From the Teacher: J. Haut
Class: Enhanced Biology & Enhanced SEA Biology
Period: 2, 4, and 5
Assignment: Week 2

If turning in paper packet and work, make sure to include this header information on all pages!

From the Student: Student Name
Teacher Name
Name of class
Period #
Assignment #

Exploring Meiosis, the Basis of Sexual Reproduction

The work in this packet is due 5/8/2020. If working online, you may turn in work digitally before the deadline. I encourage you to turn work in as you complete it. If completing paper packets, attach all work to packet before turning packet in on May 8th. You can also take pictures of paper packet work and email images to me. Make sure to have the proper heading on each page to ensure that I receive all of your work. I have broken the work down into daily tasks to help you manage your time.

My office hours are 10AM-12PM, M-F. You can email me at jhaut@tusd.net, post a question in Teams, or call me at (209) 625-9540 with questions. Please continue to check your email regularly.

Wk2: Day 1 (Introduction to unit) (turn in by 5/8/20):

1. **Read** slides 1-7 in the "Why Meiosis Matters-The case of the fatherless snake" PowerPoint found in files for week 2 in Teams.
2. **Answer** the question: What questions come to mind about this baby snake? Explain. (C-E-R)
   - You can **submit** your answer in Wk2/D1 Assignment in Teams OR write your answer on paper and include in the paper packet that you turn in on May 8. If turning in a paper packet, please clearly label the assignments at the top of the paper you turn in, so I can easily recognize the assignment and give you credit.
3. **Read** slides 9-16 in the "Why Meiosis Matters-The case of the fatherless snake" PowerPoint.
4. **Answer** the question: Was the baby snake produced by mitosis? Explain. (C-E-R)
   - **Submit** your answer as described above.
5. **Read** article: "Rattlesnake Born of a Virgin" by Rebecca Jones.
   - Optional: Mark text or take notes as needed.

*If you are turning in online work, go to Assignments in our Teams Classroom. Click on the specific assignment, click on "+Add work", and choose how you would like to upload your response. Then click "Turn in". If you plan to handwrite your work and take a picture, please write your name in pen on every page before you take a picture. Contact me if you have questions.

Wk2: Day 2 (meiosis, the basis of sexual reproduction (turn in by 5/8/20)

So, was Napoleon a result of mitosis? The answer is no. Mitosis would have produced a clone of Marsha Jones and would have then been a female. Since Napoleon is a boy, we can rule out mitosis.

Baby snakes usually come from the fertilization of a snake egg by a snake sperm. Eggs and sperm are produced by the process of meiosis.

1. **Read** pgs. 130-131 in Ch. 8 of the text book. Take notes as needed.
2. **Section Questions:** Use complete sentences to answer.
   1) Explain the differences between a somatic cell and a gamete.
   2) Describe the life cycle of humans. Refer to figure 8.14.
   3) Distinguish between diploid and haploid cells. What are the diploid and haploid number in humans?
   4) Written or Graphic Response to: Connect the human life cycle and chromosomal inheritance to you and your biological parents.
      - Write a 5-8 sentence paragraph about what you learned **OR** create, draw, and label a visual summary of the information you have learned and write a 10-20 word caption of how the graphic summarizes the key concepts learned from the reading.
3. **Submit** work in Teams or in paper packet as previously described.

WK2: Day 3 (The process of Meiosis) (turn in by 5/8/20)

1. **Read** pgs. 132-133 in Ch. 8 and **skim** pgs. 566-567 of the text book. Take notes as needed.
2. **Section Questions**: Use complete sentences to answer.
    1) Explain the importance of there being one duplication of DNA followed by two divisions in meiosis.
    2) Explain the function of *crossing over* during prophase I.
    3) Describe the appearance of the cell at a) the start of Meiosis I, b) the end of Meiosis I, and c) the end of Meiosis II.
    4) Contrast gametogenesis in the ovaries with spermatogenesis in the testes (see pgs. 566-567).
    5) Written or Graphic Response to: Compare and contrast mitosis (see pgs. 126-127) with meiosis.
        - Write a 5-8 sentence paragraph about what you have learned **OR** create, draw, and label a visual summary of the information you have learned and write a 10-20 word caption of how the graphic summarizes the key concepts learned from the reading.
3. **Submit** work in Teams or in paper packet as previously described.

WK2: Day 4 (The Origins of Genetic Variation) (turn in by 5/8/20)

There are four ways that genetic variation is introduced during meiosis and sexual reproduction: crossing over, independent assortment, random fertilization, and mutation.

1. **Read** pgs. 135-136 in Ch. 8 and p. 263 of the text book. Take notes as needed.
2. **Section Questions**: Use complete sentences to answer.
    1) Explain how independent assortment during metaphase I contributes to genetic variation.
    2) Explain how random fertilization can add a huge amount of variability to the offspring produced by sexual reproduction.
    3) Explain how crossing over during prophase I contributes to genetic variation.
    4) What is a mutation? Why are gene mutations rare, but essential?
    5) Written or Graphic Response to: Pretend you just found out that your biological mother is expecting a baby with your biological father. Why will this baby be genetically similar to you, but NOT genetically identical?
        - Write a 5-8 sentence paragraph about what you have learned **OR** create, draw, and label a visual summary of the information you have learned and write a 10-20 word caption of how the graphic summarizes the key concepts learned from the reading.
3. **Submit** work in Teams or in paper packet as previously described.

Wk2: Day 5: (turn in by 5/8/20)

When we discussed DNA replication and protein synthesis, we learned that mutations or errors can occur. Similarly, during cell division errors can result in genetic abnormalities that can range from mild to severe.

1. **Read** pgs. 137-139 in Ch. 8 of the text book. Take notes as needed.
2. **Section Questions**: Use complete sentences to answer.
    1) Explain how nondisjunction results in abnormal chromosome numbers.
    2) Explain how figure 8.22 is different from a normal karyotype.
    3) Why aren't more babies born with an abnormal chromosome number?
    4) Why might mammals be better able to tolerate an abnormal number of sex chromosomes?
    5) Explain what determines a person's sex?

So back to the mystery of Napoleon, the fatherless snake. Marsha Joan did not have an egg fertilized by a male snake. Instead, she underwent parthenogenesis. Parthenogenesis is the production of offspring from unfertilized eggs. Sex determination is also different in reptiles. The female carries ZW chromosomes and the males carry WW. This is opposite from mammals where females are XX and males are XY.

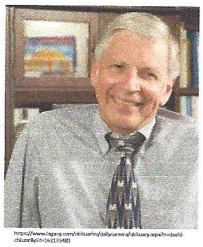
3. **Unit Reflection:** Where might meiosis "go wrong" in snakes so that a diploid egg cell is produced and how can that offspring be male?
4. **Submit** work in Teams or in paper packet as previously described.

Introduction to the

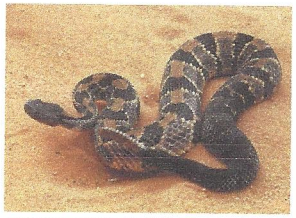
Case of the Mysterious Snake

Professor Chiszar

- Today, I want to introduce you to Professor Chiszar, who was a herpetologist in the Department of Psychology and Neuroscience at the University of Colorado.
- Prof. Chiszar studied snakes, and is particularly interested in timber rattlesnakes

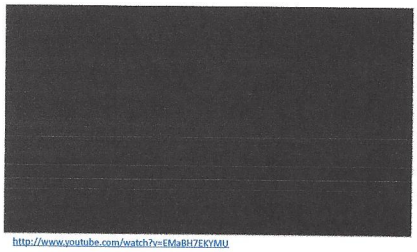


Timber Rattlesnakes



Timber rattlesnakes are a type of pit viper, which are characterized by sensory organs (pits) near their mouth that can detect infrared radiation.

Timber rattlesnake: *Crotalus horridus*



http://www.youtube.com/watch?v=EMaBH7EKYMU

One interesting thing about them is that they don't lay eggs, but instead incubate their eggs internally so the little baby snakes are born alive and "wriggling."

The newborn snake pops out at about 2:30 on the video

Timber rattlesnake: *Crotalus horridus*

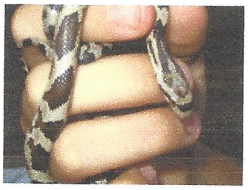
- Another interesting point that's important to keep in mind is that these baby snakes are produced by a rather typical process: male snakes produce sperm; female snakes produce eggs.
- Following mating, the two cells merge inside the female and the fertilized egg develops into a baby snake with testes or ovaries.

Professor Chiszar's big surprise

- He walked into his laboratory, which houses more than 100 snakes.
- He looked into the cage where a big female timber rattlesnake named Marsha Joan had lived alone for the last 16 years. He had collected her when she was two days old.
- Now the three-foot-long, healthy, female snake was no longer alone! Nestled with her was a tiny baby snake.

Professor Chiszar's big surprise

- When Prof. Chiszar examined the baby, he had another surprise.
- It was a boy!
- The baby boy snake was called Napoleon.



What questions come to mind about this baby snake? Explain. (C-E-R)

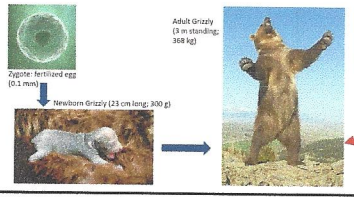
Provide your written answer in Wk2/D2 Assignment in Teams

OR

Write your answer on a sheet of paper and included in the paper packet you turn in on May 8

Where do babies come from?

- Ultimately: from cells
- How do babies grow? Mitosis



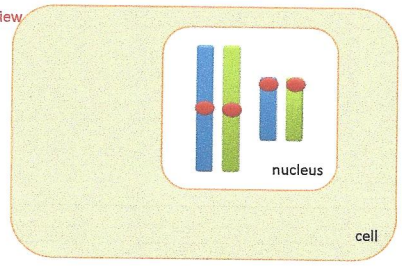
Review of Mitosis

Review

mitosis

- Diploid cell first copies DNA
- In metaphase: homologous chromosomes independently line up
- Produces two genetically identical nuclei (two genetically identical daughter cells after cell division)

Review

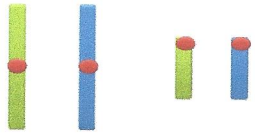


nucleus

Original eukaryotic cell is diploid with 2 pairs of chromosomes; one pair inherited from father(blue) and one from mother (green).

Review

nucleus

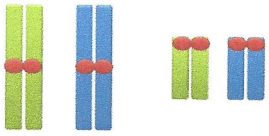


Here, we're focusing just on the chromosomes, but remember that the chromosomes are actually in the nucleus, which is inside a cell.

DNA replication: each chromosome duplicates creating two identical DNA double helices that are joined together at the centromere. The chromosomes are called bivalents (or duplicated chromosomes); each of the two identical DNA double helices that are connected to each other are called sister chromatids.

Review

nucleus



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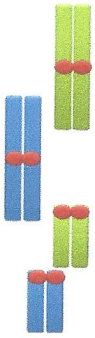
Review

nucleus

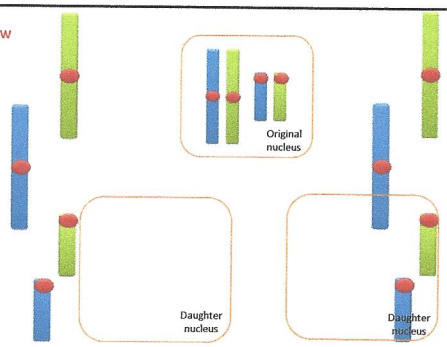


The duplicated chromosomes line up independently of each other at metaphase!! This is a key difference between mitosis and meiosis.

Sister chromatids separate to opposite sides of spindle (a structure composed of microtubules and motor proteins that move the chromatids in different directions.

Review

nucleus



The result of mitosis is two daughter cells that are genetically identical to the parent cell.

Was the baby snake produced by mitosis? Explain. (C-E-R)

Provide your written answer in Wk2/D2 Assignment in Teams

OR

Write your answer on a sheet of paper and included in the paper packet you turn in on May 8

Rattlesnake Born of a Virgin

By Rebecca Jones
August 31, 2015

Young male celebrity, a little on the wild side but comfortable in an academic setting, seeks like-minded female for long-term relationship. Turn-ons: rats and mice, dead tree stumps and long walks, er, slithers in the woods. Potential partner must be willing to relocate and must be from the right family. If only finding a girlfriend for Napoleon were that easy, David Chiszar would have arranged things by now.

As it is, the whole herpetological world is holding its collective breath, waiting to see if Napoleon – a timber rattlesnake whose birth three years ago stunned snake scholars – can father babies of his own. If he does, this would be a first. There are no known cases of snakes conceived in this manner, having offspring. Moreover, it would represent a form a cloning in nature.

“His time just hasn’t come yet,” says Chiszar, a professor of psychology at the University of Colorado and an expert in snake behavior. “I need a girl snake and I don’t have one for him. Now, if I were in timber rattlesnake country, it would be different. But this is prairie rattlesnake country.”

Besides, notes Chiszar, Napoleon’s sex life just hasn’t been his top priority up until now. “But,” he says, now that Napoleon has reached the age of sexual maturity, “I reckon I’ll be takin’ a trip to Georgia to catch one.”

Napoleon entered the world completely unexpectedly in 1995. His mother, then a 14-year-old, 3-foot timber rattler named Marsha Joan, had lived virtually her entire life chastely in her cage in Chiszar’s research lab. She was a virgin snake. Chiszar, who chaperoned her since she was two days old, vouches for that.

Yet one morning Chiszar entered the lab, and there was newborn Napoleon. His birth is one of just a handful of documented cases of virgin birth – parthenogenesis – among snakes.

“We don’t know for sure how she pulled that off,” says Chiszar, who keeps more than 100 slithery beasts as subjects for his research into snakes’ sensory mechanisms. “I’m confident she was never with a boy, because I never put a boy in her cage and I never put her in a boy’s cage. But she hauled off and had a baby.”

DNA testing of both snakes’ blood confirms that Napoleon is nearly an exact genetic copy of his mother. No father snake contributed genetic material to the feisty 5-year-old.

Parthenogenesis is standard reproductive procedure in a number of animals, including several species of fish, lizards and frogs. It’s even been documented in turkeys, through artificial means. But in the snake world, Papa Snake makes an important contribution to the next generation. Until recently, parthenogenesis had been reported – though never confirmed through DNA testing – in only one species, the Brahminy blind snake.

Chiszar and his colleagues have since been able to identify three other female snakes besides Marsha Joan that produced fatherless babies: a wandering garter snake at the University of Arizona, an Aruba island rattlesnake at the Toledo, Ohio, zoo; and a checkered garter snake at the Phoenix Zoo. There are also reports that an Australian swimming filesnake at Chicago's Brookfield Zoo did it, and a lizard – an Argentina chuckwalla – living with an elderly woman who was keeping it for her grandson in Greeley, Colo., did too.

All but one of the snakes were older mothers who had lived many years without male companionship. All the offspring were male.

A bit of genetic background: In humans, females carry two X chromosomes, while males have an X and a Y chromosome. In snakes, the reverse is true. Chiszar and other scientists speculate that baby snakes born through parthenogenesis are the product of the mother's duplicating her own chromosomes in the place of the missing father's, thereby self-fertilizing her egg. This would lead to embryos with either XX or YY sex chromosomes – and YYs don't live. Scientists don't think it's possible for a snake to produce offspring with an X and a Y chromosome – that is, a female – through parthenogenesis.

But then again, they're not even sure about that. Maybe some snake somewhere has, and it's just never been reported. Chiszar says it's possible that parthenogenesis accounts for more births than believed. In captivity, few snakes are kept alone; zoos typically pair their animals. "Even if this had occurred many times, it's likely zookeepers would have missed it, thinking it was normal birth inspired by sexual relations," Chiszar says.

Also, female reptiles have an amazing ability to store sperm for long periods, then use it to fertilize their eggs at a propitious time. "The record is seven years," Chiszar says. Thus, even when a captive female that has spent years without a mate gives birth, keepers routinely credit long-term sperm storage. "Maybe some of those cases weren't due to long-term storage," Chiszar says.

Marsha Joan died quietly of old age earlier this summer, Chiszar says. Only once her son meets a nice female timber rattler will Chiszar know whether he is fertile. If he's not, his birth could be nothing more than an insignificant misfiring of his mother's reproductive system, a freak of nature. If he is fertile, Chiszar and the other researchers may be witnessing a previously unknown adaptive skill in snakes.

"We don't know how common this is in nature," Chiszar says. "The fact that it occurs in captivity tells me it probably occurs in nature too – but having that view and demonstrating it are two different things."

Chiszar says Napoleon will probably undergo more blood tests for genetic analysis. But other than that, Napoleon's only job around the lab is just to keep growing and preparing himself for the day Chiszar finally introduces him to some pretty little female rattler.

Jones, R. (2015, August 31). Rattlesnake born of a virgin. Retrieved April 16, 2020, from https://www.petplace.com/article/reptiles/general/rattlesnake-born-of-a-virgin/