Fangs in Focus:
Demystifying the Snake's Arsenal:
Middle School Edition

Pet:	Class:
Snake	6-9

Brief Overview:
Dive deeper into the world of snakes, dissecting the mysteries of fangs and venom delivery through hands-on experiments, data analysis, and creative design. Students will become "venom engineers" as they model different fang types, analyze venom properties, and explore potential medical applications.

For the 3-5 grade version of this lesson plan, see: Fangs in Focus Grades 3-5

Essential Question
How do different snake fang designs optimize venom delivery and what potential applications could they hold for human benefit?

Lesson Breakdown
Lesson 1: Exploring the World of Snake Fangs
Lesson 2: Modeling Venom Injection
Lesson 3: Biomimicry Challenge
Lesson 4: Present It!

Subjects
- ☑ Science
- ☑ ELA
- ☑ Math
- ☑ STEM
- ☐ Art
- ☐ Other

Stem Connections
Science: animal adaptations, evolution,biomimicry
Technology: tool design (biomimicry)modeling software (optional)
Engineering: modeling and testing different types of fangs, tool design
Math: measurement of liquids, creation of a bar graph

Performance Expectations/ Standards

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

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.

CCSS Math

- **SP.B.4**: Displaying numerical data in plots like histograms and box plots
- SP.B.5: Summarizing data sets with measures of center (mean, median) and variability
- **SP.A.1:** Understanding statistics and representative samples
- **SP.B.3**: Assessing overlap and differences between data distributions
- SP.A.1 & 2: Constructing and interpreting scatter plots to investigate relationships between variables
- **G.A.2:** Solving real-world problems involving area and perimeter
- **SSE.A.1**: Using expressions and equations to represent relationships between quantities
- **F-BF.B.4**: Building and interpreting linear, quadratic, and exponential models from data
- **S-ID.A.1:** Representing and interpreting categorical data using frequency tables, bar charts, and pie charts
- **S-ID.C.4:** Using random sampling to draw inferences about a population

CCSS ELA

RI.6.7: Integrate information from diverse sources to answer questions and solve problems.

W.7.2: Write an informative essay developing a point of view.

SL.8.5: Integrate multimedia components and visual aids in presentations to explain findings.

I CAN statements

- explain the different types of snake fangs and specific venom delivery mechanisms.
- design and build a model of a specific fang type, considering its structural and functional features.
- analyze the flow of "venom" through my model and compare it to real fangs
- analyze data on venom properties (viscosity, toxicity) and relate them to different fang types.
- explore and propose biomimetic applications inspired by snake venom delivery systems.
- communicate my findings effectively in a written report and a multimedia presentation.

Materials

- Exploring the World of Snake Fangs Presentation (Middle School)
- Fangs in Focus Student Worksheet (Middle School)
- Modeling clay
- Modeling software (optional)
- Turkey basters (1 per group)
- Colored water
- Beaker
- Liquids of different viscosities (oil, soap, shampoo,etc.)

Teacher Background

Snakes have captivated our imaginations and instilled both fear and fascination for millennia. Their repertoire of adaptations is impressive, but none is more captivating than their potent arsenal: venom. Delivered through a diverse array of fangs, snake venom unlocks a wealth of ecological opportunities, shaping prey selection, predator-prey interactions, and even niche specialization.

1. Aglyphous Teeth Toothy Trappers

The simplest venom injectors, aglyphous teeth, resemble our own teeth, lacking grooves or channels for venom transport. Found in boas and some rear-fanged snakes, these fangs rely on a primitive delivery system. During a bite, the venom, secreted from modified salivary glands, flows along the grooves in the jaw and onto the teeth. Aglyphous snakes often constrict their prey, allowing the venom to seep into wounds created by their serrated teeth.

2. Opisthoglyphous Fangs: The Rear-Fanged Ambushers

A step up in complexity, opisthoglyphous fangs have a small groove or channel running down the back of the tooth, closer to the base. While not as efficient as other types, this grooved channel allows venom from modified salivary glands to flow onto the prey during chewing or scraping actions. Snakes like hognose snakes and boomslangs employ this strategy, often relying on venom's neurotoxic properties to subdue their prey.

3. Proteroglyphous Fangs: The Forward-Fixed Fury

Proteroglyphous fangs represent a significant evolutionary leap. Longer and more mobile than their predecessors, these fangs are hinged to the maxilla, allowing them to fold backwards when the mouth is closed. When striking, powerful muscles propel the fangs forward, injecting venom through a single, fixed-position groove located near the tip. This rapid, controlled delivery system is characteristic of colubrids like the coral snake and the African twig snake, allowing them to inject potent neurotoxic venoms with precision.

4. Solenoglyphous Fangs: The Masters of Speed and Efficiency

Finally, we arrive at the pinnacle of fang evolution: solenoglyphous fangs. Found in vipers

and rattlesnakes, these needle-like marvels possess a closed channel running the entire length of the fang, connected to specialized venom glands at the base. During a strike, powerful muscles contract, squeezing the venom glands and propelling the venom through the channel at lightning speed. The tip of the fang, often razor-sharp, boasts multiple openings or "spits" for injecting the venom deep into the prey's tissues. This rapid, high-pressure delivery system makes solenoglyphous fangs the most efficient venom injectors, enabling vipers to subdue even large prey with incredible speed and lethality.

Understanding the diversity of snake fangs provides insights into predator-prey relationships, shaping our understanding of ecosystem dynamics and even inspiring biomimetic advancements. From developing rapid drug delivery systems to designing self-cleaning medical devices, the study of snake fangs offers a treasure trove of potential applications.

Lesson 1: Exploring the World of Snake Fangs

Time	Materials	Activity
10 mins	Snake pictures	Show students pictures of different snakes. Ask questions like "Do all snakes have the same fangs?" and "How do snakes inject venom with these fangs?" to spark their curiosity about different fang types and venom delivery strategies.
15 mins	Fangs in Focus Student Worksheet (Middle School) Exploring the World of Snake Fangs Presentation (Middle School)	Share the presentation with the students to help them understand that not all snake fangs are the same.
20 mins	Clay Modeling software (optional) Fangs in Focus Student Worksheet (Middle School)	Make a model: Divide students into teams and challenge them to build models of specific fang types based on their unique venom delivery mechanisms. Tell students the fangs must be between 2 and 3 inches in length. Provide students with pictures of the different types of fangs. Each group should create all four models.

		Modeling software and 3D models can be used if this is available

Lesson 2: Modeling Venom Injection		
Time	**Materials**	**Activity**
20 mins	Fangs in Focus Student Worksheet (Middle School) Turkey baster Colored water Tray to collect the water Beaker	Once the models are complete, equip each team with a turkey baster filled with 50 mL of colored water (their "venom"). Have them simulate venom flow through their models, observing how the water travels and discussing how it relates to the actual fang function. Hold the model of the fang over a tray and slowly squeeze the turkey baster. Carefully pour the water that is ejected into the beaker. Have the students write their observations in their Student Worksheet. Students will also measure the amount of "venom"that is ejected from the fang.
25 mins	colored liquids (syrup, water, oil) Fangs in Focus Student Worksheet (Middle School)	After building models of different fang types, have students test them with different viscosities of colored liquids (syrup, water, oil) to simulate varying venom properties. The students should create hypotheses and identify the variables in the experiment in their worksheet.

Lesson 3: Present It!		
Time	**Materials**	**Activity**
25 mins	Fangs in Focus Student Worksheet (Middle School)	Each team prepares a presentation highlighting their tool or device, and proposed biomimetic applications. Encourage visuals and diagrams.
15 mins	Fangs in Focus Student Worksheet (Middle School)	Students present their tool designs to the class using visuals, diagrams, and explanations to showcase its features and functions. Students explain the connection to the chosen snake fang and its inspiration in a well-organized and engaging manner.

Lesson 3: Present It!		
5 mins	Fangs in Focus Student Worksheet (Middle School)	Allow students to complete the reflection questions or conduct a class discussion of the questions. The best part of this project was .....Because The part I didn't like was.....Because

Differentiation

For students who need additional support:

- Provide pre-designed templates or guiding diagrams for struggling teams.
- Have each team make only one of the fangs and share their observations with the class.
- Test the different fangs in front of the whole class.
- Allow the students to present their biomimicry designs, but do not require a full presentation.
- Tactile models: Provide 3D printed models of different fang types with distinct textures and shapes that they can explore.
- Audio descriptions: Create detailed audio descriptions of visuals like diagrams, pictures, and videos, explaining key features and functions.
- Braille resources: Offer Braille versions of key information like fang types, biomimicry examples, and design prompts.
- Assistive technology: Utilize screen readers, magnifiers, or other assistive tools to help them access visuals and text.
- Partner work: Encourage pairing sighted students with visually impaired students for collaborative learning and model exploration

For students who need additional challenges:

- Challenge advanced students to research specific venom toxins and their interaction with different fang types.
- Forensic Investigation: Challenge students to use their knowledge of snake fangs and venom to analyze bite marks and solve a fictional crime scenario. This could involve identifying the type of snake involved, estimating the size of the animal, and even speculating on the venom's potential effects. For an extra challenge, have the students write their own Crime Scene stories !

Assessment				
Category	**Criteria (4 points)**	**Criteria (3 points)**	**Criteria (2 points)**	**Criteria (1 point)**

Understanding of Fangs	Explains different types of snake fangs and their venom injection mechanisms clearly and accurately.	Provides some explanation of different fang types and their functions, but may lack detail or accuracy.	Shows limited understanding of different fang types or confuses their functions.	Demonstrates minimal understanding of snake fangs and venom delivery.
Model Construction	Creates a well-constructed model that accurately reflects the specific fang type chosen, uses appropriate materials and demonstrates problem-solving.	Builds a functional model that generally reflects the chosen fang type, but may have minor construction flaws or lack detail.	Constructs a model with significant flaws or inaccuracies in representing the chosen fang type.	Model is poorly constructed or does not effectively represent any specific fang type.
Observation and Analysis	Makes detailed and accurate observations about how "venom"flows through their model, comparing and contrasting it with the real venom delivery mechanisms of different fang types.	Observes and describes flow of "venom" in their model, but may lack detail or accuracy in comparison to real fang functions.	Observations are limited or inaccurate, hindering comparison with real venom delivery mechanisms.	Shows minimal observation or understanding of how "venom" flows through their model.
Communication and Reflection	Writes a clear and concise explanation of observations and conclusions, effectively drawing connections between model simulations and real snake fangs	Presents an explanation of observations and conclusions, but may lack clarity or detail. Connections to real fang functions might be missing or inaccurate.	Explanation is unclear or incomplete, with limited connection to real fang functions.	Written explanation is missing or poorly written, showing minimal reflection on observations or fang functions.
Biomimicry Project: Originality and Inspiration	Clearly identifies a specific snake fang type and explains its unique features used for inspiration. Proposes a novel and creative tool or device inspired by the chosen fang's function.	Identifies a specific snake fang type and draws some inspiration from its features. Tool or device shows some degree of originality, but may be derivative.	Uses a common or uninspired snake fang type and only vaguely references its features. Tool or device lacks originality and creativity.	Does not clearly identify a snake fang type or fails to incorporate its features for inspiration. Tool or device lacks originality and shows minimal connection to snake

				fangs.
Biomimicry Project: Functionality and Design	Tool demonstrates clear functionality and addresses a specific problem, Design effectively incorporates the chosen fang's features to achieve its purpose. Shows thoughtful planning	Tool or device has some functionality, but may lack clarity or address a less impactful problem. Design incorporates some features of the chosen fang, but could be more focused or efficient.	Tool or device has limited functionality or addresses a vague problem. Design shows minimal connection to the chosen fang's features and may be impractical.	Tool or device lacks functionality or fails to address a clear problem. Design does not reflect any inspiration from snake fangs and may be poorly conceived.
Biomimicry Project: Scientific Understanding	Demonstrates accurate and detailed knowledge of the chosen snake fang's structure, function, and venom properties. Applies this knowledge effectively to explain how the tool or device mimics the fang's features.	Shows some understanding of the chosen fang's features and attempts to connect them to the tool or device's function. Scientific knowledge may be incomplete or imprecise.	Shows limited understanding of the chosen fang and its features. Connection to the tool or device's function is weak or inaccurate.	Lacks scientific understanding of snake fangs. Connection to the tool or device is absent or based on inaccurate information.
Biomimicry Project: Communication and Presentation	Presents the tool or device clearly and effectively, using visuals, diagrams, and explanations to showcase its features and functions. Explains the connection to the chosen snake fang and its inspiration in a well-organized and engaging manner.	Presents the tool or device with some clarity, but may lack detail or organization. Explanation of the connection to the snake fang could be more comprehensive or compelling.	Presents the tool or device in a confusing or incomplete manner. Explanation of the connection to the snake fang is weak or missing.	Does not effectively present the tool or device. Fails to explain the connection to the chosen snake fang in a clear or understandable way.

Extension

- Challenge students to research s**nakebite prevention and awareness** in their region. They can design educational materials like posters, brochures, or videos to inform their community about snake identification, bite avoidance strategies, and basic first aid measures.
- **Venom Research Project:** Students choose a specific snake species and research its venom, including its composition, toxicity, and ecological role. They can present their findings in a scientific paper, infographic, or video presentation.
- **Debate:** Organize a debate on the ethical implications of studying and utilizing snake venom for human applications. Encourage students to consider different perspectives and explore the potential benefits and risks involved