SCIENCE·3D

THE REAL BLACK PANTHER

SCIENCE PERFORMANCE EXPECTATIONS AND DISCIPLINARY CORE IDEAS

In the Middle School Mission, students will address the following general topics. Keep reading below to find the NGSS standards for each component of the Mission. We will be adding Math and Language Arts standards to the document soon! *Note: Be sure to complete the* ***Mission Reader*** *and* ***Mission Research*** *before viewing the full* ***Mission Video****. Explore How to Use Science 3D to get suggestions on how to pace the Mission and options for the order of activities.*

- In the **Mission Reader** *The Real Black Panther*, middle school students will explore the genetic basis for color variation in leopards, the basics of genetics and inheritance, natural selection, and artificial selection. To explore these topics, students will gain important background information on the biology and behavior of leopards, the threats they face, and the ways scientists study these big cats.
- For the **Mission Research**, students use their understanding of genetics to explore Genetically Modified Organisms (GMOs), artificial selection, and resilience of crops in a changing world.
- In the **Science Mission**, students will begin by using Punnett squares to investigate genetics and work with simple ratios. Next, they will use data to investigate how having a black or yellow coat influences hunting success of leopards. Then, they will make predictions about how these results inform the relative abundance of traits in the population and how the population might change if if there was a change in the environment. Finally, students will model natural selection in a leopard population.
- In the **STEM Project**, students will expand their computing skills by following step-by-step instructions to code a model of natural selection into a database program (e.g. Microsoft Excel). They will use the model to investigate how changes in variables will affect predicted outcomes. *Note: The teacher materials allow you to provide students with as much information as needed to modify the difficulty of the programming.*
- The **Explore Your Backyard** activity will have students reinforce their understanding of traits and adaptation by exploring local organisms and predicting outcomes of environmental change.

SCIENCE/ENGINEERING AND DESIGN DISCIPLINARY CORE IDEAS AND PERFORMANCE EXPECTATIONS

MISSION READER

MS-LS1-4	Use argument based on empirical evidence and scientific reasoning to support an explanation for how characteristic animal behaviors and specialized plant structures affect the probability of successful reproduction of animals and plants: This discusses strategies leopards use for reproduction.
LS1.B	Growth and development of organisms; plant and animal reproduction and behavior: Explored for leopards.
MS-LS1-5	Construct a scientific explanation based on evidence for how environmental and genetic factors influence the growth of organisms: To effectively integrate the genetic and environmental aspects in the Science Mission activity, complete the entire exercise. At the conclusion, you can lead a class discussion about how these factors would influence the growth of individuals and the sizes of populations of leopards with black or yellow coats. Have students think about how genetics and environment might affect growth of other organisms like plants. Be sure to ask them how they would test their hypotheses. How would they separate genetic and environmental factors? The information in the reader will set up this discussion.
MS-LS2-1	Analyze and interpret data to provide evidence for the effects of resource availability on organisms and populations of organisms in an ecosystem.
LS2.A	Interdependent relationships in ecosystems: competition.
MS-LS2-2	Construct an explanation that predicts patterns of interactions among organisms across multiple ecosystems.
LS2.A	Interdependent relationships in ecosystems: predation, mutualism, interactions similar across ecosystem types.
MS2-LS2-4	Construct and argument supported by empirical evidence that changes to physical or biological components of an ecosystem affect populations.
LS2.C	Ecosystem dynamics, functioning and resilience: change through time possible.
LS4.D	Biodiversity and humans.
MS-LS3-1	Develop and use a model to describe why structural changes to genes (mutations) located on chromosomes may affect proteins and may result in harmful, beneficial, or neutral effects to the structure and function of organisms.

*ELA and Math standards to come

LS3.A	Inheritance of traits: genes and how they work.
LS3.B	Variation in traits: mutations, proteins harmful/helpful.
MS-LS3-2	Develop and use a model to describe why asexual reproduction results in offspring with identical genetic information and sexual reproduction results in offspring with genetic variation.
LS1.B	Growth and development of organisms: sexual and asexual reproduction: Cover sexual reproduction only and not in full detail.
LS3.A	Inheritance of Traits: variation comes from getting a subset of chromosomes from each parent.
LS3.B	Variation of traits: chromosomes in sexual reproduction.
MS-LS4-4	Construct an explanation based on evidence that describes how genetic variations of traits in a population increase some individuals probability of surviving and reproducing in a specific environment.
LS4.B	Natural selection: some traits common, some rare.
MS-LS4-5	Gather and synthesize information about the technologies that have changed the way human influence the inheritance of desired traits in organisms.
LS4.B	Natural selection: artificial selection.
MS-LS4-6	Use mathematical representations to support explanations of how natural selection may lead to increases and decreases of specific traits in populations over time.
LS4.C	Adaptation.
ESS3.A	Natural Resources.
MS-ESS3-3	Apply scientific principles to design a method for monitoring and minimizing a human impact on the environment
ESS3.C	Human impacts on Earth systems.
MS-ESS3-4	Construct an argument supported by evidence for how increases in human population and per capita consumption of natural resources impact Earth's systems.
ESS3.C	Human impacts on Earth systems: link to population size and need for solutions.

MISSION RESEARCH

MS-LS4-5	Gather and synthesize information about the technologies that have changed the way human influence the inheritance of desired traits in organisms.
LS4.B	Natural selection: artificial selection.
MS-ETS1-4	Develop a model to generate data for iterative testing and modification of proposed object, tool, or process such that an optimal design can be achieved: Artificial selection and GMO organisms can be discussed as an iterative and design process to attempt to optimize solutions.
ETC1.C	Optimizing the design solution: iterative process leads to optimal solutions: Artificial selection and GMO organisms can be discussed as an iterative and design process to attempt to optimize solutions.
MS2-LS2-4	Construct and argument supported by empirical evidence that changes to physical or biological components of an ecosystem affect populations: Focus here on how changes in conditions might affect individuals differently based on their traits. Students can be challenged to think about how that might affect populations overall based on how common particular traits are in a population.
MS-LS4-6	Use mathematical representations to support explanations of how natural selection may lead to increases and decreases of specific traits in populations over time.
LS4.C	Adaptation.

SCIENCE MISSION

MS-LS1-4	Use argument based on empirical evidence and scientific reasoning to support an explanation for how characteristic animal behaviors and specialized plant structures affect the probability of successful reproduction of animals and plants: This discusses strategies leopards use for reproduction.
LS1.B	Growth and development of organisms; plant and animal reproduction and behavior: Explored for leopards
MS-LS1-5	Construct a scientific explanation based on evidence for how environmental and genetic factors influence the growth of organisms: To effectively integrate the genetic and environmental aspects in the Science Mission activity, complete the entire exercise. At the conclusion, you can lead a class discussion about how these factors would influence the growth of individuals and the sizes of populations of leopards with black or yellow coats. Have students think about how genetics and environment might affect growth of other organisms like plants. Be sure to ask them how they would test their hypotheses. How would they separate genetic and environmental factors? The information in the reader will set up this discussion.
LS3.A	Inheritance of traits: genes and how they work.
LS3.A	Inheritance of Traits: variation comes from getting a subset of chromosomes from each parent.
LS3.B	Variation of traits: chromosomes in sexual reproduction.
MS-LS4-4	Construct an explanation based on evidence that describes how genetic variations of traits in a population increase some individuals probability of surviving and reproducing in a specific environment.

*ELA and Math standards to come

LS4.B	Natural selection: some traits common, some rare.
MS-LS4-6	Use mathematical representations to support explanations of how natural selection may lead to increases and decreases of specific traits in populations over time.
LS4.C	Adaptation.

STEM PROJECTS

ESS3.C	Human impacts on Earth systems: link to population size and need for solutions: This can be covered by having students imagine different human impacts that might affect the key parameters in the computer model (for example, survival rates or the number of cubs produced). Then they can explore how this would affect the population based on the assumptions made in the model.
MS-LS4-4	Construct an explanation based on evidence that describes how genetic variations of traits in a population increase some individuals probability of surviving and reproducing in a specific environment.
LS4.B	Natural selection: some traits common some rare.
MS-LS4-6	Use mathematical representations to support explanations of how natural selection may lead to increases and decreases of specific traits in populations over time.
LS4.C	Adaptation.
MS-LS2-1	Analyze and interpret data to provide evidence for the effects of resource availability on organisms and populations of organisms in an ecosystem.
LS2.A	Interdependent relationships in ecosystems: competition.
MS2-LS2-4	Construct and argument supported by empirical evidence that changes to physical or biological components of an ecosystem affect populations.

Additional content: This activity is focused largely on computing skills and the role of computer models in science.

EXPLORE YOUR BACKYARD

MS2-LS2-4	Construct and argument supported by empirical evidence that changes to physical or biological components of an ecosystem affect populations.
MS-LS4-4	Construct an explanation based on evidence that describes how genetic variations of traits in a population increase some individuals probability of surviving and reproducing in a specific environment.
LS4.C	Adaptation.

CROSS CUTTING CONCEPTS

Patterns: Mission Reader, Science Mission, STEM Projects, Explore Your Backyard
Cause and Effect: Mechanisms and Predictions: Mission Reader, Mission Research, Science Mission, STEM Projects
Scale Proportion and Quantity: Science Mission, STEM Projects
System and system models: Mission Reader, Mission Research, Science Mission, STEM Projects
Energy and matter: flows, cycles and conservation: Mission Reader
Structure and function: Mission Reader, Mission Research, Science Mission, Explore Your Backyard
Stability and change: Mission Reader, Mission Research, Science Mission

CONNECTION TO ENGINEERING, TECHNOLOGY AND APPLICATIONS OF SCIENCE

Interdependence of Science, Engineering and Technology: Mission Reader, Mission Research
Influence of Science, Engineering and Technology on Society and the Natural World: Mission Reader, Mission Research

CONNECTION TO NATURE OF SCIENCE

Scientific investigations use a variety of methods: Science Mission, STEM Projects
Scientific knowledge is based on empirical evidence: Mission Reader, Mission Research, Science Mission
Science models, laws, mechanisms and theories explain natural phenomena: Mission Reader, Science Mission, STEM Projects
Science is a way of knowing: Mission Reader, Science Mission, Explore Your Backyard
Scientific knowledge assumes an order and consistency in natural systems: All
Science is a human endeavor: Mission Reader, Mission Research, Science Mission
Science addresses questions about the natural and material world: All

SCIENCE AND ENGINEERING PRACTICES

Asking questions and defining problems: Mission Research, Science Mission, STEM Projects
Developing and using models: Mission Reader, Science Mission, STEM Projects
Planning and carrying out investigations: Mission Reader, Mission Research, Science Mission, STEM Projects
Analyzing and interpreting data: Mission Reader, Science Mission, STEM Projects

*ELA and Math standards to come

Using mathematics and computational thinking: Mission Reader, Science Mission, STEM Projects
Constructing explanations and designing solutions: Mission Research, Science Mission, STEM Projects
Engaging in argument from evidence: Mission Research, Science Mission, STEM Projects, Explore Your Backyard
Obtaining, evaluating and communicating information: Mission Research, Science Mission, STEM Projects, Explore Your Backyard

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