Lesson Plan: Sex & Reproduction

General Description
This activity focuses on interpreting data and making arguments, in the context of animal reproduction. Students create graphs to explore relationships and rank organ systems by criteria of their own making. One question leads students to consider sociological influences on biological research.

Objectives
1. Students will extrapolate from data to make comparisons of organisms.
2. Students will cooperate as a team on exercises that require critical thinking.
3. Students will reflect on the activity in a manner that increases engagement in the learning process.
4. Students graphically represent data found in tabular form and use these graphs to explore relationships among variables.

Concepts
1. There is variation in life history characters associated with reproduction.
2. The human body is a collection of systems that interact in different ways depending on perspective.
3. Our understanding of fertilization (and science in general) is guided by both biology and sociology.

Time
50 minutes. Some portions of the activity could be assigned for preparation prior to class or as a take-home assignment.

Prerequisite Skills
None

Materials
Student handouts
Introduction:
This activity focuses on interpreting data and making arguments, in the context of animal reproduction. Students create graphs to explore relationships and rank organ systems by criteria of their own making. One question leads students to consider sociological influences on biological research.

Procedure:
1. Before your class meets, do the worksheet yourself, making note of questions that are particularly difficult or questions that require alternative modes of thinking. Pay special attention to reasoning, criteria, and logic processes. This preparation will help you direct the students better during your discussion group meeting.

2. Introduce the activity as practice in applying principles of reproduction. Divide class into groups of three or four students. Hand out the worksheets and tell students to focus their energy on questions 1 and 2 – possibly dividing the groups such that half work on 1 and half work on 2. Give each team an overhead transparency and pen for use with question 1.

3. Allow students a few minutes to read the questions. As students finishing reading, they should begin talking about the tasks. If a group asks for direction, turn the question back to them. If they don’t spontaneously begin working on the question as a team, direct them by asking questions.

4. Circulate among the groups to provide support and assess progress. Encourage student teams to focus on reasoning, criteria or logic used to solve the problems. There are no “correct” answers, rather there are answers that are more correct than others. If student discussion seems to die off, challenge them to create another correct answer.

5. Provide a one-minute warning after about 20 minutes or when it seems that at least half the groups are close to being done. If groups are finished with the first two questions, have them start on questions 3 and 4 – they will then be responsible for reporting on these questions to the class.

6. Have a group report on part of the first question by summarizing the question and answer. The reporting team doesn’t need to stand in front of the class, but the speaker could stand in place. To encourage students to present to the class rather than to you, sit in the far back of the room and look at the other groups while the reporting team is talking. Ask for clarification if necessary. Ask if everyone understands the team’s answer. If there are questions from the class, encourage a student who didn’t present to answer the question. This strategy demonstrates that you require accountability in group work. If there is disagreement about a particular answer, encourage students to defend their position with evidence derived from the activity or previous learning/knowledge.

7. Proceed in this manner until the questions have been covered. Encourage the students to practice their developing scientific skills on the remaining questions.
Pre-Activity Worksheet: Sex & Reproduction

**General Description**
In the activity you will do this week during your learning/discussion group, you will be examining reproduction in various organisms. In order to be prepared for this activity, complete this worksheet.

**Reading**
Browse the “Animal Reproduction” chapter in your text. Pay particular attention to figures 46.8 through 46.10, 46.14, and 46.21. Read the section on Mechanisms of Sexual Reproduction beginning on pg. 978. Read the section on Mammalian Reproduction beginning on pg. 980 through pg. 989. Read the section on Contraception beginning on pg. 993.

**Definitions**
Write a definition of the following words. Use your text, textbook glossary, and your previous knowledge to create the best definition possible. Remember to connect your definitions to reproduction.

1) sexual reproduction

2) menstrual and estrous cycles

3) contraception

4) viviparous

**Questions**
Answer the following questions. You will explore your answers to these questions in-depth during learning/discussion group.

1) Using figure 46.14, describe which hormone has the greatest influence on testes. Defend your answer.

2) Which strategy is more successful – external or internal fertilization? Why?

3) Provide two explanations for why condoms are such a common form of birth control even though pills and sterilization are better at preventing pregnancy.
Sex & Reproduction

In this activity, you and your team will examine data and tables that provide you with information about sexual reproduction. Each question asks your team to apply or analyze this information. For each question, write the best answer that your team can create and elect one person to present your team’s answer to the class.

(1) Examine the chart "Reproductive Cycles of Some Viviparous Animals" (viviparous = live birth) and answer the following questions. You will need to draw a figure of the data provided to allow you to answer the questions below.

- Overall, is there a pattern of association between gestation period and frequency of cycles? If so, what is the pattern between these two characteristics? If not, why does your team think there is no pattern? Using your team’s figure and reasoning, provide an estimate for the number of cycles per year of vampire bats.

- Is there a pattern of association between gestation period and age at maturity? If so, what is the pattern between these two characteristics? If not, why do you think there is no pattern?

- Litter size is unknown for two of these organisms. Using the same strategies that your team used in the above questions, estimate litter size for these two species. Provide an explanation for your team’s estimates. Be prepared to defend your team’s logic.

- What factors could influence the duration of gestational period? What factors could influence cycle frequency? What factors could influence age at maturity? How tightly linked are these three characteristics? Be ready to report your answers to these questions to the class.
(2) The reproductive system is linked to other organ systems in the body. Examine the figure “Functional Relationships between the Reproductive System and Other Systems”. Determine the five most important systems to the reproductive system and rank these five systems in terms of their relative importance in the functioning of the reproductive system (i.e. which system is the most important to the functioning of the reproductive system?). Be prepared to present your team’s ranking and the criteria your team used to create your team’s ranking to the class. Use the attached page to create your team’s ranking.

(3) Read the two attached paragraphs about fertilization. Compare these descriptions in terms of the imagery used by the author, then answer the following questions. Note the ways in which your views differ from your team members’.

- When you read these two descriptions of fertilization, do you think about the event in the same way? Why or why not?

- Do you think that gender roles guide these descriptions? Is there a connection between how we think about the characteristics of men and women and the descriptions of fertilization?

- Identify the particular words in each paragraph that indicate a tone or bias of the author.

- Would your idea of gender roles differ if you were first introduced to fertilization by the alternative article?

(4) Examine Table 28-1. Using the information available, invent two hormone-based birth control methods that target the male reproductive system. Consider how these methods would work and their effects on male reproductive function. Be prepared to describe your drugs to the class, and answer the following questions: What other organ systems might these drugs affect, and how would the systems be affected? What would happen if you gave these hormone-based drugs to females?
## Reproductive Cycles of Some Viviparous Animals

<table>
<thead>
<tr>
<th>Species</th>
<th>Reproductive Information</th>
<th>Common name</th>
<th>Latin name</th>
<th>gestation</th>
<th># cycles/yr</th>
<th>age at maturity</th>
</tr>
</thead>
<tbody>
<tr>
<td>human</td>
<td></td>
<td>Homo sapiens sapiens</td>
<td>40 weeks</td>
<td>13</td>
<td>13 years</td>
<td></td>
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<tr>
<td>picked dogfish shark</td>
<td></td>
<td>Squalus acanthias</td>
<td>2 years</td>
<td>2</td>
<td>25 years</td>
<td></td>
</tr>
<tr>
<td>house cat</td>
<td></td>
<td>Felix domesticus</td>
<td>2 months</td>
<td>every 20 days*</td>
<td>5-9 months</td>
<td></td>
</tr>
<tr>
<td>standard horse</td>
<td></td>
<td>Equus caballus</td>
<td>11 months</td>
<td>every 21-22 days*</td>
<td>10-15 months</td>
<td></td>
</tr>
<tr>
<td>vampire bat</td>
<td></td>
<td>Desmodus rotundus</td>
<td>8 months</td>
<td>unknown</td>
<td>9 months</td>
<td></td>
</tr>
<tr>
<td>Asian elephant</td>
<td></td>
<td>Elephas maximus</td>
<td>22 months</td>
<td>4</td>
<td>9-12 years (female)</td>
<td>10-15 years (male)**</td>
</tr>
</tbody>
</table>

* length of cycle depends on photoperiod (length of day)  
** bulls often do not breed until 30 years

<table>
<thead>
<tr>
<th>Body System</th>
<th>Ranking</th>
<th>Logic</th>
</tr>
</thead>
<tbody>
<tr>
<td>integumentary system</td>
<td></td>
<td></td>
</tr>
<tr>
<td>reproductive system</td>
<td></td>
<td></td>
</tr>
<tr>
<td>urinary system</td>
<td></td>
<td></td>
</tr>
<tr>
<td>skeletal system</td>
<td></td>
<td></td>
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<tr>
<td>muscular system</td>
<td></td>
<td></td>
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<tr>
<td>nervous system</td>
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<tr>
<td>endocrine system</td>
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<tr>
<td>cardiovascular system</td>
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<tr>
<td>lymphatic system</td>
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<td></td>
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<tr>
<td>respiratory system</td>
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<tr>
<td>digestive system</td>
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</tbody>
</table>
**INTEGUMENTARY SYSTEM**
- Covers external genitalia; provides sensations that stimulate sexual behaviors; mammary gland secretions provide nourishment for newborn.

**REPRODUCTIVE SYSTEM**
- Reproductive hormones affect distribution of body hair and subcutaneous fat deposits.

**SKELETAL SYSTEM**
- Pelvis protects reproductive organs of females; portion of ductus deferens and accessory glands in males.
- Sex hormones stimulate growth and maintenance of bones; sex hormone at puberty accelerate growth and closure of epiphyseal plates.

**MUSCULAR SYSTEM**
- Contraction of skeletal muscles eject semen from male reproductive tract; muscle contractions during sexual act produce pleasurable sensations in both.
- Reproductive hormones, especially testosterone, accelerate skeletal muscle growth.

**NERVOUS SYSTEM**
- Controls sexual behaviors and sexual function.
- Sex hormones affect CNS development and sexual behaviors.

**ENDOCRINE SYSTEM**
- Hypothalamic regulatory factors and pituitary hormones regulate sexual development and function; oxytocin stimulates smooth muscle contractions in uterus and mammary glands.
- Steroid sex hormones and inhibin inhibit secretory activities of hypothalamus and pituitary.

**CARDIOVASCULAR SYSTEM**
- Distributes reproductive hormones, provides nutrients, oxygen, and waste removal for fetus; local blood pressure changes responsible for physical changes during sexual arousal.
- Estrogens may maintain healthy vessels and slow development of atherosclerosis.

**LYMPHATIC SYSTEM**
- Provides IgA for secretion by epithelial glands; assists in repair and defense against infection.
- Lysozymes and bactericidal chemicals in secretions provide nonspecific defense against reproductive tract infections.

**RESPIRATORY SYSTEM**
- Provides oxygen and removes carbon dioxide generated by tissues of reproductive system.
- Changes in respiratory rate and depth occur during sexual arousal, under control of the nervous system.

**DIGESTIVE SYSTEM**
- Provides additional nutrients required to support gamete production and (in pregnant women) embryonic and fetal development.

**FOR ALL SYSTEMS**
- Secretion of hormones with effects on growth and metabolism.

**URINARY SYSTEM**
- Urethra in males carries semen to exterior; kidneys remove wastes generated by reproductive tissues.
- Accessory organs secretions may have antibacterial action that helps prevent urethral infections in males.

**FIGURE 28-27** Functional Relationships between the Reproductive System and Other Systems.
INeNIAL STAGE OF REPRODUCTION: FERTILIZATION

In vertebrates, as in all sexual animals, the first step in reproduction is the union of male and female gametes, a process called fertilization. Fertilization consists of three stages: (1) penetration, (2) activation, and (3) fusion. The male gametes of vertebrates, like those of other animals, are small, motile spermatozoa. Each sperm is shaped like a cone, with a head containing a haploid nucleus and a long tail. Sperm are among the smallest cells in the body. The female gametes, called eggs or oocytes, are large cells. In many vertebrates the eggs contain significant amounts of yolk.

Penetration

In fishes and amphibians, fertilization is typically external, whereas in all other vertebrates it occurs internally. Internal fertilization is achieved by the release of a mature egg into a body cavity in which sperm can be introduced. There the egg can be fertilized by one of the many sperm that are introduced into the female reproductive tract during mating. The actively swimming sperm migrate up the oviduct until they encounter a mature egg.

Like a traveling princess, the mammalian egg is surrounded by a great deal of baggage (Figure 41-1). The egg cell itself is encased within an outer membrane called the zona pellucida, which is in turn surrounded by a protective layer of follicle cells. The first sperm to worm its way through this barrier adheres to the egg membrane by the tip of the sperm cell head, the acrosome. From its acrosome, the sperm releases enzymes that cause the plasma membranes of the sperm and egg cell to fuse. Egg cytoplasm bulges out at this point, engulfing the head of the sperm and permitting the sperm nucleus to enter the cytoplasm of the egg (Figure 41-2).

Times Mirror Mosby Publishing, St. Louis.

<table>
<thead>
<tr>
<th>TABLE 28-1</th>
<th>Hormones of the Reproductive System</th>
</tr>
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<tbody>
<tr>
<td><strong>Hormone</strong></td>
<td><strong>Source</strong></td>
</tr>
<tr>
<td>Gonadotropin-releasing hormone (GnRH)</td>
<td>Hypothalamus</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>Follicle-stimulating hormone (FSH)</td>
<td>Anterior pituitary</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>Luteinizing hormone (LH)</td>
<td>Anterior pituitary</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>Androgens (primarily testosterone and dihydrotestosterone)</td>
<td>Interstitial cells of testes</td>
</tr>
<tr>
<td>Estrogens (primarily estradiol)</td>
<td>Granulosa and thecal cells of developing follicles, corpus luteum</td>
</tr>
<tr>
<td>Progestins (primarily progesterone)</td>
<td>Granulosa cells from mid-cycle through functional life of corpus luteum</td>
</tr>
<tr>
<td>Inhibin</td>
<td>Sustentacular cells of testes and granulosa cells of ovaries</td>
</tr>
</tbody>
</table>
Demonstrate your new understanding of reproduction by answering the following question:

From the perspective of a human fetus, which body system is the most important? Defend your answer in four or five sentences. You do not need to know or describe anything about prenatal development to answer this question, although you could do so.