

An Unusual Case of Animal Reproduction

by

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Part I – Andrea Smith’s Dilemma

Andrea Smith was taking notes for her biology exam. Her professor has told her that the exam would cover, in part, the differences between sexual and asexual reproduction. As she reviewed her notes and prepared for today’s class, she was thinking about her own reproductive dilemma. If only asexual reproduction were the case for humans, maybe she wouldn’t be in this mess. Or at least there wouldn’t be questions about who was the father of her twins. *“ Dwelling on it isn’t going to help me prepare for class, and right now I have got to finish this chapter on animal reproduction,”* she thought. She tried to concentrate and forget about her current dilemma as she feverishly typed on her notepad:

*Asexual or sexual reproduction: 3 types of asexual reproduction: (1) **fission**: separation of a parent organism into two or more individuals of equal size, (2) **budding**: growth of new individuals from outgrowths of existing organisms, and (3) **fragmentation** accompanied by **regeneration**: the breaking of the body into several pieces, some or all of which develop into new complete individuals through the regrowth of lost body parts. NOTE: Be able to explain the differences between sexual and asexual reproduction!*

She suddenly let out a long sigh. “It’ll be fine,” she thought. “I just hope that none of my family or friends watches the show. What was I thinking when I agreed to this? But that’s what Xavier wanted, and I will do whatever it takes to prove he is the father. Besides I am going to need the money if I have to take care of these babies on my own!”

The next day in class she was feeling even more nervous and was becoming increasingly angry as she thought about her current situation. Her thoughts were interrupted by the sound of her professor’s voice:

“OK, class,” her teacher was saying, “that wraps up asexual reproduction. Let’s move on to reproductive cycles and patterns. Most animals exhibit cycles in their reproductive activity. Reproductive cycles are often controlled by hormonal and environmental cues. Animals may reproduce either exclusively asexually or sexually while other animals alternate between the two methods. For example, some animals can lay eggs of two types, depending on the environment and/or season. One egg type matures only if it is fertilized while the other type does not require fertilization for development, a process called *parthenogenesis*. Some animals, and in rare cases humans, have both male and female reproductive systems. Some hermaphrodites can fertilize themselves, but most must mate with a member of the same species. Please look over these handouts and answer the questions that follow.”

As the other students read through the assignment, Andrea was thinking: “I’m dealing with a case of sexual reproduction that no doubt started with the fertilization of my egg with, hopefully, Xavier’s sperm. That reminds me, I need to make sure I go over internal and external fertilization again in my notes. I’m not sure I completely understand it.”

All this started the night Xavier had come over to talk to Andrea about their break-up. He had smelled and looked so good that evening. The events of that night had left Andrea wondering if there was really some truth to that stuff about pheromones, which Andrea has learned in her class were chemical signals released by one organism that influence the behavior of another individual of the same species. Even though Andrea had met someone else and had

been seeing Neo for a while, she hadn't been able to resist Xavier. Neither she nor Xavier had behaved like themselves that night. It was unlike them not to use some barrier method of contraception. As the class wrapped up, Andrea's mind was still on her upcoming appearance on a daytime talk show. In some ways she was dreading it; but she was determined to prove what she believed she had known all along: That Xavier was the father of her twins.

Questions

1. What is the difference between asexual and sexual reproduction?
2. List and define some types of asexual reproduction. Give one example of each.
3. What is the difference between parthenogenesis and hermaphroditism?
4. What is the difference between internal and external fertilization?
5. What is the function of pheromones?

Part II – The Pregnancy

“I can’t believe it has come to this! Airing our dirty laundry on national television. I never thought Xavier would let things get so out of hand.”

It was late and Andrea was so upset she couldn’t sleep. She tried studying for the upcoming exam, but she couldn’t concentrate. She decided to get an early start on packing. She was so angry with Xavier. How could he have left her pregnant and alone, she thought, as she neatly added her new dress to the bag? How could he think that their babies might belong to someone else? She grabbed her journal, about to add it to the bag, but instead sat in her cozy corner chair and began to read:

January 12, 2007

I’m pregnant with twins! Sometimes it’s still hard to believe because it was so unexpected. I feel like I am about to pop! I know that Xavier is the father of my babies and I can’t wait for us to be a family. But he has doubts about it all because he knows that I met someone else during the brief time that we split up. And he wants to be sure that he is the father before we can move on. But what if it is Neo, the new guy I met? There’s a slight chance but I doubt it. I know the exact time of conception. It was the night Xavier came over to talk about our relationship. It was a little over a week after that night that the pregnancy test detected the increase in HCG. I guess I just missed him so much.

I do regret that Xavier hasn’t been around much during the pregnancy. He has missed the development of our babies. In the past months, I have heard the babies’ heartbeats and felt them moving around. I wish he would come back because it’s obvious that I am pregnant now. Hopefully we can talk through our differences and get back together before the pregnancy gets difficult—the frequent urination and back pain my OB/GYN keeps warning me about. I know there is no way he will ever let me go through labor alone. I only pray the contractions are not more than I can bear. Xavier seems committed to the idea of a paternity test. Hopefully it won’t come to that, but if it does, we’re going to a daytime show to figure all this out.”

“Wow! That seems like a lifetime ago,” she thought. “Now we have these beautiful twins and we don’t seem any closer to becoming the real family I dreamed about. Well this will all be over in a couple of days. I am 110% confident that the twins belong to Xavier, not Neo. I can’t wait to see the look on Xavier’s face and hear him apologize once he sees the results of the paternity test!”

Questions

1. What does Andrea mean by time of conception?
2. How is HCG used to determine pregnancy?
3. List some changes that occur with the fetus/mother during the 1st, 2nd, and 3rd trimesters.
4. What hormones are responsible for inducing and regulating labor?
5. What trimester is Andrea in during this journal entry?

Part III – The Results

Andrea replayed the words over and over again in her mind: “Xavier, you ARE the father!” She was ecstatic. Finally, she could breathe, knowing that Xavier was the father of her babies. Then she heard what the host had to say next... “Neo... YOU ARE the father!”

Andrea looked around in disbelief. She heard herself saying, “What do you mean? You just said Xavier was the father! If Xavier is the father, how can *he* be the father?” she asked as she pointed toward Neo.

“Well, this is a first, even for our show. But it appears that your twins were fathered by both of these men.”

“I can’t believe it. The first time I do something like this and I end up with twins and two fathers! Not only did I expose myself to potentially deadly STDs, but now I have two children, whom I have no doubt that I will be raising alone, and I have put my school career in jeopardy,” Andrea thought.

She still couldn’t believe this was really happening to her. How was it possible that her TWINS have different fathers? What were the events that must have happened within her body that could lead to these circumstances? She grabbed her journal from her bag and flipped back to the entry describing her feelings the day she found out she was having twins:

August 23, 2006

I just came back from another Dr’s appointment. Dr. Blossom informed me that I am having two babies—twins—fraternal. I don’t know if they are boys or girls yet. One could be a boy and the other a girl. I still can’t believe this has happened. Xavier has to be the father. He has to be! I will have to just play the hand I have dealt myself. How stupid was I? I was going to practice abstinence after Xavier and I broke up...and I certainly wasn’t planning on meeting and getting involved with Neo! I can’t believe that Neo and I didn’t use a condom either. And it’s no excuse that we had been drinking. I just got caught up in the moment with Xavier—going down memory lane and things got all sentimental. I could have at least thought to use the rhythm method and kept track of when ovulation may occur. This has to be the most irresponsible thing I have ever done! Why did I stop taking my birth control pills anyway? And I have no idea where I put that diaphragm. Undoubtedly, some people will judge me as the type of woman who should have a tubal ligation that would permanently prevent any pregnancy.

Everything hit her at that very second. She closed her journal and just sat there for a moment. Andrea was reminded that she had stopped taking the pill the month before she became pregnant. She remembered that physicians recommend that a woman wait at least one cycle after she stops taking the pill before becoming pregnant because there is a chance that multiple ovulations may occur. Did it have something to do with *oogenesis*? Andrea was so confused she just couldn’t keep things straight in her mind. She thought about it for a minute to let it all sink in.

Andrea sat back and thought about the lecture on animal reproduction the week before. She pulled out her lecture notes on the menstrual cycle, the basic foundation of everything that she was going through.

Questions

1. Describe the two types of cycles that occur in female mammals (menstrual vs. estrous).
2. Compare and contrast the sterilization techniques (vasectomy and tubal ligation) and the temporary and reversible methods discussed in the case.
3. What are the functions of GnRH, FSH, LH, estrogen, and progesterone?
4. How can the paternity results be explained? Your answer should consider the amount of time before and after ovulation a woman is at risk for pregnancy and how long sperm can survive in the reproductive tract. Your discussion may include the following terms: *ova*, *oogenesis*, and *fertilization*, etc.



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Andrea's Lecture Notes: The Female Reproductive Cycle

(I) The female reproductive cycle involves both the uterus and the ovaries:

Menstrual cycle = uterine cycle

- Refers to the specific changes that occur in the uterus

Ovarian cycle

- Cyclic events in the ovaries that regulate the menstrual/uterine cycle

(II) Hypothalamus secretes *gonadotrophin-releasing hormone (GnRH)* which stimulates the anterior pituitary to secrete *follicle stimulating hormone (FSH)* and *luteinizing hormone (LH)* into the blood. FSH and LH regulate the ovarian cycle.

-OVARIAN CYCLE:

Follicular Phase

- FSH and LH stimulate a follicle to grow
- The growing follicle releases *estrogen*

Ovulation

- An LH surge triggers *ovulation*

Luteal Phase

- *LH* stimulates ruptured follicle to become *corpus luteum*
- Corpus luteum secretes estrogen and *progesterone*, which inhibits LH and FSH secretion from the pituitary
- Corpus luteum disintegrates
- Estrogen and progesterone levels decrease, releasing the inhibitory effect on the hypothalamus and the pituitary
- FSH and LH are released and a new cycle begins

(III) Ovarian hormones, estrogen and progesterone, regulate the uterine (menstrual) cycle

-UTERINE CYCLE:

Proliferative Phase

- increasing estrogen levels causes the uterine lining (*endometrium*) to thicken: prepares the uterus for implantation of the *blastocyst*

Secretory Phase

- increased levels of estrogen and progesterone following ovulation maintains the endometrium by increasing blood supply and growth of endometrial glands that secrete nutrients

Menstrual Flow Phase

- decreased levels of estrogen and progesterone cause the uterine arteries to spasm, depriving the endometrium of blood: endometrium disintegrates, resulting in *menstruation*