ScienceNews

EDUCATOR GUIDE

October 7 & 21, 2023

Snake Gulps and Chromosome Sequencing

SOCIETY FOR SCIENCE

SN EDUCATOR GUIDE

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About this Guide

Engage students with news articles from the October 7 & 21, 2023 double issue about record-breaking snake gulp proportions and recent studies that fully sequenced Y chromosomes for the first time and teach about relative values vs. absolute measurements and genetics.

This Guide includes:

Article-based Comprehension Q&A — This little snake's "big gulp" puts 7-Eleven to shame. Stretchy tissue in snake's jaws enables them to swallow prey much wider than themselves. And the Gans' egg-eater snake takes the cake — or egg — for most outsized meals. Learn how snakes gulp down meals much bigger than themselves while answering questions discussing proportions and comparing relative values vs. absolute measurements.

> **Related standards include NGSS-DCI:** HS-LS4; MS-LS4
>
> **Student Comprehension Worksheet** — These questions are formatted so it's easy to print them out as a worksheet.
>
> **Paired Articles:**
> *Science News:* "A little snake's big gulp may put all other snakes to shame"
> Readability Score: 10.4
>
> *Science News Explores:* "This egg-eater may have the biggest gulp of any snake its size"
> Readability Score: 6.9

Activity — Scientists are still chipping away at the challenge of completing the puzzle of human genetics. Draw diagrams of DNA, chromosomes, genes and other genetics terms to review their relationships before piecing together the new findings of recent studies that fully sequenced Y chromosomes for the first time.

> **Related standards include NGSS-DCI:** HS-LS3; MS-LS3
>
> **Student Activity Worksheet** — These questions are formatted so it's easy to print them out as a worksheet.
>
> **Paired Articles:**
> *Science News:* "The Y chromosome's genetic puzzle is finally complete"
> Readability Score: 10.7
>
> *Science News Explores:* "Explainer: What are genes?"
> Readability Score: 6.6

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Article-based Comprehension, Q&A: Little snake, big gulp

Directions for teachers: To engage students before reading the article, have them view the video "Watch a Gans' egg-eater snake eat an egg," then have students answer the "Before Reading" questions as a warmup in class or for homework. Then, ask students to read the online *Science News* article "A little snake's big gulp may put all other snakes to shame" and have them answer the "During Reading" questions. As an optional extension for deeper analysis on proportions and relative values, have students discuss the "After Reading" questions. This article also appears in the October 7 & 21, 2023 issue of *Science News*. *Science News Explores* offers another version of the same article written at a middle school reading level.

Before Reading

1. Watch this video of a snake eating an egg. Describe the steps this snake goes through to eat this egg.

The snake opens its mouth wide to swallow the egg whole. Then, the snake waves back-and-forth, breaking the egg. Then the snake spits up the eggshell.

2. Which would surprise you more: an ant carrying an entire raisin or a squirrel carrying an entire raisin? Explain your answer.

Answers will vary. But probably, the ant would cause more surprise because it is smaller than the squirrel; therefore, its strength relative to its body size must be higher than the squirrel.

During Reading

1. What is the scientific name of the Gans' egg-eater snake?

Dasypeltis gansi *is the scientific name of the Gans' egg-eater snake.*

2. Describe the three steps this snake uses to eat an egg.

First, the snake swallows the egg whole. Then, it uses its spine to crack the egg, digesting the contents. Finally, it spits the shells back out.

3. How wide in centimeters was the head of the biggest Gans' egg eater snake that Bruce Jayne studied? According to Jayne's study, approximately how wide of an object could this snake swallow?

The biggest Gans' egg eater snake had a head about 1 centimeter in width. According to Jayne's results, this snake could swallow a cylinder approximately 5 centimeters wide.

4. Describe the size of the petite Burmese python (*Python molurus bivittatus*) relative to the Gan's egg-eater snake. How did the python's gulp-size compare with that of the Gan's egg-eater?

The petite Burmese python was about the same size as the largest Gan's egg-eater. However, the gulp-size of the python was about 4.4 centimeters, which is smaller than the Gan's egg-eater.

5. What does Jayne say about why the Gans' egg-eater might have evolved its unique abilities?

Jayne says the Gans' egg-eater may have evolved its large gulp-size because it eats eggs, which are short and round compared to other types of prey. Snakes with larger gulp-sizes would have an advantage because they could eat bigger eggs with more nutrients.

6. Why is a snake's mouth size not a reliable indicator of gulp-size?

Some snakes have more stretchy tissue in their mouths, allowing them to open their mouth bigger.

7. Besides eggs, what is another snake dietary preference for which Jayne wants to study gape-size?

Jayne wants to study fish-eater snakes.

After Reading

1. Consider the following statements: (1) That house is big. (2) That house is bigger than other houses on the block. Which one is an example of a relative comparison? How do these statements differ in what they communicate, and which is more informative? Explain.

Statement #2 is an example of a relative comparison. Statement #1 only says the house is big, whereas #2 says that the house is bigger than the houses around it. Statement #2 is more informative because it provides a scale to better understand what the term "big" means in this instance.

2. Use an example from this article to show the use of relative comparisons.

Comparing the gape-size of two species of snake is an example of a relative comparison from this article.

3. What measurements were used to quantify a relative comparison in the article? What units were used to make these measurements? Give the measurements from the article.

The measurements that helped quantify relative comparisons in the article were width of the snake's head and width of a cylinder it could swallow. A unit used to make these measurements in this article was

centimeters. A Gan's egg-eater having a head width of about 1 cm could swallow a cylinder about 5 cm wide. The Burmese Python's head width was also about 1 cm but could swallow a cylinder only about 4.4 cm wide.

4. Why might the author of a study choose to use relative values instead of other precisely defined units? How did the comparison help to give context to the research finding? Regarding the snake study, do you think the primary research paper reported the relative values, precisely defined values or both? Explain your answer?

Reporting relative values allows researchers to compare two values, making it easier to make sense of data and understand that the Gan's egg-eater snake's gape-size was relatively large compared to a snake with the same head width. The primary research paper likely gives precise measurements in a standard unit and relative values because the researchers must demonstrate how they compare the gape-sizes of different snake species.

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Student Comprehension Worksheet: Little snake, big gulp

Directions: Watch this video and answer the "Before Reading" questions. Then read the online *Science News* article "A little snake's big gulp may put all other snakes to shame" and answer the following questions as directed by your teacher.

Before Reading

1. Watch this video of a snake eating an egg. Describe the steps this snake goes through to eat this egg.

2. Which would surprise you more: an ant carrying an entire raisin or a squirrel carrying an entire raisin? Explain your answer.

During Reading

1. What is the scientific name of the Gans' egg-eater snake?

2. Describe the three steps this snake uses to eat an egg.

3. How wide in centimeters was the head of the biggest Gans' egg eater snake that Bruce Jayne studied? According to Jayne's study, approximately how wide of an object could this snake swallow?

4. Describe the size of the petite Burmese python (*Python molurus bivittatus*) relative to the Gan's egg-eater snake. How did the python's gulp-size compare with that of the Gan's egg-eater?

5. What does Jayne say about why the Gans' egg-eater might have evolved its unique abilities?

6. Why is a snake's mouth size not a reliable indicator of gulp-size?

7. Besides eggs, what is another snake dietary preference for which Jayne wants to study gape-size?

After Reading

1. Consider the following statements: (1) That house is big. (2) That house is bigger than other houses on the block. Which one is an example of a relative comparison? How do these statements differ in what they communicate, and which is more informative? Explain.

2. Use an example from this article to show the use of relative comparisons.

3. What measurements were used to quantify a relative comparison in the article? What units were used to make these measurements? Give the measurements from the article.

4. Why might the author of a study choose to use relative values instead of other precisely defined units? How did the comparison help to give context to the research finding? Regarding the snake study, do you think the primary research paper reported the relative values, precisely defined values or both? Explain your answer?

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Science Bite Activity: The genetics puzzle

Directions for teachers: Ask students to complete the first set of questions with a partner. They will need to have a basic understanding of DNA and genes. Point them to the *Science News Explores* article "Explainer: What are genes?" for help with genetics and genomics vocabulary and definitions. Partners will need a sheet of paper or small poster board and markers or pencils for their diagrams.

Have students read the *Science News* article "The Y chromosome's genetic puzzle is finally complete" individually, with a partner, or as a class. Make sure that a large space is clear on your wall or board. Put students in groups and provide sticky notes to each group. Ask groups to identify all the new pieces of information about the Y chromosome that were discovered in the two studies referenced in the article and have them write each piece of information on its own sticky note. Ask students to put their sticky notes in the designated space, overlapping any notes that have the same information.

As a class, review the sticky notes and add any findings that are missing. For each new finding, discuss what was known prior to that finding. Did it disprove information that was previously accepted as true? Then discuss how scientists reached the new finding, as described in the article.

Use the prompts in the third section below ("Putting the puzzle together") to lead a class discussion about the future of genetics research based on the article.

Genetics basics

1. What is DNA and how is it organized? Where did you get your DNA?

DNA is short for deoxyribonucleic acid. It's a molecule with a double helix structure that carries genetic information from one generation to another. Packaged into chromosomes within cell nuclei, DNA gives cells instructions for building and maintaining life, including the making of proteins. We get our DNA from our biological parents.

2. What are genes? What are alleles? How do they relate to a genotype?

Genes are the segments of DNA that provide instructions for making proteins. We get a version of a gene, called an allele, from each of our biological parents. A genotype is an organism's complete set of genes.

3. Draw a Punnett square that shows the possible combinations of chromosomes between male (XY) and female (XX) sexes. Circle the instances in which chromosomes combine to produce a female-sexed baby and give the probability that this might occur.

Students should draw a Punnett square with four possible combinations of genotypes: XX, XX, XY and XY, and should circle instances of XX. The probability of these instances is 50%.

4. With a partner, use the *Science News Explores* article "Explainer: What are genes?" to create a diagram that shows the relationships among the following terms: DNA, nucleotide, gene, chromosome, telomere, centromere, nucleus and cell. Think about starting with a sketch of a cell, labeling its parts, then creating more sketches as needed until all the terms have been depicted and labeled. Note: Some of the terms are linked to *Science News Explores* "Scientists Say" articles that will give you more information.

Student answers will vary.

Gathering new puzzle pieces

After reading the *Science News* article, work in groups to identify every new piece of information that scientists learned from the new studies mapping Y chromosomes. Write each new finding on its own sticky note and place it on the wall of your classroom. Check to see if other groups already put sticky notes with similar information on the wall — if so, overlap your sticky notes.

As a class, review the sticky notes and add any findings that are missing. For each sticky note discuss what was known prior to the new finding. Did that finding disprove information that was previously accepted as true? Then, discuss how scientists determined the new finding and what challenges they faced, as described in the article.

Two example answers are given below.

New finding: Scientists mapped the entire Y chromosome.
What was known prior: Prior to these two studies, scientists had never mapped the entire Y chromosome, and only understood it in parts.
How scientists determined the new finding: Scientists worked to put the puzzle of the Y chromosome together, navigating challenges like palindromic sequences of DNA and repeated sequences of DNA.

New finding: The TSPY2 *gene varies in location from person to person.*
What was known prior: Before the study mapping 43 Y chromosomes — when there was only one reference Y chromosome that was not fully sequenced — it was thought that the TSPY2 *gene was located near the tip of the Y chromosome.*
How scientists determined the new finding: By comparing the Y chromosomes from 43 men, the scientists discovered that the TSPY2 *gene could be located at one of two places.*

Putting the puzzle together

1. Why was the sequencing of 43 people, 21 of whom were of African descent, integral to the ability of scientists to discover the findings in this study?

The number of Y chromosomes sequenced increased the data sample size from the earlier reference chromosome. The new sample also came from a diverse group of people. This allowed the scientists to make comparisons among the chromosomes to discover differences.

2. Based on the article, what is one takeaway about what is important in the design of genetics research studies?

Student answers will vary but should reference the need for multiple data points that are gathered from a diverse range of subjects.

3. What do you think the next step should be for the scientists in the article? Why?

Scientists should continue their sequencing of Y chromosomes, making sure the chromosomes are from a diverse group. Gathering more data will allow them to gain a better understanding of potential medical applications and implications.

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Student Activity Worksheet: The genetics puzzle

Directions: Complete the first set of questions with a partner. Use the *Science News Explores* article "Explainer: What are genes?" and other "Scientists Say" articles for reference information and definitions of some of the terms.

Then read the *Science News* article "The Y chromosome's genetic puzzle is finally complete" in class as directed by your teacher and complete the remaining prompts with your group and as a class.

Genetics basics

1. What is DNA and how is it organized? Where did you get your DNA?

2. What are genes? What are alleles? How do they relate to a genotype?

3. Draw a Punnett square that shows the possible combinations of chromosomes between male (XY) and female (XX) sexes. Circle the instances in which chromosomes combine to produce a female-sexed baby and give the probability that this might occur.

4. With a partner, use the *Science News Explores* article "Explainer: What are genes?" to create a diagram that shows the relationships among the following terms: DNA, nucleotide, gene, chromosome, telomere, centromere, nucleus and cell. Think about starting with a sketch of a cell, labeling its parts, then creating more sketches as needed until all the terms have been depicted and labeled. Note: Some of the terms are linked to *Science News Explores* "Scientists Say" articles that will give you more information.

Gathering new puzzle pieces

After reading the *Science News* article, work in groups to identify every new piece of information that scientists learned from the new studies mapping Y chromosomes. Write each new finding on its own sticky note and place it on the wall of your classroom. Check to see if other groups already put sticky notes with similar information on the wall — if so, overlap your sticky notes.

As a class, review the sticky notes and add any findings that are missing. For each sticky note discuss what was known prior to the new finding. Did that finding disprove information that was previously

accepted as true? Then, discuss how scientists determined the new finding and what challenges they faced, as described in the article.

Putting the puzzle together

1. Why was the sequencing of 43 people, 21 of whom were of African descent, integral to the ability of scientists to discover the findings in this study?

2. Based on the article, what is one takeaway about what is important in the design of genetics research studies?

3. What do you think the next step should be for the scientists in the article? Why?