in the lesson?**
  - After the discussion, the teacher will create groups of 3-5 students. The teacher will want to have an even number of groups; one half will be "for" and one half will "against" genetic engineering in the debate.
  - The teacher will introduce the debate topic. The teacher will tell students that one team will be presenting for genetic engineering, and one team will be against genetic engineering. The teacher will not tell the students which side they will represent, yet. The students will be told to brainstorm ideas for each side within their groups. This will help students to develop their arguments when they are preparing to counter the argument coming from the opposing side. The attached document provides potential sources to help with the research.
  - Finally, the teacher designate groups as pro or con. The teacher will place pieces of paper labeled with group numbers and pro/con in a cup. The label follow: Group 1 pro, Group 1 con, etc. One student per group will select a paper from the cup. The students will begin mapping out their approach to the debate. Students may continue to use resources to assist them in developing their arguments. The teacher will remind the students that they want to work quietly so as not to give the opposing team an unfair advantage.
  - The teacher will continue to circulate to provide assistance as needed.

- **Closure: How will the teacher assist students in organizing the knowledge gained in the lesson?**
  - Preparing to debate, debating, and watching the other groups debate will help the students to organize their recently-acquired knowledge.
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should also redesign this activity so the students are only focusing on themselves and not comparing themselves to others. Especially at the middle school level, students are very critical of their bodies and how others see them because they are going through puberty. With this, this lesson plan would need to be reworked so that the lesson is very individualized and not so much comparing themselves to others. “Equity involves individuals…” (Smith, 2016, p.1). In not comparing themselves to others, the lesson will be more equitable as minority students are not being asked to compare themselves to the dominant culture. In students being able to develop themselves as individuals, they will be working toward their own expectations and their own goals. In doing this, students will not have to be compared to the dominant culture in doing the activity.

What is most important in addressing cultural relevancy in lessons is to remember that students are individuals and that individuals bring with them different funds of knowledge, experiences, strengths and areas of improvement to work with in the classroom. As teachers, it is our job to bring out the best potential in students based on what they bring to the classroom and not see their differences as deficits, but rather see them as assets to instruction.
This is a resource from CPALMS (www.cpalms.org) where all educators go for bright ideas!

Resource ID#: 130646

Primary Type: Lesson Plan

Genetics Has Gone to the Dogs!

This lesson uses pooches to teach about pedigrees and the impact of artificial selection on individuals and populations as well as to drive home math concepts already discussed in lessons on Punnet squares.

Subject(s): Science, Mathematics
Grade Level(s): 7
Intended Audience: Educators

Suggested Technology: Computer for Presenter, Microsoft Office

Instructional Time: 2 Hour(s)
Resource supports reading in content area: Yes
Keywords: Science, Genotype, Phenotype, Pedigree, artificial selection, selective breeding, inbreeding
Resource Collection: FCR-STEMLearn Diversity and Ecology

ATTACHMENTS

Hip_Dysplasia.docx
Pedigree_Rubric.docx
Pedigree_PPT.pptx
Pedigree_PreTestAndKey.docx
Dog_Articles.docx
Pedigree_ChecklistTemplate.xlsx

LESSON CONTENT

- Lesson Plan Template: General Lesson Plan
- Learning Objectives: What will students know and be able to do as a result of this lesson?

Students will be able to:

- read a pedigree to identify phenotype and determine the possible genotype of an organism
- use a pedigree to determine the probability that an organism's offspring will be affected by genetic disease
• **Prior Knowledge: What prior knowledge should students have for this lesson?**

Students should know that parents pass traits to their offspring. They should also know that some diseases and disorders are passed from parent to offspring.

This lesson should take place after the lesson on Punnett squares.

• **Guiding Questions: What are the guiding questions for this lesson?**

How do doctors determine the risk of genetic disease in an individual?

If humans can use our knowledge of inheritance to obtain desired traits in an individual, should we? Why or why not?

How are Chihuahuas and Great Danes both members of the same species, domesticated dogs (*Canis familiaris*)? How do humans impact the look and temperament of dog breeds?

• **Engage: What object, event, or questions will the teacher use to trigger the students’ curiosity and engage them in the concepts?**

Begin with the pre-test. Students should take no more than about 15 minutes to complete the test. Remind them that this is an assessment to see what they already know about what you are going to teach, so if they don’t know, they should do their best but not take too much time on any one question. (Note that the answer key is included in the attached document beginning on the third page.)

Once the pre-test has been collected, begin with the PowerPoint.

The teacher will introduce the standards and learning goals.

The teacher will ask the essential questions. This can be followed by a brief discussion about things students already know about genetics and genetic engineering.

Advance to the slide of the Great Dane and Chihuahua. Prompt students to turn and talk to their shoulder or face partner about the questions. Students can write any questions that they have on sticky notes; if the teacher does not answer them during the course of the lesson, they can ask later.

Pairs share what they discussed with the whole class. This should take no more than about 5 minutes.

• **Explore: What will the students do to explore the concepts and skills being developed through the lesson?**

The Explore section encompasses a short period of direct instruction about how to read a pedigree (PowerPoint slides 6-13). The teacher answers questions as he/she moves along. The teacher should have the Pedigree Checklist Template (attached) in front of her/him during the PowerPoint to record student misconceptions.

During the lecture, students practice reading pedigrees and interpreting them using their white boards. (Each student arrives at his or her own answer, but they can correct misconceptions after everyone has shared.)

• **Explain: What will the students and teacher do so students have opportunities to clarify their ideas, reach a conclusion or generalization, and communicate what they know to others?**

Once you get to “Real World Implications” (slide 14), the teacher will give students their sample pedigree about German Shepherds and hip dysplasia (Hip Dysplasia attachment). Students will determine the probability that each individual in Generation III will be affected by hip dysplasia.

The teacher hands out articles I and II (Dog Articles attachment), and the rubric (Pedigree Rubric attachment). Students will complete a 2-3 paragraph opinion response in which they discuss whether humans should continue to selectively breed dogs for desirable traits (like sense of smell, size, etc.) knowing that this selective breeding can reduce genetic variability in the population and increase the incidence of genetic disorders.

• **Elaborate: What will the students do to apply their conceptual understanding and skills to solve a problem, make a decision, perform a task, or make sense of new knowledge?**

Once complete, students will form teams for “pro” and “con” for artificial selection, and the teacher will facilitate a friendly debate. Each side will have 5 minutes to go around the group once. Each group will have a recorder (to write down ideas) and a speaker (to share ideas with the whole class). The teacher will facilitate group discussion as students talk back and forth about artificial selection.
Potential "Pros" and "Cons" for artificial selection:

(These will either be sample student responses or you can suggest these to students to spark further discussion before groups begin to debate.)

Pros:

- Artificial selection doesn't just pass along faulty genes; it helps us select for desirable ones, too.
- It helps us understand the impact of genetic pre-disposition in research on human diseases, like cancer.

Cons:

- It hurts the animal, who will have no choice but to suffer through painful and debilitating illness if affected.
- It hurts the population because of decreased genetic variability.

- **Summative Assessment**

  The pre-test can be given again to show growth with regard to the learning goal, however, the primary assessment of this lesson is the written assignment, which asks, "Should people continue to breed and/or purchase purebred dogs that have desirable traits if the artificial selection of these dogs leads to an increase in genetic disorders?"

- **Formative Assessment**

  The teacher will use a pre-test to determine existing knowledge (as well as understanding of prior lessons on Punnett squares).

  The teacher may use a checklist during the PowerPoint/Explore session to ensure that students are able to correctly use a pedigree and are ready to move on to the analytical portion of the lesson.

- **Feedback to Students**

  Students will get immediate feedback during formative assessment as well as feedback on their summative assessment via the rubric.

**ACCOMMODATIONS & RECOMMENDATIONS**

- **Accommodations:**

  Students who need accommodations can have a leveled passage according to their Lexile. The whole group will be using various Kagan structures. Gifted students will use the "Elaborate" section of the lesson to further pursue the impact of artificial selection on a species.

- **Extensions:**

  Students will research the requirements of the American Kennel Club for pure-bred animals and write about how dog shows, pop culture (think *101 Dalmatians*), and puppy mills impact species and how our knowledge and documentation of the artificial selection might apply to other species (think endangered species).

  Students can also research examples where limited gene pools in humans caused an increase in undesirable traits in offspring. Examples include the Fugate family in Kentucky (the "blue people"), the Hapsburg Jaw and other deformities in the Hapsburg family that resulted from generations of inbreeding, and the rapid spread of hemophilia in European royalty during the late 19th/early 20th centuries.

  Sample articles:

  - "Why the Fugate Family Has Blue Skin" by Stacy Conradt (*Mental Floss*)
  - "Inbreeding caused demise of the Spanish Hapsburg dynasty, new study reveals" by Fiona Govan (*The Telegraph*)
  - "Hemophilia: The Royal Disease" by Yelena Aronova-Truntscheva and Clyde Freeman Herreid (from the National Center for Case Study Teaching in Science)

- **Suggested Technology:** Computer for Presenter, Microsoft Office

- **Special Materials Needed:**

  - Class sets of the Pre-Test (pp. 1-2 only), Dog Articles, Hip Dysplasia, and Rubric attachments should be printed in advance.
  - Whiteboards/dry erase boards and dry erase markers - a class set
  - The teacher should have a copy of the Pre-Test key (pp. 3-4) and Pedigree Checklist.
Additional Information/Instructions

By Author/Submitter

Note that this lesson addresses only the artificial selection portion of SC.7.L.16.4. Technological manipulations (cloning and genetic engineering) are not addressed.

SOURCE AND ACCESS INFORMATION

Contributed by: Melissa Cuevas
Name of Author/Source: Melissa Cuevas
District/Organization of Contributor(s): Collier
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Related Standards

<table>
<thead>
<tr>
<th>Name</th>
<th>Description</th>
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<tbody>
<tr>
<td>SC.7.L.16.2:</td>
<td>Determine the probabilities for genotype and phenotype combinations using Punnett Squares and pedigrees.</td>
</tr>
<tr>
<td>SC.7.L.16.4:</td>
<td>Recognize and explore the impact of biotechnology (cloning, genetic engineering, artificial selection) on the individual, society and the environment.</td>
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<td><strong>Remarks/Examples:</strong> Integrate <a href="#">HE.7.C.1.4</a>. Describe how heredity can affect personal health.</td>
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<td>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.</td>
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<tr>
<td></td>
<td>a. Develop a uniform probability model by assigning equal probability to all outcomes, and use the model to determine probabilities of events. For example, if a student is selected at random from a class, find the probability that Jane will be selected and the probability that a girl will be selected.</td>
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<td>b. Develop a probability model (which may not be uniform) by observing frequencies in data generated from a chance process. For example, find the approximate probability that a spinning penny will land heads up or that a tossed paper cup will land open-end down. Do the outcomes for the spinning penny appear to be equally likely based on the observed frequencies?</td>
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Hip Dysplasia in German Shepherds

Hip dysplasia is an abnormal formation of the hip socket. It causes arthritis and severe pain, which leads to loss of mobility and can cripple the animal as it ages. This condition is passed from parent to offspring.
### Pedigree Charts and Genetic Engineering Rubric

<table>
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<th>Written Assignment</th>
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<td>The student clearly states an opinion about artificial selection and fully supports it using evidence from the provided text.</td>
<td>The student has a clear opinion about artificial selection and minimally supports it from the text.</td>
<td>The student's opinion is not clear or there is an opinion, but it is not supported at all using evidence from the text.</td>
<td>The student summarizes the text or submits an opinion that is unrelated to the provided text and question.</td>
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<th>Using a Pedigree Chart</th>
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<td>The student can use a pedigree chart to identify phenotypes and genotypes, and can predict the probability that a trait will be passed on to future generations.</td>
<td>The student can use a pedigree chart to identify phenotypes and genotypes.</td>
<td>The student can use a key to determine the number of males and females, numbers of affected individuals, and identify phenotypes on a pedigree chart.</td>
<td>The student can determine the number of males and females and determine the number of affected individuals on a pedigree chart.</td>
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**Comments:**

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Genetics Has Gone To the Dogs!

Essential Questions:
How do doctors determine the risk of genetic disease in an individual?
If humans can use our knowledge of genetics to influence the desired traits in an organism, should we?

Standards
SC.7.L.16.2 Determine the probabilities for genotype and phenotype combinations using Punnett Squares and pedigrees.

SC.7.L.16.4 Recognize and explore the impact of biotechnology (cloning, genetic engineering, artificial selection) on the individual, society, and the environment.

MAFS.7.SP.3.1 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.

Turn and Talk!
Are Chihuahuas and Great Danes the same species?
How do people influence the look and temperament of dog breeds?

Learning Goals:
By the end of this lesson, I will be able to use a pedigree to determine the phenotype and genotype of an organism.
I will also be able to determine the probability that traits and genetic disorders will be passed on to a new generation, and assess the impact of genetic modification on individuals and populations.

Pedigree:
A chart that shows phenotype and family relationships between generations of individuals.
How to read a pedigree

Pedigrees can tell us things about an individual without using words. For example, a male is represented by a square, while a female is represented by a circle.

Pedigree Practice

Use your white board!
How many females are in this pedigree?
How many offspring are in Generation II?

How to read a pedigree

By connecting the individuals using different lines, you can show their relationship. Their placement on the pedigree can also tell you about things like birth order.

Pedigree Practice

If affected individuals have droopy ears, how many individuals have droopy ears according to this pedigree?
Is the individual at generation III-2 male or female?

Phenotypes and Genotypes

Most pedigrees only show phenotypes.
By looking at multiple generations, you can determine probable genotypes of individuals.
You can also use pedigrees to help visualize the passage of certain traits, like droopy ears or genetical disease.

Using Pedigrees to Determine Phenotype Probability

Individuals can be carriers for a trait without displaying a trait.
This means they may look totally normal, but they could pass on the faulty gene to their offspring.
If I infer based on my pedigree that the parents are heterozygous and that the trait is recessive, what is the probability that the offspring will show the trait?
Using Pedigrees to determine probability

Since we assumed based on the pedigree that both parents were heterozygotes, we can create a Punnett Square.

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According to our calculations, there is a 1 in 4 chance (or 25%) that the offspring will show the trait.

Independent Practice

Use the pedigree to determine the probability that the puppies of generation III will be affected by the trait, then read the articles and respond.

Real World Implications

How do people use pedigrees?

Dog breeders use pedigrees to track the lineage of purebred dogs and to select parents with desirable traits.

Selective breeding to emphasize a certain trait is called artificial selection. (This contrasts with natural selection, since the organisms do not select their own males.)

Real World Implications

The AKC (American Kennel Club) says that in order to register a dog, its parents must be registered as members of the same breed.

This limits the size of the gene pool for purebred, which means that faulty genes are more likely to be passed on, just like the desirable ones.

How does this impact purebred dogs?
Genetics Has Gone to the Dogs!
Pre-Test

True or False

1. ___ Parents pass physical traits (like fur color, size, or eye color) to their offspring.
2. ___ If a couple has female offspring, they will inherit their traits only from their mother.
3. ___ Changes in DNA can cause changes to an organism's phenotype or genotype.

Multiple Choice
Select the best answer.

4. ___ Where does an organism get its genetic material?
   a. From its mother.
   b. From its father
   c. Half from its mother and half from its father.
   d. It depends on if the organism is male or female.

5. ___ Which of the following is an example of an inherited trait?
   a. Joe is a good cook.
   b. Joe has long hair.
   c. Joe has brown hair.
   d. Joe speaks Spanish.
"Teal toes" is a simple recessive genetic disorder in which people produce teal pigment in their toes. The teal toe genotype is represented as $tt$. The pedigree chart above shows people with and without teal toes. Mark each individual's genotype.

1. How many of the people represented in this pedigree chart have the disorder?

2. If generation III - 4 marries a man with teal toes, what is the probability that her children will have teal toes? Use a Punnett square to prove your answer.
Genetics Has Gone to the Dogs!
Pre-Test Answer Key

True or False

1. T Parents pass physical traits (like fur color, size, or eye color) to their offspring.
2. F If a couple has female offspring, they will inherit their traits only from their mother.
3. T Changes in DNA can cause changes to an organism’s phenotype or genotype.

Multiple Choice
Select the best answer.

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6. "Teal toes" is a simple recessive genetic disorder in which people produce teal pigment in their toes. The teal toe genotype is represented as $tt$. The pedigree chart above shows people with and without teal toes. Mark each individual's genotype. **See above. Note that some unaffected individuals could be homozygous $TT$ or heterozygous $Tt$; we don't have enough information to draw a conclusion.**

7. How many of the people represented in this pedigree chart have the disorder? **Four**

8. If generation III - 4 marries a man with teal toes, what is the probability that her children will have teal toes? Use a Punnett square to prove your answer. **She is heterozygous $Tt$ (she must have one $t$ from her $tt$ father, but since she doesn't have teal toes herself, she must have inherited a $T$ from her mother) and her husband must be homozygous $tt$ since he has the disorder, so her children have a 50% chance of inheriting teal toes.**

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Excerpts from “The Genetics of . . . Dogs: Biologists say our champion purebreds could use some reverse engineering”
Lisa Davis, Discover Magazine

If a giraffe is an animal designed by committee, a bulldog must have been put together by a vet facing large house payments. Newborn bulldogs typically have heads so out of proportion to a mother’s birth canal that they have to be delivered by cesarean section. By the time they become adults, their skulls are as big around as the dogs’ height at the shoulder. Bulldogs also frequently have bad hearts. "I have a friend who’s been trying to breed bulldogs for years," says Janice Koler-Matznick, founder of the Primitive and Aboriginal Dog Society. "She’ll get a litter of three puppies, all of which die, or they’ll all have bad hearts, and she’ll have to put them down. It’s just heartbreaking."

Koler-Matznick isn’t too keen on German shepherds, either, at least not the ones that win at dog shows. ("They have this wonderfully long rear end, which is also crippled," she says.) Or bloodhounds. ("They’ve been selected to be a giant nose on legs, but unfortunately those legs don’t work too well.") Koler-Matznick isn’t naturally cranky, and she doesn’t hate purebreds. She has spent decades as a dog trainer, a professional handler at dog shows, and a dog breeder, among other things. But she likes her dogs healthy and happy and has come to believe that much of dog breeding is bad for the species, engendering not just design flaws but also a terrible propensity toward genetic disorders. She’s not alone. If you think of creating purebreds as a kind of genetic engineering—employing intensive artificial selection to increase the frequency of desired genes—then Koler-Matznick is part of a reverse engineering movement. Along with a few disillusioned breeders, veterinary researchers and even geneticists are looking for ways to undo the problems humans have created.

Many of these problems are entirely predictable, says conservation biologist Dan Wharton. As director of the Central Park Zoo in New York City and manager of the American Zoo and Aquarium Association’s breeding programs for gorillas and snow leopards in North America, Wharton is professionally committed to the science of genetics. But he also has two Pembroke Welsh corgis at home, and a few years ago it struck him that his two interests were running head-on into each other. "Some of the concepts of dog breeding are left over from our understanding of genetics a hundred years ago," he says. "What breeders are doing and what they expect doesn’t necessarily match up."

Take linebreeding, which involves mating closely related dogs with a desired trait—perfectly droopy ears, for example. Linebreeding works. It will, as breeders put it, "set" a trait, ensuring that at least some pups in the litter will carry droopy-ear genes, and only droopy-ear genes, to pass on to future generations. "But from a biological point of view, linebreeding is also what we call inbreeding," Wharton says. "And inbreeding has a downside."

... Humans and dogs alike have two copies of each chromosome, giving them two full sets of genes. If Mom gives her kid a cracked version of some gene, the copy from Dad
can usually do the job. But if Mom and Dad are brother and sister, they may well be
carrying the same malfunctioning gene, and some of their children are likely to get a
double dose. Call it linebreeding or call it inbreeding, it's a great way to increase the
chance of genetic disease. And so basenjis are prone to a potentially deadly type of
anemia, English mastiffs to blindness, and Bedlington terriers to a metabolic problem
that can cause them to hoard enough copper from food to fatally damage their livers.

Admittedly, some dogs swim in smaller gene pools than others. Every topknotted,
squash-faced shih tzu can be traced to a group of just 14 dogs brought out of China
before the Cultural Revolution. But the gene pools of nearly all show breeds are closed:
The bylaws of the American Kennel Club prevent breeders from registering a dog
unless its parents were registered, which means no new genes can be introduced to
freshen things up. Add to that the effects of the "popular sire" syndrome, when breeders
use a showstopper of a dog to produce way more than his fair share of puppies, and not
even the supernumerous breeds like Labrador and golden retrievers are immune to the
dangers of genetic bottlenecking.

One remedy, Wharton says, would be to convince dog fanciers to change the way they
think about breed purity—to focus their concern on specific genes rather than on the
dog. After all, the vast majority of genes in both a Chihuahua and a Great Dane code for
basic dog; the difference comes down to slight variations in a few genes that code for
each breed's signature traits. "One can inbreed those genetic traits without inbreeding
the whole dog," Wharton says.

Excerpts from “The Genetics of . . . Dogs: Biologists say our champion purebreds could
use some reverse engineering” by Lisa Davis, Discover Magazine, Tuesday, April 01,
Excerpts from “Genetics and the Shape of Dogs: Studying the new sequence of the canine genome shows how tiny genetic changes can create enormous variation within a single species”
Elaine A. Ostrander, American Scientist

A pekingese weighs only a couple of pounds; a St. Bernard can weigh over 180. Both dogs, though vastly different in appearance, are members of the same genus and species, *Canis familiaris*. How dog breeds can exhibit such an enormous level of variation between breeds, and yet show strong conformity within a breed, is a question of interest to breeders and everyday dog lovers alike. In the past few years, it has also become a compelling question for mammalian geneticists.

The "dog genome project" was launched in the early 1990s, motivated by scientists' desire to find the genes that contributed to many of the ills suffered by purebred dogs. Most dog breeds have only been in existence for a few hundred years. Many exhibit limited genetic diversity, as dog breeds are typically descended from a small number of founders, created by crossing closely related individuals. Further, breeds often experience population bottlenecks as the popularity of the breed waxes and wanes. As a result of this population structure, genetic diseases are more common in purebred dogs than in mixed-breed dogs. Scientists have been motivated to use dog populations to find genes for diseases that affect both humans and dogs, including cancer, deafness, epilepsy, diabetes, cataracts and heart disease. In doing so we can simultaneously help man and man's best friend.

Dog Breeds

... Dogs are thought to have arisen perhaps as recently as 40,000 years ago, with initial domestication events occurring in eastern Asia. Most domestic breeds that we recognize today, however, likely are the product of human breeding over the last 200-300 years. Many of the most common modern breeds were developed in Europe in the 1800s. Some of the breeds represented in antiquity, including the greyhound and the pharaoh hound, are particularly interesting to study, as it is unclear whether dogs from these breeds are re-creations of ancient breeds or whether dogs alive today can truly trace their lineage to founders from thousands of years ago.

The American Kennel Club (AKC) currently recognizes about 155 breeds of dog, but new breeds are created and given breed-recognition status frequently. What defines a dog breed? Although a dog's parentage can be recognized by its physical attributes—coat color, body shape and size, leg length and head shape, among others—the concept of a breed has been formally defined by both dog fanciers and geneticists.

Dog regulatory bodies such as the AKC define an individual’s breed by its parentage. For a dog to become a registered member of a breed (say, a golden retriever), both of its parents must have been registered members of the same breed, and their parents in
turn must be registered golden retrievers. As a result, dog breeds in the United States today are generally closed breeding populations with little opportunity for introduction of new alleles (variations in the genome). At a genomic level, purebred dogs are usually characterized by reduced levels of genetic heterogeneity compared to mixed-breed dogs. Breeds that derive from small numbers of founders, have experienced population bottlenecks or have experienced popular-sire effects—that is, the effect on the breed of a dog who does well in shows producing a disproportionate number of litters—display further reductions in genetic heterogeneity.

## Pedigree Checklist Template

<table>
<thead>
<tr>
<th>Student</th>
<th>How Many Females?</th>
<th>Offspring in Gill</th>
<th>Droopy Ears</th>
<th>Gill-2 Male or Female?</th>
<th>Probability</th>
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Resource ID#: 71558

Primary Type: Lesson Plan

5E Natural Selection Module

This resource uses a variety of techniques to address the factors that contribute to natural selection. Included in the lesson is a hook to engage students, a weblab exercise, a poster activity for expression and a hands-on simulation.

Subject(s): Science, Mathematics
Grade Level(s): 7
Intended Audience: Educators
Suggested Technology: Computer for Presenter, Computers for Students, Internet Connection, Interactive Whiteboard, Basic Calculators, LCD Projector, Computer Media Player

Instructional Time: 5 Hour(s)
Resource supports reading in content area: Yes
Freely Available: Yes
Keywords: evolution, natural selection, peppered moth, competition, overproduction, environmental change, genetic variation
Resource Collection: FCR-STEMLearn Physical Sciences

ATTACHMENTS

Natural Selection Presentation.pdf
Engage Butterfly outlines.pdf
Natural Selection Presentation.pptx
Explore Natural Selection WebLab.docx
Elaborate Moth Mania lab.docx
Elaborate Moth Mania lab.pdf
Elaborate Peppered Moths.pdf

LESSON CONTENT

- Lesson Plan Template: Learning Cycle (5E Model)

http://www.cpalms.org/Public/PreviewResource/PrintResource/71558?display=block&Private=true&ProtectedUser=true&IsPrintPreview=true
• **Learning Objectives: What will students know and be able to do as a result of this lesson?**

Students should be able to explain how natural selection occurs, and understand how the 4 different factors (overproduction, variation, competition, and environmental change) can cause selection to occur. They should be able to offer an example of each and explain how some organisms in a given population may be more likely to survive and pass on their genes to the next generation.

• **Prior Knowledge: What prior knowledge should students have for this lesson?**
  - Students should be able to discuss how Darwin formed his theory of evolution by natural selection and explain what he said about how species changed over time, specifically referencing the evidence Darwin used to form the theory.
  - Students should know what an adaptation is, and be familiar with the Galapagos species and their adaptations.
  - Students should know that a useful mutation is a change in the genetic makeup of an organism that leads to a change in the appearance or function of the organism. They may not all have a clear understanding of genetics, inheritance, or DNA if evolution is taught before genetics, but it makes it harder to explain what is really happening between generations.
  - Students should know that offspring inherit characteristics from their parents.
  - Students should know that a population is a group of organisms of the same species, and that only members of the same species can produce offspring.
  - Students must be comfortable working in groups.
  - Students must be accustomed to working successfully in unstructured lab situations.
  - Students should be familiar with lab reports.
  - Students need to be able to use data tables and graph trends.

• **Guiding Questions: What are the guiding questions for this lesson?**
  - How can natural factors working on a population lead to change in a population over time?
  - What does it mean that some organisms are selected by the environment to survive and reproduce?

• **Engage: What object, event, or questions will the teacher use to trigger the students' curiosity and engage them in the concepts?**

Materials needed: PowerPoint presentation, Butterfly outline for each student, art supplies

1. **Students will be given an outline shape of a butterfly and told to design the best butterfly possible in 5 minutes. A powerpoint with student directions for each phase of this lesson is provided. A printable sheet of moths is also included.**

   This will be a very short amount of time, especially if the shapes are not cut first. However, keeping it to 15 minutes total should be just enough time for them to complete the Explore weblab assignment. If students need more time, then the two activities can be extended over two days. You can also have them work in partners, but it makes fewer moths and they are small for two kids to work on at once.

2. **The students are then told their butterflies are out in the real world and at risk of predation. The students will be given 45 seconds to hide their butterfly in the room. Then a hungry bird comes and hunts for butterflies. This should take about 3 minutes total.**

   Depending on the number of students/ butterflies, the designated area for hiding should be fairly small. Students must be clear that they cannot hide underneath or behind any objects. You should also set an upper and lower height range depending on how high you want to stretch up or bend down. Make sure that their belongings are cleared out of the way.

   You can hunt yourself, or can designate a student to be a hunter. If you are going to be the hunter (and you trust your kids enough), you might want to close your eyes while they put up the moths so it is not too easy for you to find them. You can also designate a student to be the hunter. He or she should be out of the room or blindfolded while the students are hiding the moths. I have also had teachers and administrators come hunting, and the kids are pleased with the celebrity guest stars, but it takes more effort to organize and takes longer.

3. **Whole Group Debrief (5 min)**

   - What did you notice about the butterflies that got nabbed first?

   The brightest, prettiest butterflies will probably go first. Some of them will survive due to luck and timing, which happens in nature too.

   - What was different about the survivors?

   They were better camouflaged, so they were harder for the predator to find. They survived until time was called.

   - How do you think that relates to the way a species might change over time?

   Organisms that are hardest to find are more likely to survive. If they survive, they might pass down the genes that helped them survive to their offspring. Then their offspring have an advantage, and number of organisms with the adaptation will increase in the population. Those without an advantage are more likely to die, and their traits die with them.

• **Explore: What will the students do to explore the concepts and skills being developed through the lesson?**
Materials needed: Student laptops with shockwave installed, lab sheet

Students will explore the weblab simulation created by the Education Development Center, Inc. and programmed by MathResources, Inc. as part of Enlivening Genetics Education Project. They will complete the included worksheet that follows along with the simulations.

http://www2.edc.org/weblabs/NaturalSelection/NaturalSelectionMenu.html

The questions go in order. It usually takes my advanced students about 30 minutes to complete. I let them work with partners.

The weblab uses Shockwave, and has been around a while. It can sometimes be problematic to get the permissions to install Shockwave on student computers. However, the simulation does a very nice job of going through natural selection and letting them play around with the different scenarios. If tech is a problem in terms of student access, I've done this as a whole group with a projector, still making them answer the questions on the worksheet to hold them accountable for the activity. If it won't work at all, the main ideas are covered in the other components of this lesson plan.

- Explain: What will the students and teacher do so students have opportunities to clarify their ideas, reach a conclusion or generalization, and communicate what they know to others?

Materials needed: PowerPoint presentation, 11x17 paper for posters, art materials, animal reference pictures

1. Using the "Factors Leading to Natural Selection" section of the powerpoint provided teacher will explain the four factors that contribute to natural selection, overproduction, variation, competition, and environmental change. Students should take down notes for the basic explanations, and go through how sea turtles illustrate how the factors might work on a population.

Overproduction is the hardest for the kids to understand. They confuse it with overpopulation. Overproduction means far more offspring are produced that can survive due to competition and limiting factors. Overpopulation occurs when a limiting factor is removed and more of those offspring survive than the system can support. If there is no variation, no selection can occur and it is simply a matter of luck who survives to pass on their identical trait. Without competition, everyone survives so no selection. Students should be clear about what organisms are competing for - often they are competing not to be eaten by someone else. In an evolutionary context, competition occurs within the species to force selection. Competition with other species in a similar niche is part of ecology, and usually leads to the extinction of one of the species. Environmental change does not have to be, and in terms of evolution has rarely been, related to human impact on the environment.

2. Students will create posters in groups illustrating the four factors acting on a population of their choice, and will be assessed according to the rubric below. Students will evaluate posters and will vote on which to hang in the room as a reference during the unit.

I only give the kids the class period for their posters. They always want more time, but on task groups do have enough time to create a good idea. I give them one tabloid size (11x17) piece of white paper, and provide art boxes. I also have field guides and books on animals to give them references for their illustrations, and ideas for populations. I don't let them use computers or phones because it eats up too much time, and I want them to think creatively. I also have them lay their finished work out (names on back) with a sticky note on the front, so that all of my students can vote on which posters they want to hang up on the wall. Then I post them and leave them up through the test. This makes them selective and critical about how well the poster reminds them of the factors, and is a good way for students to assess the relative quality of their work.

**Poster Rubric (26 points)**

1. The population illustrates each of the four factors leading to natural selection realistically. (12 points possible)
   - Explanation clearly shows how the factor is working on the population, makes sense, and is realistic. (3 points)
   - Explanation shows how the factor works, but the scenario is not entirely clear or thoroughly explained. (2 points)
   - Factor is included, but the explanation doesn't make sense. (1 point)
   - Factor is not represented on poster (0 points)

2. Text on the poster explains the factor appropriately (4 points possible)
   - 1 point for each factor for at least a complete sentence explaining how the scenario relates to the factor.

3. Pictures illustrate the factors at work (8 points possible)
   - 1 point for each factor for at least some illustration in color representing the factor.
   - 1 point for each factor if the illustrations drawn relate to scenario

4. Each factor is written on the poster as a clear heading, large enough to read. (1/2 point each factor)

Make-up Assignment:

Make sure that you write with clarity of expression and show depth of thought, as you are not making the poster portion of the original assignment.

1. Give a description of each factor (overproduction, variation, competition, and environmental change) and how it affects selection.
2. Come up with a story that shows that factor working on a population.

- Elaborate: What will the students do to apply their conceptual understanding and skills to solve a problem, make a decision, perform a task, or make sense of new knowledge?

Materials needed: Powerpoint presentation, pre-prepared white and black "moths", matching background, forceps, blindfold, lab sheet.

1. Using the powerpoint provided, the teacher will present the story of the peppered moth. Students will take notes and answer formative assessment questions during the discussion.

I include a slide on the difference between camouflage and protective coloration (like chameleons and cuttlefish who can change color to suit the environment) to emphasize that change occurs within a species, not within an individual. Individuals are born with or without an adaptation, and live or die accordingly. They cannot change to suit their environment. I also like to emphasize that the peppered moth scenario shows that selection can occur over a relatively short period of time, as long as an alternative variation already exists within a population, like the black morph. In the case of rapid environmental change where no favorable variation exists, most populations do not survive. Evolution takes a long time when you are hanging around waiting for a random mutation to occur.

2. Students will conduct a simulation of the peppered moth scenario using paper moths. They will collect and combine data sets for the class, and will graph their analysis. They will submit a lab report following the provided lab guide for evaluation.

1. Preparation: Before the lab, prepare white and black paper moths and matching white and black backgrounds.

   The moths need to be cut out and I laminated mine. I divide the class into two groups. Each group needs 100 white moths if they are going to have enough if every white moth survives. I also created a laminated background of 3 sheet long speckled white paper on one side, with black construction paper on the other for their forest. I have seen some labs that use hole punched dots on the same paper background as an alternative to the little moths I use.

2. Step 1: Each lab group needs to start with a 3:1 ratio of light colored moths to the dark colored moth mutation and arrange them on the light colored background. Predator should not see placement.

   They need to start with the light colored background facing up on their desks. I divide the class into two large groups to run the simulation.

   For each round, they choose one student to be the predator. I let them change predators between each round. The forceps will be their beak, and they can only use the one hand to pick up the moths. With the forceps and the tiny moths it is not easy to pick them up.

   Predator must be blindfolded or close his eyes while the other students have 5 seconds to spread out their initial moth population on the background sheet. Remind them that they can't hide them as they are testing coloration not craftiness. Make sure they record the initial population in their data tables.

3. Step 2: The predator has 5 seconds to hunt as many moths as he can, using only the forcep "beak" to capture the prey.

   If they spin the predator a bit, then another student needs to make sure to guide them to the table. It makes it more fun, but it is OK if they just close their eyes.

4. Step 3: For every moth that survives, students add one more moth of the same coloration.

   If they get all of the individuals of one variation in the round they need to add one to the population. They have to count all the moths for both phenotypes, and record the new population in the data table.

5. Step 4: Repeat for two more rounds with the light background, and 3 with the dark background.

   I have the two groups combine their data for the class so they have a better data set to graph.

3. Students use the following class period to complete the analysis and conclusions.

The background and the simulation should be completed in one class period, but they can't get the analysis and conclusions done. I usually give them the following class period to finish the lab report for submission. I let them work together to complete the work, but collect an individual report from each student. If they miss the simulation, they can get the data from a classmate and still complete the lab report.

- Summative Assessment

Students will complete the following essay question either as part of their unit exam or as a research extension to their lab report:

Use a real example to illustrate the process of natural selection. Make sure that you can justify how at least 3 of the 4 factors that contribute to natural selection apply to the scenario. Do not use one we have already discussed in class, and make sure that your
example is based on research, not made up to suit the scenario.

- **Formative Assessment**

  Engage: After designing their moths and seeing the result of the hunt, students should be able to explain that some moths were easier to see, and were therefore less likely to survive.

  Explore: While exploring the web lab, students will complete a lab sheet with comprehension check questions. Instructor will check for understanding throughout activity.

  Explain: Students' groups will produce a poster, which will be evaluated according to a rubric. Students will evaluate posters and select the best to be posted in the room. Posters should illustrate each factor (variation, competition, overproduction, and environmental change) with a realistic example.

  Elaborate:

  1. During the initial presentation of the story of the peppered moth, students' understanding will be assessed through questions built into the Powerpoint presentation.
  2. Students will complete a lab report, which will be graded for accuracy.

- **Feedback to Students**

  Engage: Students should get feedback as a whole group through discussing their ideas and building to consensus.

  Explore: Teacher will check for comprehension during weblab. Grade should be for completion.

  Explain: Students will receive feedback from peers and will compare their work to others. Students will receive points based on rubric.

  Elaborate: Students will discuss and share ideas during discussion. Students will get a grade on the lab report.

**ACCOMMODATIONS & RECOMMENDATIONS**

- **Accommodations:**

  Lesson and timing is designed for skilled/ gifted learners. Additional time and scaffolding should be provided as needed based on preparation and ability. Working with larger collaborative groups can also be used. Textbook resources in alternate languages can be used to support ELLs, and poster assignment might be done in primary language.

- **Extensions:**

  The summative assessment can be extended to a more complete research assignment for students that need additional depth.

- **Suggested Technology:** Computer for Presenter, Computers for Students, Internet Connection, Interactive Whiteboard, Basic Calculators, LCD Projector, Computer Media Player

- **Special Materials Needed:**

  Engage: PowerPoint presentation, Butterfly outline for each student, art supplies.

  Explore: Student laptops with shockwave installed, lab sheet.

  Explain: PowerPoint presentation, 11X17 paper for posters, art materials, animal reference pictures/ field guides.

  Elaborate: PowerPoint presentation, pre-prepared white and black "moths", matching background, forceps, blindfold, lab sheet, timer.

**Additional Information/Instructions**

**By Author/Submitter**

Plan includes 5 component activities structured on a 5E model, a hook, a weblab exploration, a collaborative poster activity, and a lab. Each activity reinforces the factors leading to natural selection and evolution, but can be completed on their own. All supporting materials are provided, and powerpoint includes student direction for each
activity in separated sections.

This lesson could be used as part of a study of SC.912.L.15.13.

Supports MAFS.K12.MP.4.1:Model with mathematics.

Includes practice graphing authentic data sets.

SOURCE AND ACCESS INFORMATION

Contributed by: Elisabeth McCormack
Name of Author/Source: Elisabeth McCormack
District/Organization of Contributor(s): Pinellas
Is this Resource freely Available? Yes
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Related Standards

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<th>Description</th>
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<tr>
<td>LAFS.68.RST.1.3;</td>
<td>Follow precisely a multistep procedure when carrying out experiments, taking</td>
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<td></td>
<td>measurements, or performing technical tasks.</td>
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<tr>
<td>LAFS.68.RST.3.9;</td>
<td>Compare and contrast the information gained from experiments, simulations,</td>
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<td>video, or multimedia sources with that gained from reading a text on the</td>
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<td>SC.7.L.15.2;</td>
<td>Explore the scientific theory of evolution by recognizing and explaining</td>
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<td>ways in which genetic variation and environmental factors contribute to</td>
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<td>evolution by natural selection and diversity of organisms.</td>
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Print Page | Close this window
The Story of the Peppered Moth

x There was a mutant moth that showed up occasionally that was all black.

The Story of the Peppered Moth

x The trees were no longer clean, but sooty black. Which variation of the peppered moth now had the advantage?

The Story of the Peppered Moth

x Imagine you are a hungry bird in the forest. Who are you going to eat first?

Camouflage vs. Protective coloration

x Camouflage uses two or more colors to create a matching pattern that let an organism blend into its surroundings.

x Protective coloration is an adaptation in which color matching is used to match the background.

x Which is which below? Explain why.

x Which are we talking about for the moths? Why does this matter?

The Story of the Peppered Moth

x However, in the early 19th century (around the same time Darwin was working out his theory of natural selection) people started burning coal to power their factories. Smokestacks poured polluted smog into the air. Everything started to turn black, even the trees and rocks in the forest.

The Story of the Peppered Moth

x In 1850, there were 23 light moths for each dark one. Ten years later, the ratio was one light to 23 dark moths. This is evolution at work.

x The story isn't over. In the 1950s the British government passed clean air legislation that stopped the smokestacks from dumping the dirty smoke into the air, and things that had been stained black by the soot became light again. What do you think is happening to the peppered moth population now?
Peppered Moth Simulation

× We are going to try our own Peppered Moth simulation. There are two phenotypes of moths, the dominant light colored variation and the dark colored mutation. We will start by simulating an unpolluted forest on your light colored table background.
× Each lab group needs to start with a 3:1 ratio of light colored moths to the dark colored moth mutation.
× Choose one lab member to be your predator. The forepaws will be their "beak". They must close their eyes while the moth population is spread out on the table. Record the initial population in your data table.
× Take 5 seconds to set out the moths, then open the predator around to disorient them (just a little). They then have 5 seconds to hunt as many moths as they can, using only their forepaws "beak" to capture their prey.
× For every moth that survives, add one more moth of the same phenotype. Record the new population in your data table.
× Repeat for five generations.

Peppered Moth Simulation

× Now the industrial revolution pollutes the forest, and darkens the trees.
× Swap over to the dark table background. Move your entire population of moths to the new background. If you do not have a dark moth mutation in your population, add one.
× Follow the same procedure as before. Again, for every moth that survives, add one more moth of the same phenotype. Record the new population in your data table.
× Repeat for five more generations.
× Make sure your data is recorded accurately.
Your mission

- Design the BEST butterfly ever!
- You may use whatever strategy you want, but make sure you can justify why your butterfly is better than everyone else’s.
- You have 6 minutes to cut out the shape and color it in. Make sure you settle on a vision that you can actually accomplish in the time you have.

Your task today: WEBLAB

- Work through the web simulation found at http://www2.cdc.org/whelabs/NaturalSelection/Main.html
- The questions on the worksheet will follow the simulation.
- Explore the scenarios, and play around with the parameters as you go, but make sure you complete all the questions on the sheet if you want credit for the work.

Time’s up!

- Your butterfly is now out in the “real” world, and its tough out there.
- You have 45 seconds to find a place within the designated area for your butterfly to hang out.
- Then a hungry bird is coming for lunch!!!
- Roll the tape and stick it to the back, and then stick your butterfly where your think it will be most likely to survive. You must stay within the designated zone AND you cannot hide behind or underneath any object. It must be possible for everyone to see your butterfly if they are looking at it.

Factors Contributing to Natural Selection

Who Survived?

- What did you notice about the butterflies that got nabbed first?
- What was different about the survivors?
- How do you think that relates to the way a species might change over time?

Theory of Evolution by Natural Selection

- As we said, Darwin’s theory of evolution states that species gradually changed over many generations and became better adapted to the environment through the process of natural selection.
- Natural selection occurs because individuals that are better suited to their environment are more likely to survive and reproduce, and their better adapted genes are more likely to be passed down to the next generation.
- Birds with big beaks would be better suited to cracking open hard seeds, and would have an advantage if they lived on an island with lots of seeds, but would die out if they had to catch insects. This is an example of natural selection.
Factors Affecting Natural Selection
- Darwin identified three factors that affect the process of natural selection:
  - Overproduction: Most species produce far more offspring than can survive.
  - Variation: Variations are any differences between individuals of the same species.
  - Competition: Because food and resources are limited, members of a species must compete with each other to survive.
- Changes in the environment can also affect an organism's ability to survive, and can lead to natural selection.
- Selection occurs when organisms with helpful traits survive to be the parents of the next generation. Over a long time, natural selection can lead to change.

Poster Rubric (26 points possible)
- The population illustrates each of the four factors leading to natural selection realistically. (5 points)
- Explanation clearly shows how the factor is working on the population, makes sense, and is realistic. (5 points)
- Explanation shows how the factor works, but the scenario is not entirely clear or thoroughly explained. (4 points)
- Factor is included, but the explanation doesn't make sense. (2 points)
- Factor is not represented on poster. (0 points)
- Text on the poster explains the factor appropriately. (4 points possible)
- One point for each factor for at least a complete sentence explaining how the scenario relates to the factor.
- Pictures illustrate the factor at work (8 points possible)
- One point for each factor for at least some illustration to help representing the factor.
- One point for each factor if the illustrations don't relate to scenario.
- Each factor is written on the poster as a clear heading, large enough to read. (6 points each factor)

Moth Mania:
The Peppered Moth Story
NATURAL SELECTION AT WORK!

Poster Activity
- Each group will create a poster illustrating the factors that can lead to natural selection.
- First, come up with a scenario that shows the factors working on a population. Be creative!
- Now, create a poster that illustrates how these factors work. (Make sure the name of the factors and short description of what is happening is included in the poster. Remember writing on posters should be BIG so it can be read across the room)

Factors contributing to Natural Selection:
- Overproduction
- Geneic Variation
- Competition
- Environmental Change

The Story of the Peppered Moth
- For centuries, peppered moths lived in England and the "normal" form of the moth was a light colored with black speckles.
Title: Moth Mania: A Natural Selection Simulation

Purpose: The purpose of this lab is to demonstrate the impact environmental change can have on the characteristics of a population by simulating the story of the peppered moth.

Background: Summarize the story of the peppered moth. Explain the factors leading to natural selection in the peppered moth population.

Data Analysis:

Data Table: Simulation Moth Populations

<table>
<thead>
<tr>
<th>Clean Forest (Light Desks)</th>
<th>Light Phenotype</th>
<th>Dark Phenotype</th>
</tr>
</thead>
<tbody>
<tr>
<td>Starting population</td>
<td>3</td>
<td>1</td>
</tr>
<tr>
<td>Round 1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Round 2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Round 3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Polluted Forest (Dark Desks)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Round 4</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Round 5</td>
<td></td>
<td></td>
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<tr>
<td>Round 6</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ending population</td>
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</tbody>
</table>

Graph: Simulated Moth Populations over Time

- Draw a line on the graph indicating where the forest changed from light to dark.
- Referring to your graph, explain what occurred in the simulation.
Conclusions

1. Error Analysis: What factors in the game might have distorted the outcomes we saw in the simulation? Remember error is not mistakes you made, but ways the simulation can't re-create reality.

2. Using specific examples, explain how environmental change can impact populations over time, leading to the evolution of a species.

3. We tend to think of evolution as a slow process. Why was the moth population able to adapt to the environmental change so quickly in this example?

4. How does the story of the peppered moth relate to your understanding of natural selection?

5. Extension: Research another real example of natural selection and summarize the situation. Do not use one we have already discussed in class.
Adaptations: Will You Survive?

This unit begins by classifying animals into major groups (mammals, birds, reptiles, amphibians, fish, vertebrates and those having live births and those which lay eggs) according to their physical characteristics and behaviors.

Students will review the path of the flow of energy from the Sun as it is transferred along the food chain through the producers to the consumers, and recognize ways plants and animals, including humans, can impact the environment.

Students will compare and contrast adaptations of animals and plants that enable them to survive.

Subject(s): Science
Grade Level(s): 5
Intended Audience: Educators

Instructional Time: 3 Hour(s)

Keywords: adaptation, producers, prey, predators, consumers, omnivores, herbivores, physical adaptations, behavioral adaptations, migration, hibernation, camouflage

Instructional Component Type(s): Lesson Plan, Worksheet, Project, Presentation/SlideShow, Video/Audio/Animations, Learning Site

Resource Collection: FCIT-STEM Learn Diversity and Ecology

ATTACHMENTS
Adaptations_Cloze.docx
Animal_AdaptationProject.docx
Adaptation.pptx
Research_Organizer.docx
Adaptation_TaskCards.docx

LEsson CONTENT
Lesson Plan Template: General Lesson Plan

Learning Objectives: What should students know and be able to do as a result of this lesson?

Students will be able to demonstrate the flow of energy through a food web.
Students will be able to identify adaptations and physical characteristics of organisms which help survive in an ecosystem.
Students will be able to explain the relationship between the prey and predator in a given ecosystem.

Prior Knowledge: What prior knowledge should students have for this lesson?
SC.1.1.17.1: Through observation, recognize that all plants and animals, including humans, need the basic necessities of air, water, food, and space.
SC.2.L.17.1: Compare and contrast the basic needs that all living things, including humans, have for survival.
SC.3.L.17.1: Describe how animals and plants respond to changing seasons.
SC.3.L.15.1: Classify animals into major groups (mammals, birds, reptiles, amphibians, fish, vertebrates and those having live births and those which lay eggs) according to their physical characteristics and behaviors.
SC.4.L.17.3: Trace the flow of energy from the Sun as it is transferred along the food chain through the producers to the consumers.
Guiding Questions: What are the guiding questions for this lesson?

- How are animals classified within an ecosystem? What are the characteristics of each of the classification groups?
- What is prey? What are predators?
- Given a food web, what would happen if you completely eliminated any one species in that web?
- What are some biomes you are familiar with? What is an ecosystem? What is a community? What is a population? What is the habitat?
- What are adaptations? What are behavioral adaptations? What are physical (inherited) adaptations?
- How does an organism’s physical characteristics help it to adapt and survive in its environment?

Teaching Phase: How will the teacher present the concept or skill to students?

Day 1

1. Students will watch the BrainPOP videos "Vertebrates" and "Invertebrates" to review animal classifications. These videos require an account to view; if you don’t have an account, you can substitute the BrainPOP video "Classifying Animals," which is available on YouTube.
2. List the animal classifications of mammals, fish, birds, reptiles, amphibians, and invertebrates. Using dry erase boards, each student in the group will write one classification on their board. Groups will pass the boards around the group, listing the characteristics of each of the animal groups for about one minute.
3. Create a two-column chart to organize the information, which students will copy into their journals.
4. Each student can be given a set of animal pictures from magazines or printable picture websites such as clip-art which will be used to create a foldable, capturing the information from the two column chart, which will be glued into their journals.

Day 2

1. Students will view the free BrainPOP video "Food Chains."
2. Given organism cards, the student will create a food chain.
3. In their science journals, the students will individually create a sequential flow map to illustrate the food chain that created.
4. Students in each group will combine their organism pictures to create a food web. (Remind the students that the arrow should be pointing from the prey to the predator)
5. Journal Assignment: The students will copy the food web into their journal. They will then write a summary of the possible prey/predator interaction(s) which occurred in the food web.

Day 3

1. Watch the "Will You Survive?" PowerPoint.
2. Students will take notes on the power point using a cloze worksheet.
3. Students will be given a die-cut butterfly or a butterfly coloring sheet. They will color the butterfly to camouflage it within the classroom. The students will place the colored butterfly within the classroom.
4. Classes can look for the butterflies as part of the next day's opening activity.

Day 4

1. Create a graphic organizer to represent the various ecosystems in Florida. (See attached Research Organizer)
2. Students will brainstorm the ecosystems in Florida, including coral reefs, dunes, marshes, swamps, hardwood hammocks, mangroves, pinelands and scrub, and write them in the first row of the research organizer. See the South Florida Information Access Kid's Page "Florida Ecosystems" for Information on all of these habitats.
3. As a class, choose one specific ecosystem that students should be familiar with. Define "ecosystem" and list all living and non-living things using words or pictures on the second line of the research organizer.
4. Choose one threatened or endangered species from your ecosystem. This will be the animal studied and researched for the PowerPoint project used as the final summative assessment.

Day 5

1. Students will rotate throughout the task cards and answer the questions. The class will review the correct answers as a group.
2. Student groups will present their PowerPoint presentation.

Guided Practice: What activities or exercises will the students complete with teacher guidance?

Please refer to the Teaching Phase. The following activities described there will be used as guided practice:

- BrainPOP quizzes/discussions
- Classification of animals
- Two-column chart of the characteristics of classification (discussion)
- "Will You Survive?" PowerPoint presentation/discussion
- Ecosystems graphic organizer
- Review task cards

Independent Practice: What activities or exercises will students complete to reinforce the concepts and skills developed in the lesson?

Please refer to the Teaching Phase: The following activities described there will be used as independent practice:

- Creating individual food chains
- Combining the food chains to illustrate the food web and writing the summary to explain the relationships
- Cloze activity during PowerPoint
- Butterfly camouflage
- Task cards

Closure: How will the teacher assist students in organizing the knowledge gained in the lesson?

The PowerPoint presentations should be a culminating assessment to bring all major points of the standard together.
Summative Assessment
Students will create their own adaptations PowerPoint presentation that includes the following:

- the physical characteristics of a Floridian threatened or endangered species
- its prey and predators
- description of its biome, ecosystem and habitat
- an explanation of adaptations which help the species survive
- what impacts have humans had on this environment

Formative Assessment
- Science journals (Note: If you are not using journals, students can create a small journal for the lesson by compiling papers into one packet)
- Task cards

Feedback to Students
- Feedback in the student journals
- Rubric guidelines

ACCOMMODATIONS & RECOMMENDATIONS

Accommodations:
Pre-cut the butterflies if a die-cutter is not available.

Students may need a brief lesson in using PowerPoint to create their own slides.

Extensions:
Include current events such as python hunting in the Everglades or the controversial 2015 Florida black bear hunting to create a classroom debate. Students would be assigned either the pro or con of the controversy.

Students may write a paragraph summarizing the cloze activity.

Suggested Technology: Computers for Students, Microphones

Further Recommendations:
Print out the PowerPoint presentation slides for any students who may be absent.

SOURCE AND ACCESS INFORMATION

Contributed by: Patricia Goss
Name of Author/Source: Patricia Goss
District/Organization of Contributor(s): Orange
Access Privileges: Public
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Related Standards

<table>
<thead>
<tr>
<th>Name</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>SC.5.L.15.1</td>
<td>Describe how, when the environment changes, differences between individuals allow some plants and animals to survive and reproduce while others die or move to new locations.</td>
</tr>
<tr>
<td>SC.5.L.17.1</td>
<td>Compare and contrast adaptations displayed by animals and plants that enable them to survive in different environments such as life cycles variations, animal behaviors and physical characteristics.</td>
</tr>
</tbody>
</table>

Remarks/Examples:
Adaptations PowerPoint Cloze

Adaptations are any ____________ or ____________ characteristics of an animal that help it to ____________ in its environment. These characteristics fall into three main categories: ____________, ____________, ____________, and ____________. Any or all of these types of adaptations play a critical role in the survival of an animal.

A physical adaption is some type of ____________, ____________ made to a part of the body.

Examples:

- ____________
- ____________
- ____________
- ____________
- ____________
- ____________
- ____________
- ____________
- ____________
- ____________

A behavioral adaptation is something an animal does or how it acts, usually in response to some type of external stimulus.

Examples of some behavioral adaption:

- ____________
- ____________
- ____________
- ____________
- ____________
- ____________
- ____________
- ____________
- ____________
- ____________

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Adaptations PowerPoint Cloze

Adaptations are any behavioral or physical characteristics of an animal that help it to survive in its environment. These characteristics fall into three main categories: body parts, body coverings, and behaviors. Any or all of these types of adaptations play a critical role in the survival of an animal.

A physical adaption is some type of structural modification made to a part of the body.

Examples:

- Webbed feet
- Sharp Claws
- Large beaks
- Wings/Flying
- Feathers
- Fur
- Scales

A Behavioral Adaptation is something an animal does - how it acts - usually in response to some type of external stimulus.

Examples of some Behavioral Adaptations:

- What an animal is able to eat
- How an animal moves
- How an animal may protect itself
  - Migration
  - Hibernation
  - Dormancy
  - Camouflauge
Animal Adaptation Project

You and a partner will be working together to create a PowerPoint presentation to share and teach to the class. You will be using your textbook, class printed sources, technology to complete your research. Please design your presentation with the following slides:

1. Title page with names of presenters
2. Description of ecosystem and habitat
3. Map of Florida with the habitat highlighted
4. Your organism's physical characteristics
5. How your organism's physical characteristics help it to adapt and survive in its environment
6. Your organism's prey and predators
7. Behavioral adaptations that allow your organism to survive in this environment
8. Impacts that animals, plants, and/or humans have had on this environment

Be sure to have 2-3 sentences on each slide with appropriate pictures. Use transitions and animations to make your presentation more interesting. Be sure to edit your PowerPoint for correct spelling, grammar, and punctuation. Use the rubric on the next page as a guideline.
<table>
<thead>
<tr>
<th>Category</th>
<th>4-Excellent</th>
<th>3-Good</th>
<th>2-Fair</th>
<th>1-Poor</th>
</tr>
</thead>
<tbody>
<tr>
<td>Grammar &amp; Spelling</td>
<td>Author makes no errors in grammar or spelling that distract the reader from the content.</td>
<td>Author makes 1-2 errors in grammar or spelling that distract the reader from the content.</td>
<td>Author makes 3-4 errors in grammar or spelling that distract the reader from the content.</td>
<td>Author makes more than 4 errors in grammar or spelling that distract the reader from the content.</td>
</tr>
<tr>
<td>Capitalization &amp; Punctuation</td>
<td>Author makes no errors in capitalization or punctuation, so the essay is exceptionally easy to read.</td>
<td>Author makes 1-2 errors in capitalization or punctuation, but the essay is still easy to read.</td>
<td>Author makes a few errors in capitalization and/or punctuation that catch the reader's attention and interrupt the flow.</td>
<td>Author makes several errors in capitalization and/or punctuation that catch the reader's attention and interrupt the flow.</td>
</tr>
<tr>
<td>Habitat</td>
<td>Author states the organism's habitat and includes two or more pieces of text evidence to support their reasoning.</td>
<td>Author states the organism's habitat and includes one piece of text evidence to support their reasoning.</td>
<td>Author states the organism's habitat but does not include text evidence to support their reasoning.</td>
<td>Author does not include the organism's habitat in the writing piece.</td>
</tr>
<tr>
<td>Physical Adaptation</td>
<td>Author states two or more physical adaptation for the organism and explains how they help it survive in its environment.</td>
<td>Author states one physical adaptation for the organism and explains how it helps the organism survive in its environment.</td>
<td>Author states one physical adaptation for the organism, but no explanation is given to how it helps the organism survive in its environment.</td>
<td>Author does not include a physical adaptation for the organism.</td>
</tr>
<tr>
<td>Behavioral Adaptations</td>
<td>Author states two or more behavioral adaptations for the organism and explains how they help the organism survive in its environment.</td>
<td>Author states one behavioral adaptation for the organism and explains how it helps the organism survive in its environment.</td>
<td>Author states one behavioral adaptation for the organism, but no explanation is given to how it helps the organism survive in its environment.</td>
<td>Author does not include a physical adaptation for the organism.</td>
</tr>
<tr>
<td>Presentation</td>
<td>Presentation flows well and logically and in a creative way. Correct number of slides</td>
<td>Presentation flows well. Acceptable understanding. Correct number of slides.</td>
<td>Presentation is not in relevant order. Lacks 1-2 slides.</td>
<td>Presentation is unorganized. Lacks a number of slides.</td>
</tr>
</tbody>
</table>
ADAPTATIONS: Will You Survive?

SC.5.L.17.1: Compare and contrast adaptations displayed by animals that enable them to survive in different environments such as life cycles, animal behaviors, and physical characteristics.

SC.5.L.15.1: Describe how, when the environment changes, differences between animals help them to survive and reproduce, while others die or move to new locations.

ADAPTATIONS: Will You Survive?

- Adaptations are any behavioral or physical characteristics of an animal that help it to survive in its environment.

ADAPTATIONS: Will You Survive?

- These characteristics fall into three main categories:
  1. body parts
  2. body coverings
  3. behaviors.

- Any or all of these types of adaptations play a critical role in the survival of an animal.

ADAPTATIONS: Will You Survive?

Environment: all of the living and non-living things around an organism

Ecosystem: all the living things, from plants and animals to microscopic organisms, that share an environment

Habitat: the natural home or environment of an animal, plant, or other organism

ADAPTATIONS: Will You Survive?

- A physical adaption is some type of structural modification made to a part of the body.

Examples:

- Webbed feet
- Sharp claws
- Large beaks
- Wings/flying
- Feathers
- Fur
- Scales
ADAPTATIONS: Will You Survive?

A behavioral adaptation is something an animal does or how it acts, usually in response to some type of external stimulus.

ADAPTATIONS: Will You Survive?

Hibernation: to go into a deep sleep
Dormancy: not moving much and needing little food or air

ADAPTATIONS: Will You Survive?

Examples of some behavioral adaptations:
- What an animal is able to eat
- How an animal moves
- How an animal may protect itself
  - Migration
  - Hibernation
  - Dormancy
  - Camouflage

ADAPTATIONS: Will You Survive?

Food Chain: The sequence of the transfer of food energy from one organism to another in an ecological community. A food chain begins with a producer, usually a green plant or alga that creates its own food through photosynthesis.

Food Web: a system of interlocking and interdependent food chains.

ADAPTATIONS: Will You Survive?

Camouflage: a pattern of body coloring that helps a living thing blend in with the place where it lives
Migration: to travel long distances to warmer ecosystems or to follow food sources

ADAPTATIONS: Will You Survive?

Predator: an animal that naturally preys on others
Prey: an animal that is hunted and killed by another for food
Producer: any green plant or any of various microorganisms that can convert light energy
Consumer: any animals that prey on plants or other animals
<table>
<thead>
<tr>
<th>ADAPTATIONS: Will You Survive?</th>
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<tbody>
<tr>
<td><strong>Herbivore</strong>: a kind of animal that feeds chiefly on grass and other plants</td>
</tr>
<tr>
<td><strong>Carnivore</strong>: a kind of animal that depends only on flesh or meat of other organisms for their nutrition</td>
</tr>
<tr>
<td><strong>Omnivore</strong>: a kind of animal that eats either other animals or plants</td>
</tr>
</tbody>
</table>
In the first row, write all the Florida biomes you can think of. Choose one you wish to research.
In the second row, write all of the living and non-living things within your chosen ecosystem.
In the third row, write the threatened or endangered animal you will be researching.
Task Card Activity Instructions

1. Copy the task cards onto tag board/card stock and laminate for durability.
2. Copy one task card answer sheet for each student in class.
3. Students may work in partners or individually.
4. Place the task cards around the room preferably in numerical order.
5. Students should move at their own pace (usually allow approximately 30-50 seconds per card) to answer the questions in the cards. Using a countdown clock will usually keep students on task.
6. Students will return to their seat and review/discuss the answers.

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<td>1.</td>
<td>C</td>
<td>2.</td>
<td>ABC</td>
<td>3.</td>
</tr>
<tr>
<td>4.</td>
<td>C</td>
<td>5.</td>
<td>ABCD</td>
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<tr>
<td>1. Adaptations are:</td>
<td>5. Adaptations may include:</td>
<td>9. Physical adaptations include all EXCEPT:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>A. Physical</td>
<td>A. Habitat</td>
<td>A. Webbed feet</td>
<td></td>
<td></td>
</tr>
<tr>
<td>B. Behavioral</td>
<td>B. Body coverings</td>
<td>B. Sharp Claws</td>
<td></td>
<td></td>
</tr>
<tr>
<td>C. Both</td>
<td>C. Body parts</td>
<td>C. Large beaks</td>
<td></td>
<td></td>
</tr>
<tr>
<td>D. Neither</td>
<td>D. Behaviors</td>
<td>D. Migration</td>
<td></td>
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<tbody>
<tr>
<td>2. A behavior adaptation may include (choose all that apply)</td>
<td>6. All living and non-living things are included in a</td>
<td>10. Camouflage is</td>
<td></td>
<td></td>
</tr>
<tr>
<td>A. Migration</td>
<td>A. Ecosystem</td>
<td>A. traveling long distances</td>
<td></td>
<td></td>
</tr>
<tr>
<td>B. Camouflage</td>
<td>B. Habitat</td>
<td>B. coloring to blend in with the surroundings</td>
<td></td>
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<tr>
<td>C. Hibernation</td>
<td>C. Environment</td>
<td>C. sleeping through the winter</td>
<td></td>
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<tr>
<td></td>
<td>D. Community</td>
<td>D. not moving much and using very little food or air</td>
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</tbody>
</table>

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3. True or False?
An ecosystem includes only the living organisms that share an environment.

7. Which of these would be considered a "producer"?
   A. mammals
   B. flowers
   C. birds
   D. trees

11. Which of these are not characteristics of a mammal?
   A. lays eggs
   B. hair/fur
   C. warm-blooded
   D. breathes through gills

4. Which of these are not considered a type of predator?
   A. Carnivore
   B. Omnivore
   C. Herbivore
   D. all of the above

8. Which statement is true?
   A. Food webs are made up of food chains.
   B. Food chains are made up of food webs.

12. Every food chain begins with...
   A. predators
   B. consumers
   C. producers
   D. scavengers

14. Characteristics of all birds include:
   A. feathers
   B. laying eggs
   C. ability to fly
   D. Ability to swim

13. Omnivores eat
   A. meat only
   B. plants only
   C. Meat and plants

15. As a predator, the polar bear uses which of the physical adaptations to hide from prey:
   A. migration
   B. hibernation
   C. camouflage

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Resource ID#: 72595

Primary Type: Lesson Plan

Genetically Engineering Athletes

In this lesson, students will learn about aspects of biotechnology and apply their understanding to a debate about using genetic engineering to engineer better athletes.

Subject(s): Science
Grade Level(s): 6, 7, 8
Intended Audience: Educators
Suggested Technology: Computer for Presenter, Computers for Students, Internet Connection, LCD Projector, Microsoft Office, Computer Media Player

Instructional Time: 4 Hour(s)
Resource supports reading in content area: Yes
Freely Available: Yes
Keywords: biotechnology, traits, genetic engineering, genetics, selective breeding, athletics, cloning
Resource Collection: FCR-STEMLearn Diversity and Ecology

ATTACHMENTS

- WhatIsBiotechnology.pptx
- TraitsOfAthletesWorksheet.docx
- HowToDebateAsATeam.docx
- SourcesForResearch.docx

LESSON CONTENT

- **Lesson Plan Template:** General Lesson Plan

- **Learning Objectives:** What should students know and be able to do as a result of this lesson?
  1. Students will understand how genetics plays a role in success in sports.
  2. Students will be able to describe the different types of biotechnology (e.g. cloning, genetic engineering, artificial selection).
  3. Students will form a position on the role of biotechnology in society.
4. Students will debate their positions on genetic engineering in athletics.
5. Students will understand that science can stir up ethical debates among scientists and in the general population.

- **Prior Knowledge: What prior knowledge should students have for this lesson?**
  - Students should have knowledge of basic genetic concepts and heredity.
  - They should understand that selective breeding is considered biotechnology; it is just a simpler form that has been around for many, many years.
  - They should understand what biotechnology is.
  - They should understand what ethics are and why they are important.

**Students may sometimes find it difficult to understand how genetics contribute to success in various areas. They are also often confused about the types of biotechnology and how they are used. Many students may be confused by why ethics should be considered in cases like that covered in the lesson plan (“after all, it is making something better”). Exposure to many examples will help students understand how “beneficial” biotechnology can be controversial ethically, although many adults struggle with these concepts, as well.**

- **Guiding Questions: What are the guiding questions for this lesson?**
  1. What are some of the physical characteristics of good athletes?
  2. Why are some athletes better at some sports and not others?
  3. Is it okay to genetically engineer a better human?

- **Teaching Phase: How will the teacher present the concept or skill to students?**
  - The lesson will begin with a review of biotechnology as a field; biotechnology dates back to the days when people figured out how to selectively breed animals and plants to obtain desired traits. Selective breeding proceeded to the actual manipulation of genetic material in organisms. Use the attached PowerPoint.
  - As a hook to pull students in, two YouTube video clips will help students to begin to grasp these concepts. First, show the clip YouTube - Genetic Engineering for Human Enhancement (show from 3:30-6:14). Follow the first video with this clip from the film Gattaca depicting a futuristic society in which genetic engineering of zygotes has become common practice. The Gattaca clip will expose students to the idea of custom choosing the traits of one’s offspring.
  - Ask students what fields they think they would benefit from genetic engineering of humans. Hopefully, someone will suggest sports, but if not, they need to be led to that. This clip, Race, Science, and Athletics, provides an interesting look at characteristics for success in some sports.

- **Guided Practice: What activities or exercises will the students complete with teacher guidance?**

  The students will complete the worksheet - Traits of Athletes (attached). To do this students will use internet and/or library research. Often, students will already have insight into some sports. The teacher will remind the students that when traits are discussed in this lesson plan, the traits will be those relevant to success in the sport, not trivial traits.

  The teacher will be circulating to ensure that students are completing the assignment accurately and thoughtfully. While they are working in their groups, the teacher may ask:
  - What are the characteristics of good _____? (soccer players, swimmers, figure skaters, gymnasts)
  - Why would one person be better at playing football, while another is better at basketball?
  - What makes it difficult for a long distance runner to win in a sprinting event?
  - Just because we CAN do something (like cloning), does that mean we should?

Once the assignment is completed, the teacher will lead a brief, free-form, class discussion addressing a few of these traits.

- **Independent Practice: What activities or exercises will students complete to reinforce the concepts and skills developed in the lesson?**
  - After the discussion, the teacher will create groups of 3-5 students. The teacher will want to have an even number of groups; one half will be “for” and one half will “against” genetic engineering in the debate.
  - The teacher will introduce the debate topic. The teacher will tell students that one team will be presenting for genetic engineering, and one team will be against genetic engineering. The teacher will not tell the students which side they will represent, yet. The students will be told to brainstorm ideas for each side within their groups. This will help students to develop their arguments when they are preparing to counter the argument coming from the opposing side. The attached document provides potential sources to help with the research.
  - Finally, the teacher designate groups as pro or con. The teacher will place pieces of paper labeled with group numbers and pro/con in a cup. The label follow: Group 1 pro, Group 1 con, etc. One student per group will select a paper from the cup. The students will begin mapping out their approach to the debate. Students may continue to use resources to assist them in developing their arguments. The teacher will remind the students that they want to work quietly so as not to give the opposing team an unfair advantage.
  - The teacher will continue to circulate to provide assistance as needed.

- **Closure: How will the teacher assist students in organizing the knowledge gained in the lesson?**
  - Preparing to debate, debating, and watching the other groups debate will help the students to organize their recently-acquired knowledge.
The teacher will lead a final conversation reminding the students that this "science fiction" is not so fictional any more. In fact, their generation will be making a lot of decisions about this topic as they get older.

**Summative Assessment**
- The final assignment will be a debate between teams over the ethical dilemma of genetically engineering people to be better athletes. A rubric can be found at Rubistar Rubric. If the teachers need to do a site search for the rubric on RubiStar, the number is 2449663.
- There are two attached documents that will help students as they prepare for the assessment. The teacher will find "How to Debate as a Team" and "Sources for Research" attached to the lesson plan (both documents are for the students to use).

**Formative Assessment**

The teacher will be circulating to ensure that students are completing the assignment accurately and thoughtfully. While they are working in their groups, the teacher may ask:
- What are the characteristics of good _____? (soccer players, swimmers, figure skaters, gymnasts)
- Why would one person be better at playing football while another is better at basketball?
- What makes it difficult for a long distance runner to win in a sprinting event?
- Just because we CAN do something (like cloning) does that mean we should?

Student answers to these questions will inform teacher about how well the student is grasping this information.

**Feedback to Students**
- While the teacher is circulating and asking questions such as those listed above in Formative Assessment, the teacher will listen for any misconceptions in student responses and provide verbal feedback.
- Feedback will also be given for the final Summative Assessment using the rubric provided (see Summative Assessment).

**ACCOMMODATIONS & RECOMMENDATIONS**

**Accommodations:**
- The first part of the lesson will be to research the traits of athletes and how they can make an athlete more successful. This is probably best done in pairs if students need additional assistance. They are to use textbook, outside sources, or computer sources to assist in this assignment.
- As the second part of the lesson is a larger group assignment, the structure will be helpful for students who need additional assistance through the student-student interactions. The teacher may wish to form teams such that weaker students are grouped with stronger students.
- The nature of the activity will help to meet the different strengths of class members while teaching the concepts.

**Extensions:**

Students may write "newspaper" articles or create news reports to explain the influence of genetics on sports. Another option would be for students to try to design the perfect athlete, emphasizing which type(s) of biotechnology they would plan to use.

**Suggested Technology:** Computer for Presenter, Computers for Students, Internet Connection, LCD Projector, Microsoft Office, Computer Media Player

**Special Materials Needed:**

Materials for research – computers, textbooks, etc.

**Further Recommendations:**

The lesson may be challenging for those students who are not the best at working together, as it requires a lot of give and take. Therefore, some extra teacher guidance may be required, as well as paying special attention to student personalities when assigning students to groups.

Some students may struggle with the idea of "better" or "worse" genetically. The teacher should try to encourage students to think scientifically, not judgmentally.

**SOURCE AND ACCESS INFORMATION**

**Name of Author/Source:** Anonymously Submitted

http://www.cpalms.org/Public/PreviewResource/PrintResource/72595?display=block&Private=true&ProtectedUser=true&IsPrintPreview=true
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Printed On: 12/9/2018 11:59:03 PM
Print Page | Close this window
<table>
<thead>
<tr>
<th>Sport</th>
<th>Physical/Body Traits</th>
<th>Mental Traits</th>
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<td>Football</td>
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<td>Baseball</td>
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<td>Swimming</td>
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<td>Running – Long Distance</td>
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<td>Running - Sprinting</td>
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<td>Bicycling</td>
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<td>Rowing/Crew</td>
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</table>
How to Debate as a Team

Teamwork is essential for success on a team debate. This means listening to each other, participating and working as needed, and staying focused on the debate topic.

Preparation:

- Choose one member to be the team captain. This person will be responsible for keeping the group on track and for insuring that the group will be prepared for the debate.
- Research will take two days of in-class time. If you wish to spend time outside of class, you may.
- As a group, you will need to decide on the following:
  - The main argument your group wants to put forth
  - At least 3 additional arguments to support your cause
  - Which team member will present each argument during the debate
  - Which team member will present a closing statement to wrap up your case

During the debate:

- Listen respectfully, whether or not you agree with what is being presented.
- Listen attentively, so that you will be able to counter statements, or so that you will be able to decide the winning team.
- Speak clearly and slowly enough for everyone to understand you.
- Speak only when it is your turn.

Format:

- Team One member will present the team’s opening arguments – 1 to 3 minutes
- Members of Team One will present the supports for the team opinion – 1 to 3 minutes each
- Break between – time for Team Two to prepare counterarguments – 5 minutes
- Counterarguments
- Team Two member will present the team’s counterarguments – 1 to 3 minutes
- Members of Team Two will present the supports for the team counterarguments – 1 to 3 minutes each
- Break – time for Team One member to prepare closing statement (3 minutes)
- Closing Statement – Given by member of Team One to tie together all that has been presented and possibly counter any statements (2 to 3 minutes)

Following the debate, the audience will vote to choose the winning team.
Genetically Engineering Athletes

Possible Sources for Research

Genetic Engineering:

- http://agbiosafety.unl.edu/basic_genetics.shtml
- http://www.geneticengineeringinhumans.com/

Sports and Body Structures:

- http://sportsmedicine.about.com/od/anatomyandphysiology/a/genetics.htm
- http://www.brianmac.co.uk/bodytype.htm
- http://experiencelife.com/article/just-your-type/
- http://www.theguardian.com/science/2004/aug/05/1
What Is Biotechnology?

There are several important areas of biotechnology.

These include:
- selective breeding
- cloning
- genetic engineering

Definition of Biotechnology

Biotechnology is "any technological application that uses biological systems, living organisms or derivatives thereof, to make or modify products or processes for specific use."

- (UN Convention on Biological Diversity, Art. 2)

Selective Breeding

Selective breeding is the process by which people choose which traits they would like to have in the new generation of offspring. They then select which organisms to breed in order to produce offspring with those traits.

An example of this is breeding "teacup" dogs. Breeders cross small dogs in an attempt to produce offspring that are tiny.

In other words, biotechnology is the use of living things to make things that will be useful to us. This could include medicines, animals with certain traits, plants that grow quickly, or even complete organisms.
Cloning

In the process of cloning, the genetic material is removed from an egg cell and replaced with the genetic material from a body cell of another organism. That egg cell then grows into an exact copy of the organism that is being cloned (the body cell donor).

One example of this is Dolly the sheep. This site will show you how the process works. Click and Clone

Genetic Engineering

Genetic engineering involves directly changing the DNA of an organism. This could be adding or deleting traits directly on the DNA strand. Organisms produced in this way are referred to as GMOs, or genetically modified organisms.

An example of this include some plants used for food, Glo-fish, and bacteria that can produce human insulin.
References

<table>
<thead>
<tr>
<th>Criteria</th>
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<th>Minimal</th>
<th>Emerging</th>
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<th>Highly Effective</th>
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<td>Opportunities are given to work together and share. The teacher and students work together as a whole class to complete activities, but only as a whole class.</td>
<td>Many opportunities are given for the teacher and the students to work together, learn cooperatively and share. Collaboration is required in some parts of the lesson, but not all parts. The teacher works together with small student groups. Student-centered.</td>
<td>Students work together cooperatively and share throughout the lesson. Working collaboratively and sharing is required in all parts of the lesson. Teacher acts as a facilitator to knowledge construction. Lesson is completely student-centered.</td>
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<td><strong>Differentiation</strong> - Students get the opportunity to express their learning in many different ways.</td>
<td>Differentiation is not observed.</td>
<td>Students are only given one option to use to gain knowledge and express their learning.</td>
<td>Students have more than 1 way to gain knowledge, but are only expected to express their learning in 1 way.</td>
<td>Students are welcome to express their learning in multiple ways.</td>
<td>Several ways for students to express their learning are present and are developmentally and culturally relevant to more than just the dominant culture.</td>
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<td><strong>Language and Literacy Development</strong> - Students get the opportunity develop their reading and speaking skills as they learn new content.</td>
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**Criteria:**
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- Differentiation
- Language and Literacy Development
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<td>Language production through questioning, rephrasing and modeling and challenges students to apply their academic language production to new contexts.</td>
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**Criteria**

- **Voice**: Students get the opportunity to work together cooperatively and share their knowledge, experiences, strengths, backgrounds, interests, and needs in order to facilitate knowledge construction with the instructor and each other.
- **Differentiation**: Students get the opportunity to express their learning in many different ways.
- **Language and Literacy**: Students get the opportunity to develop their reading and speaking skills as they learn new content.

**Context**

- **Dogs**

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**Rubric for Culturally Responsive Lessons/Effective Pedagogy**

- **Minimal**
  - Students are not observed.
  - Voice is not observed.

- **Not Observed**
  - Criteria: Students get the opportunity to work together cooperatively and share their knowledge, experiences, strengths, backgrounds, interests, and needs in order to facilitate knowledge construction with the instructor and each other.
  - Differentiation: Students get the opportunity to express their learning in many different ways.
  - Language and Literacy: Students get the opportunity to develop their reading and speaking skills as they learn new content.

- **Emerging**
  - Opportunities are given for the teacher and the students to work together. Collaboration is not required in the lesson. The teacher works as a whole class to complete the activities in the lesson.
  - Students are given one opportunity to express their learning in many different ways.

- **Effective**
  - Opportunities are given for the teacher and the students to work together. Collaboration is required in some parts of the lesson, but not all parts. The teacher works as a whole class to complete the activities, but only as a whole class.
  - Students are only given one opportunity to express their learning in many different ways.

- **Highly Effective**
  - Opportunities are given for the teacher and the students to work together. Collaboration is required in all parts of the lesson. Teacher acts as a facilitator to knowledge construction. Lesson is completely student-centered.
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<td>Students are given the opportunity to work together, learn cooperatively or share. However, collaboration is not required in the lesson to complete the activities in the lesson. Teacher-centered.</td>
<td>Opportunities are given to work together and share. The teacher and students work together as a whole class to complete activities, but only as a whole class.</td>
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<td><strong>Differentiation</strong> - Students get the opportunity to express their learning in many different ways.</td>
<td>Differentiation is not observed.</td>
<td>Students are only given one option to use to gain knowledge and express their learning.</td>
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<td><strong>Language and Literacy Development</strong> - Students get the opportunity to develop their reading and speaking skills as they learn new content.</td>
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<td>The teacher models academic language.</td>
<td>Instructional activities push students to produce language and academic language development are shown in scaffolds.</td>
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<td>correctly. Students are engaged in brief, repetitive drill-based activities.</td>
<td>development are shown in the lesson plan or lesson materials.</td>
<td>produce academic language and scaffolds students to develop their academic language production through questioning, rephrasing and modeling.</td>
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<td>Perspectives are presented in multiple ways that are inclusive to both dominant and non-dominant backgrounds. Cultural norms from non-dominant backgrounds are addressed.</td>
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<td>Challenge is not observed.</td>
<td>Social Justice is not observed.</td>
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<td>Understanding and recall is all that is asked for.</td>
<td>Minimal attempts at connecting social concerns that are relevant for students is evident.</td>
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<td>Most of what is asked for is recall or basic understanding. However, 1 or 2 opportunities for higher order thinking and application are present. Student understanding is enhanced.</td>
<td>One structured, very clear connection to social concerns that is relevant to students is evident. Lesson challenges students to act upon at least one of these social justice themes.</td>
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<tr>
<td>More than 2 opportunities for higher order thinking are present. Student understanding is enhanced.</td>
<td>More than one structured, very clear connection to social concerns that is relevant to students is evident. Lesson challenges students to act upon at least one of these social justice themes.</td>
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<td>Many opportunities for higher order thinking are present. Student understanding and application is enhanced. Higher order thinking is student-centered with the teacher acting as the facilitator.</td>
<td>Students are given opportunities to connect the content to social justice issues of their choosing that are relevant to them and challenges themselves to act upon them.</td>
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<td>Equity/Decolonization</td>
<td>Dominant discourses, deficit perspectives and possible biases in expectations are minimized so students from non-dominant backgrounds (ELLs, students living in poverty, special needs students, minority races and ethnicities and various gender and sexual orientations) have equitable access and ability to participate as those from the dominant backgrounds.</td>
<td>The dominant perspective is the only one being taught. However, the lesson gives recommended accommodations to students' varied ability level as required by law. Standards for student performance are given. Feedback will be given.</td>
<td>Attempt to make the lesson inclusive is present. However, limited scaffolds are given for cultural inclusion.</td>
<td>Multiple perspectives of non-dominant backgrounds are presented in multiple ways. Students are given multiple forms of access.</td>
<td>Perspectives are presented in multiple ways that are inclusive to both dominant and non-dominant backgrounds. Cultural norms from non-dominant backgrounds are addressed.</td>
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