



Who wants to be the Model Organism?

Biology Worksheet Teacher Material

OVERVIEW

This activity will enable students to explore what makes a species the best *Model Organism* and choose the best species from a list of plants & animals endemic to the Four Corners region.

KEY CONCEPTS

- Model organisms are any non-human species that are widely studied in the laboratory setting and have a very particular experimental advantage.
- Model organisms are easy to maintain and breed in a controlled environment.
- Model organisms are Domesticated for empirical studies but can also be found in the wild.

CONTENT OBJECTIVES

- Students will review concepts about what qualifies a species as a *model organism*.
- Students will choose one species from the provided list as the best Model Organism candidate based on their background knowledge and justify why that is their choice.
- Students will create an infographic material that will explain their reasoning why they chose the species as their Model Organism.

PACING AND SCHEDULING

→ This activity is designed to be done in teams of two, maximum of three students. Each member of the team should have a role to accomplish the task efficiently and consistently.

→ This activity is designed to be stretched out into 2 - 3 days in class and some outside class hours as a take home assignment.

TEACHING METHODS

- This lesson is designed for 9 and 10th grade HS Biology students
- This task should be given to the students AFTER the “*Introduction to Model Organisms*” activity.

CURRICULAR CONTENT: WHO WANTS TO BE A MILLION DOLLAR MODEL?

Day 1:



Part 1: Click and Learn: (This part is intended for a 55-minute class period and may extend up to half a period due to the heavy reading and sorting of information)

Now that you know what qualifies a species as a *model organism*, imagine that you are a Space Biologist and you happened to land on the planet [Tsé Bit'a'í](#) that has very limited but

unique biodiversity. Click all the links that correspond to the Model Organism candidate from the table below to know more about them, then decide which is the best model. You may also search for more online information about each of these candidates to help you decide.

Note to the teacher: Make sure that members of each team have agreed on tasks such as: *note taker, reader, etc. before they begin. It is advisable that each member of the team has their own computers.*

Table 1.

CANDIDATE	SOURCES OF INFORMATION
<p>Russian Thistle (Tumbleweed) Genus <i>Salsola</i></p>  <p>Fig. 1 Russian Thistle, Adapted from <i>Invasive.ORG</i> (2018), retrieved from https://www.invasive.org/browse/subinfo.cfm?sub=6375</p>	<p>→ https://www.desertusa.com/flowers/tumbleweed.html → http://www.efloras.org/florataxon.aspx?flora_id=1&taxon_id=129079</p>
<p>Gunnison's Prairie Dogs (<i>Cynomys gunnisoni</i>)</p>  <p>Fig. 2 A Gunnison Prairie Dog. Adapted from USGS (2017), retrieved from https://www.usgs.gov/news/technical-announcement/taking-bait-majority-prairie-dogs-are-consuming-plague-vaccine</p>	<p>→ https://animalia.bio/gunnisons-prairie-dog → https://web.archive.org/web/20050424211652/http://sevilleta.unm.edu/data/species/mammal/sevilleta/profile/gunnison-prairie-dog.html → https://academic.oup.com/gbe/article/12/5/618/5819143</p>

Stink Bug (Beetle)
Genus *Eleodes* (Coleoptera, Tenebrionidae)



Fig. 3. Stinkbugs (aka "clown beetles or darkling beetles). Adapted from DesertUSA (2022), retrieved from <https://www.desertusa.com/insects/stinkbug.html>

→ <https://beetleidentifications.com/desert-stink-beetle/>
→ <https://zookeys.pensoft.net/article/3838/>
→ <https://www.insectidentification.org/insect-description.php?identification=Desert-Stink-Beetle>
→ <https://www.youtube.com/watch?v=nFeh9VfV0z8>
→ <https://pubmed.ncbi.nlm.nih.gov/26016880/#:~:text=The%20genome%20is%2015%2C828%20bp,and%2013%20protein%2Dcoding%20genes.>

Blue Corn
(*Zea mays*)



Fig. 4. Blue Corn (a.k.a. Blue Hopi Corn). Adapted from HOSS (n.d.). Retrieved from: <https://hosstools.com/product/blue-hopi-field-corn/>

→ <https://pubs.nmsu.edu/h/H226/index.html>
→ <https://homeguides.sfgate.com/germination-hopi-blue-maize-74048.html>
→ <https://academic.oup.com/g3journal/article/11/2/jkaa062/6080733>
→ <https://www.geochembio.com/biology/organisms/maize/>

Western diamondback rattlesnake
(*Crotalus atrox*)



Fig. 5. A Western diamondback rattlesnake. (2011) "westerndiamondback2.jpg" (On-line), Animal Diversity Web. Accessed July 08, 2022 at <https://animaldiversity.org/collections/contributors/usfws/westerndiamondback2/>

→ <https://www.desertmuseum.org/kids/oz/long-fact-sheets/Diamondback%20Rattlesnake.php#:~:text=Identifying%20Features,with%20a%20triangular%20shaped%20head.>
→ <https://www.nps.gov/band/learn/education/upload/Western%20Diamondback%20Rattlesnake%20FACT%20SHEET.pdf>
→ https://animaldiversity.org/accounts/Crotalus_atrox/pictures/collections/contributors/usfws/westerndiamondback2/
→ https://animaldiversity.org/accounts/crotalus_atrox/
→ <https://www.sciencedirect.com/science/article/abs/pii/S1055790314004242>

Part 2: *The X-files.*

The table below lists some of the general key features of model organisms. After reading about your candidates in Part 1, type an “x” mark in the column where these features apply to the organism. Type “NI” if there is no information provided from the table in Part 1 or in any online research that you did.

Note: Students’ entry in this Table may vary depending on how extensive they read the provided information and their research.

Table 2:

Features	Russian Thistle	Gunnison Prairie Dog	Stink Bug	Blue Corn	Western Rattlesnake
Easy to maintain		X	X	X	
Easy to breed	X	X	X	X	
High reproductive rate	X	X	X	X	X
Short generation time (birth to reproduction)			X	X	
Small (or manageable) in size		X	X		

Day 2:

Part III. *Love it or Leave it.*

Use the data from Table 2 and your background knowledge about Model Organisms in choosing the best candidate. Once you have your top species, log in to your Canva.com account through your FMS email and create an infographic that shows why your chosen species is the best candidate.

Below is a rubric that will guide you on what should be discussed in your infographic:

Note to Teachers: Students were advised to utilize the designing tool **Canva** in creating their infographic material to show their understanding of the concept of *Model Organisms*. However, other tools can also be used to create an infographic material such as google slides, padlet, powerpoint slides, biorender, word document and other online design and publishing tools.

Model Organism Infographic			
	Proficient 5 Points	Emerging 3 Points	Beginning 1 Points
Content	Shows all the key features that makes species the best Model Organism: > Maintenance > Breeding > Reproduction > Generation Time > Spatial	1 to 3 key features are missing. (Refer to the list under proficient column).	More than 3 key features are missing. (Refer to the list under proficient column).
Visual Aids	Includes clear and relevant diagram/figures that explain why this species is the best Model Organism.	Some diagram/pictures are clear but some are hard to see or understand.	Some of the diagram/pictures are unclear and/or hard to see due to their size, quality or position.
Clarity & Neatness	> The message that the infographic wants to convey is clear and precise. > Big, easy to read fonts were used that has a good contrast to the background color.	Information is present but the presentation is good to average due to color and/or organization of texts and images.	Information is present but the presentation is fair due to color and/or organization of texts and images.
Sources	At least 5 sources listed in a visible portion of the infographic material.	There are only 3 - 4 listed sources in a visible portion of the infographic material.	There is less than 3 listed sources in a visible or vague portion of the infographic material.

Once done with your infographic material, please upload it in Canvas, under the submission tab with the title: *Who Wants to Be the Model Organism?*

Note to Teachers: If resources are available, students may print their finished infographic material showing their chosen species from the list on Table 1. Canvas is the Learning Management System that our school uses during the conception of this activity/lesson and due to paper shortage, online submissions are highly encouraged and strongly recommended.

Below is an example of a possible student infographic material:

FUN FACTS ABOUT STINKBUGS

THE PERFECT MODEL ORGANISM

One female can lay up to 2000 eggs a year!



Stand on their head if they are threatened. Hence they are also called "clown beetles"

STINK BUGS OF THE SW QUICK GUIDE

MAINTENANCE

- Easy to maintain
- Food source is cheap & easy to find



REPRODUCTION RATE

- Very high
- Low mortality in ideal conditions

SPACIAL NEEDS

- Doesn't need a big space to live & thrive
- Small in size (~2-19 mm in length)

LIFE SPAN

- Short (8-10 months)

A very close relative of the stink bugs, *Asbolus*, has its mitochondrial genome been sequenced in 2015.

But you're only a BUG! Lady, I'm a beetle and yes, I'm a better model organism than you!



References:

- <https://beetleidentifications.com/desert-stink-beetle/>
- <https://zookeys.pensoft.net/article/3838/>
- <https://www.insectidentification.org/insect-description.php?identification=Desert-Stink-Beetle>
- <https://www.youtube.com/watch?v=nFeh9VfV0z8>

STANDARDS ALIGNMENT

NM STEM Ready! Standards (NGSS):

HS-LS1-1: Construct an explanation based on evidence for how the structure of DNA determines the structure of proteins which carry out the essential functions of life through systems of specialized cells.

Farmington Municipal School District Measurement Topics:

→ C1: HS-LS3-1 : Understand and ask questions that arise from examining models or a theory to clarify relationships about the role of DNA and chromosomes in coding the instructions for characteristic traits passed from parents to offspring.

→ C2: HS-LS1-1 : Understand and construct an explanation based on evidence for how the structure of DNA determines the structure of proteins, which carry out the essential functions of life through systems of specialized cells.

REFERENCES:

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http://www.efloras.org/florataxon.aspx?flora_id=1&taxon_id=129079

J.A. (2022, June 17). *ThePetFAQ*. <https://thepetfaq.com/darkling-beetle/>

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M. Tsuchiya, et.al. (2020). *First Genome Sequence of the Gunnison's Prairie Dog (Cynomys gunnisoni), a Keystone Species and Player in the Transmission of Sylvatic Plague*, *Genome Biology and Evolution*, Volume 12, Issue 5, May 2020, Pages 618–625

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S. Leonelli, et.al (2013). *What makes a Model Organism?* *Endeavour*, Volume 37, Issue 5, 2013, Pages 209 - 212

Tumbleweed: Russian Thistle (n.d.). DesertUSA.

<https://www.desertusa.com/flowers/tumbleweed.html>

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