



ARIZONA-SONORA
DESERT
MUSEUM

Bat Research Simulation

A 120 minute Desert Discovery Lab

To the Teacher:

Thank you for making the *Bat Research Simulation* Desert Discovery Lab a part of your curriculum. The purpose of this exciting educational lab is to introduce middle and high school students to the natural history, importance and diversity of bats as well as to provide them with a simulated, hands-on research experience through which they practice data collecting, organization, analysis and research techniques. This Teacher Information Packet provides resources to help you prepare for the lab and integrate these concepts into your classroom curriculum.

This packet contains resources for pre- and post- program information and activities along with a vocabulary list and suggested further resources. These materials were developed to help you extend this class topic with both introductory and follow-up lessons. We hope you'll find this information useful and easy to incorporate into your science curriculum.

The lab is divided into two distinct sections. The first consists of a bat natural history lesson, featuring live animals and a variety of natural history artifacts. The second consists of a simulation within which students are divided into five research teams, each given the task to collect mist-net data from one location in the "Chiricahua National Monument". **Please consider dividing your class into 5 research teams before attending the lab.** Students will identify and take weight and wingspan measurements of each made-to-scale bat model "caught" in their "mist-nets". Students will compare their "capture data" to actual data from previous years. Teams will be asked to observe trends in the data, then to utilize available resources and their newly acquired bat knowledge to hypothesize possible scenarios that account for observed population changes over time.

Classroom Set-Up: (for labs at your school)

- Your classroom should be set up with 5 work-stations, one for each research team.
- Ideally, the data-taking portion of the lab should be set up in a large open area, preferably outside. If there is a field, garden, MPR or other large space available, please reserve that space for our simulation. This area will be used to set up 5 (4' by 5') "capture nets".

Please make sure students are aware that this lab is an in-depth, hands-on, two-hour session that will require their utmost cooperation to complete successfully. We recommend that you make it a part of their science grade.

For more information about the Desert Museum and the Sonoran Desert, visit our website at www.desertmuseum.org. We look forward to working with you and your students.

Sincerely,
ASDM Conservation Education and Science Department

BAT RESEARCH SIMULATION

Become a bat researcher and learn how scientists study bats in the field. Collect your own model bats, take measurements, identify species and compare your data to actual bat data from the Sonoran Desert. You will then get to identify trends in bat populations, and discover why it's important to learn more about these commonly misunderstood animals.

LAB OBJECTIVES

Bat Natural History:

- Describe at least 5 characteristics of bats.
- Demonstrate understanding of bat diversity.
- Develop an appreciation for the importance/value of bats to humans and the ecosystem as a whole.
- Describe ways in which humans impact bat populations.
- Describe dangers to bats.
- Explain strategies for species preservation.

Research Methodology:

- Utilize measurement tools and methods.
- Practice data collection and organization.
- Compare collected data with established data set.
- Use critical thinking skills in data analysis.
- Create hypothesis based on data and comparative species information.
- Propose conservation strategies based on data and resulting hypothesis.

ARIZONA ACADEMIC STANDARDS IN SCIENCE CORRELATION

The *Bat Research Simulation* Lab and supplemental activities correlate to these Arizona Academic Science Standards. See each activity for specific standards and performance objectives.

Inquiry Process	SC07-S1C3-01,02,05,06&07	SC07-S3C2-01
SC06-S1C1-02	SC08-S1C3-01,02,05&08	SC08-S3C2-01
SC07-S1C1-01	SCHS-S1C3-07	SCHS-S3C2-01,04&05
SC08-S1C1-01	Life Science	SC06-S4C1-06&07
SCHS-S1C1-01&02	SC05-S3C1-02&03	SC06-S4C3-02
SC06-S1C2-01,02,04&05	SC07-S3C1-01,02&03	SC07-S4C3-03,04&05
SC07-S1C2-01,02,04&05	SC08-S3C1-01&02	SCHS-S4C3-01&02
SC08-S1C2-01,02,04&05	SCHS-S3C1-01,02,03,04&05	SC08-S4C4-01,05&06
SCHS-S1C2-01,02,03,04&05	SC06-S3C2-01	SCHS-S4C4-02,04&06
SC06-S1C3-01,02,04&06		

2008 AZ Math Standards	2012 AZ Common Core - Math		
M06-S2C1-01,02&04	6.SP.4	6.SP.5	
M07-S2C1-01&02	8.SP.1		
M08-S2C1-01,02	7.SP.2	7.SP.3	8.SP.2
MHS-S2C1-01&03	HS.S-ID.1	HS.S-ID.6	HS.N-Q.1
M06-S3C4-01	6.EE.9		
M07-S3C4-01	6.EE.9	7.RP.2	
M06-S4C4-01			
M07-S4C4-07	7.G.2		

Arizona State Science Standards

Strand 1: Inquiry Process

Concept 1: Observations, Questions and Hypotheses

Concept 2: Scientific Testing (Investigating and Modeling)

Concept 3: Analysis and Conclusions

Strand 3: Science in Personal and Social Perspectives

Concept 1: Changes in Environments

Concept 2: Science and Technology in Society

Strand 4: Life Sciences

Concept 1: Characteristics of Organisms /Structure and Function of Living Systems

Concept 3: Organisms and Environments/ Populations of Organisms in an Ecosystem/
Interdependence of Organisms

Concept 4: Diversity, Adaptation and Behavior

2008 Arizona State Math Standards

Strand 2: Data Analysis, Probability and Discrete Mathematics

Concept 1: Data Analysis

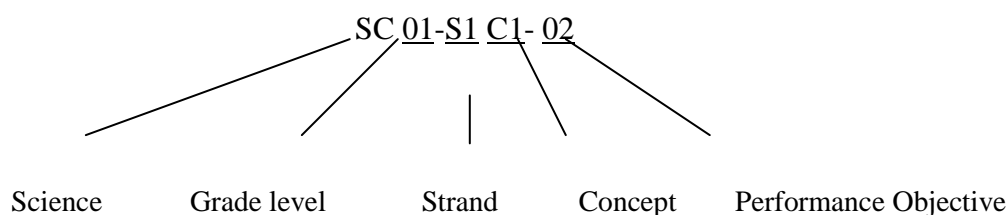
Strand 3: Patterns, Algebra and Functions

Concept 4: Analysis of Change

Strand 4: Geometry and Measurement

Concept 4: Measurement

The shorthand for each standard is read this way:



2010 Arizona Common Core Standards - Math

Domain: The Number System

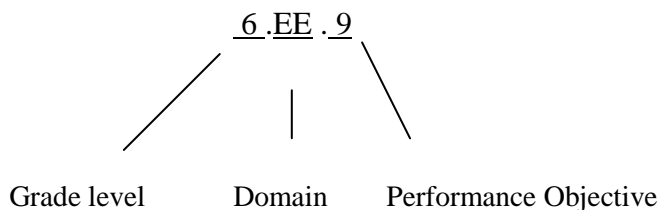
Domain: Ratios and Proportional Relationships

Domain: Expressions and Equations

Domain: Statistics and Probability

Domain: Geometry

The shorthand for each standard is read this way:



RESOURCES

Websites/Organizations

- Arizona-Sonora Desert Museum: 2021 N. Kinney Rd., Tucson, AZ 85743. Phone: (520)883-3025. www.desertmuseum.org
- Bat Conservation International, Inc.: P.O. Box 162603, Austin, TX, 78716. Phone: 1-800-538-2287. www.batcon.org
- Desert USA: www.desertusa.com/animal.html (this site contains information and photos on many nocturnal desert creatures)
- The Nature Conservancy: www.tnc.org
- NASA, GSFC, USGS, NBII, MU-SPIN collaboration: “The Adventures of Echo the Bat” – story introduces the use of remote sensing to study big brown bat migration in Arizona <http://science.hq.nasa.gov/kids/imagers/intro/story.html>

Literature:

- Arizona-Sonora Desert Museum. *A Natural History of the Sonoran Desert*. Tucson: ASDM Press, 1999.
 - Bat Conservation International. *About Bats: Educator’s Activity Book*. Austin: Bat Conservation International, Inc., 1991.
 - Harvey, Michael J. et al. *BATS of the United States*. Arkansas Game and Fish Commission, 1999.
 - Tuttle, Merlin D. *Battered by Harsh Winds*. Austin: Bat Conservation International, Inc., 2005.
 - Tuttle, Merlin D. *Discover Bats!* Austin: Bat Conservation International, Inc., 1998.
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VOCABULARY

Adaptation - A body part or behavior of an animal or plant that helps it survive in its environment (i.e. an eagle has sharp talons that help it grab and hold its prey)

Carnivore – animal that eats meat

Chiroptera - taxonomic order in which bats belong, translates to “hand-wing”

Desert - An area that is lacking in usable moisture most of the year

Endangered – An animal or plant that is so rare, it may become extinct

Endangered species – A listing given by the U.S. Fish and Wildlife Service to species of plants and animals whose population numbers have dropped so low that they are in danger of becoming extinct

Echolocation – The process by which some animals locate objects by emitting sounds and hearing them echoed

Endothermic – Describes an animal that controls its own body temperature internally

Frugivore – animal that eats fruit

Habitat – The place in which an animal or a plant lives that provides the food, water, shelter and space needed for its survival

Habitat Loss – The use of an animal’s or plant’s habitat by people, making it no longer usable by those animals and plants.

Hibernate – The slowing down of all body processes for the duration of winter, like going into a very deep sleep

Insectivore – animal that eats insects and arthropods

Megabat - Members of Megachiroptera - are commonly referred to as flying foxes because of their fox-like faces. They are found only in the Old World tropics.

Microbat – Members of Microchiroptera, which are highly varied in appearance but generally smaller than Megachiroptera. They occur worldwide.

Migrate – To travel from one area to another in search of resources to support feeding and reproduction, and /or to avoid unfavorable climactic conditions

Migration corridor – The route along which animals migrate between seasonal feeding and breeding grounds. Migration corridors are typically linear habitats surrounded by a wider matrix of less intact habitat.

Nectarivore – animal that eats nectar

Nocturnal – Active at night

Piscivore – animal that eats fish

Pollination – The spreading of pollen from the male parts (anther) to the female parts (stigma) of a flower, either between flowers of the same kind or within the same flower, resulting in the production of seeds and fruits

Pollinator – An animal that carries pollen from one flower to another, aiding in pollination

Roost – A place for birds and bats to rest; to land or rest in a roost

Sanguivore – animal that eats blood

Seed dispersal – The spreading of seeds

Vertebrate – animal with a backbone

PRE-PROGRAM INFORMATION & ACTIVITIES

ANTICIPATORY ACTIVITIES: GRADES 6-12

A variety of activities to hook student interest in bats and issues surrounding bats

Benefits of Bats

Students investigate products (manipulatives and pictures) to explore the importance of bats for humans and nature.

Bats: Maligned or Malicious?

Students explore views and myths about bats, and present their findings.

Species Profiles

Pictures and information for North American Bat Species

POWERPOINT PRESENTATIONS

Grade 6 Bats A to Z: An Alphabet Book About Bats

Information and pictures about bats

Grades 7-12 (adaptable for Grade 6) **Why Care About Bats**
Information and pictures about bats, with teacher notes in the notes section

EXPLORATION ACTIVITIES

A variety of activities for students to explore natural history, importance of and threats to bats

Grades 6-8 **The Wing's the Thing (Bat Anatomy)**
Students identify and label bat anatomy on a diagram.

Grades 9-12 (adaptable for Grade 8) **Bats of Arizona – Classification**
Using a glossary of Scientific Names given to bats, students translate names into descriptive characteristics.

Grades 7-12 **Threats to Bats (article)**
Students read an article regarding impacts threatening bat populations world-wide.

Grades 7-12 **Plotting Populations – Graph drawing activity**
Students draw graph of bat population data, and interpret graph to draw conclusions.

Grades 7-12 **Caves and Humans – So Happy Together? – Impact of Human Use**
In a worksheet activity, students analyze various scenarios of cave use and its impacts on the environment and bats.

Grades 6-8 **Bats and Echolocation** (adaptable for Grades 9-12)
Students experiment with reflected sound waves in order to analyze echo return time and calculate the distance of the reflecting surface.

POST-PROGRAM INFORMATION & ACTIVITIES

APPLICATION/ELABORATION ACTIVITIES

A variety of activities for students to apply program concepts and elaborate on the importance of bats to humans and to the larger ecosystem, threats to bat populations, and strategies for preservation.

Grades 6-8 **Bats: A Creativity Book for Young Conservationists**
Recommended activities: Save the Cave, Dear Editor and Bat Rap
Students engage in various creative thinking activities to review characteristics, importance and issues about bats.

Grades 6-8 **Pest Control - It All Adds up – Word Problems**
Students solve word problems about bats' eating habits and impacts on crops.

Grades 6-8 **Make and Play Game**

Students play a situational dice game to simulate a year in the life of a bat and the obstacles it faces.

Grades 6-8 **Bats: Need Nectar, Will Travel**

Students role play as nectar-feeding bats on their annual migration, and try to avoid various hazards that hinder their progress.

Grades 7-12 **Decades of Decline – graph interpretation**

Students analyze graphs for trends in bat populations and draw conclusions.

Grades 7-12 **Cave Conservation– Why Care? – Research and Role Play**

Students research views of interest groups and present information in a role-playing activity.

Grades 6-12 **Speak up for Bats**

Students engage in letter-writing campaign to lawmakers requesting support for white-nose syndrome research.

Grades 6-12 **Build a Bat House**

Students build bat houses for roosting bats.

FURTHER RESOURCES

Bats Live – A Distance Learning Adventure

http://www.batslive.pwnet.org/resource/lesson_plans.php

Resource Center for K-8 curricula

Mathwire – Math Activity Themes- Bats <http://mathwire.com/themes/themebat.html>

Standards-based math activities that incorporate bat themes

ASDM All About Bats Teacher Information Packet

<http://www.desertmuseum.org/center/edu/resources.php>

Resources for Grade 3-12 curricula

ASDM Sonoran Desert Bat Fact Sheets <http://www.desertmuseum.org/kids/bats/>

Pictures and Information for some of the Sonoran Desert Bat species

