1. AUTHENTICITY - Sex Chromosomes

Directions: Read the scenario below, then discuss the guiding questions in the Task to reflect on our teaching practice.

Ms. B has been teaching human biology in her 9th grade science classroom for 25 years. This past year, her district asks that teachers include examples related to transgender people when they teach about gender and sex. Although Ms. B cares about supporting her transgender students, she does not have experience discussing this topic. She worries she will give a harmful impression, especially if she overemphasizes it.

When her class begins to discuss the connection between sex and sex chromosomes, Ms. B asks her students open their textbooks to the page on XX and XY chromosomes (*excerpt below*). At the end of the passage, Ms. B summarizes: " XX chromosomes are for girls and XY for boys." **She nervously mentions that sometimes, that isn't the case, and looks directly at one out transgender student while doing so. She then immediately moves on, always referring to XX as female/woman/girl or XY as male/man/boy. She never mentions it again.**

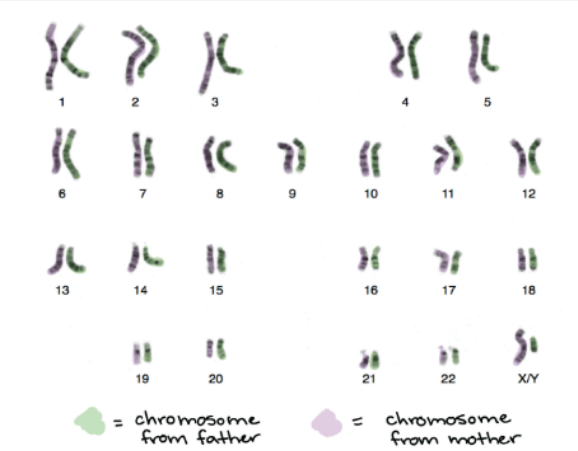


Image modified from "Karyotype," by the National Institutes of Health (public domain).

Human sperm and eggs, which have only one homologous chromosome from each pair, are said to be haploid (1n). When a sperm and egg fuse, their genetic material combines to form one complete, diploid set of chromosomes. So, for each homologous pair of chromosomes in your genome, one of the homologues comes from your mom and the other from your dad.

The sex chromosomes, X and Y, determine a person's biological sex: XX specifies female and XY specifies male. These chromosomes are not true homologues and are an exception to the rule of the same genes in the same places. Aside from small regions of similarity, the X and Y chromosomes are different and carry different genes.

1. AUTHENTICITY

- Embed gender inclusion in curriculum.
- Reflect on our own knowledge & comfort level w/ topic.
- Align lessons with our own developing understanding of gender and sex diversity.
- Use empirical scientific research to inform content, not political agendas.
- Encourage students to question their assumptions & explain in different ways.

➔ **TASK 1**

Using the principle of **Authenticity**, discuss the issues that arise in this example. Consider:

- ➔ What impression(s) might the teacher leave on students? On transgender students?
- ➔ What decision(s) did the teacher make?
- ➔ How authentic was the teacher for students?
- ➔ What are some ways we could improve the situation? Beforehand? Afterwards?
- ➔ If a teacher doesn't have experience with this, where can they go for help? What can they do?

2. CONTINUITY- An Inquiry About Intersex

Directions: Read the scenario below, then discuss the guiding questions in the Task to reflect on our teaching practice.

Mr. G teaches high school biology. He usually teaches genetics in this order: 1) meiosis, 2) chromosomes, 3) genes, and 3) gene expression. When he gives lecture notes about meiosis, Mr. G defines it as "a type of cell division that produces four genetically unique, haploid daughter cells." To connect meiosis to a relatable example, Mr. G says, "In humans, meiosis produces egg cells in women and sperm cells in men."

Later, the students learn more details about the chromosomes inside each cell. Mr. G says, "In humans, a healthy individual has 46 chromosomes. Two of these chromosomes are the sex chromosomes -- girls have XX and boys have XY chromosomes." The students then model nondisjunction during cell division using pop-beads.

Near the end of the class, a student asks, "I heard a story in the news about intersex athletes who aren't male or female, and they might have more than just XX or XY chromosomes."

Mr. G gets visibly flustered but tries his best to explain. He replies, "**Yes, I've heard of intersex diseases. They can happen when the sex chromosomes have a mutation or there are too many chromosomes. That's why the process of meiosis is so important for making healthy sperm and eggs.**"

Several students raise their hands. The first one asks, "So can transgender people still make sperm and eggs?" The bell dismisses class before Mr. G can answer. The next time Mr. G has a substitute teacher, he creates a special lesson. Students are to watch the National Geographic documentary, *Gender Revolution*, together, then write a reflection about the film. After Mr. G returns, they never discuss the ideas again.

2. CONTINUITY

- Begin units with a diversity lens, rather than oversimplifying and reworking details later.
- Consistently include gender, where applicable, as one of the themes/lenses for analysis.
- Refrain from highlighting or tokenizing gender as a one-time lesson, extension, or reaction to behavior. No "very special" lessons.
- Students are taught a more complex truth rather than an oversimplified "rule" with "exceptions".

➔ **TASK 2**

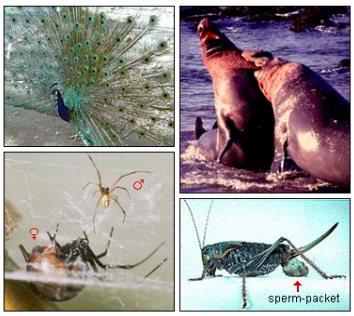
Using the principle of **Continuity**, discuss the issues that arise in this example. Consider:

- ➔ What impression(s) might the teacher leave on students? On transgender students?
- ➔ What decision(s) did the teacher make?
- ➔ What are some ways we could improve the situation? Beforehand? Afterwards?
- ➔ If a teacher doesn't have experience with this, where can they go for help? What can they do?

3a. AFFIRMATION - Sexual Selection Strategies

Directions: Review the example below, then discuss the guiding questions in the Task to reflect on our teaching practice.

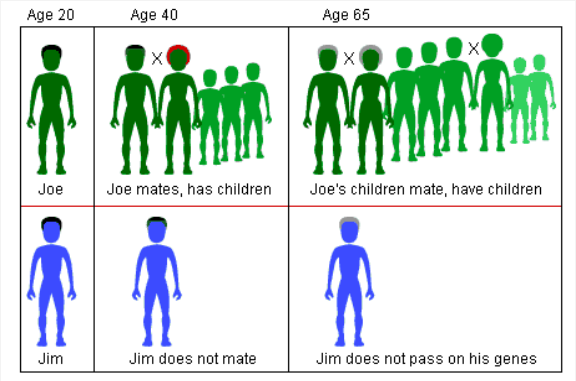
Sexual Selection



Sexual selection is a "special case" of natural selection. Sexual selection acts on an organism's ability to obtain (often by any means necessary!) or successfully copulate with a mate.

Selection makes many organisms go to extreme lengths for sex: peacocks (top left) maintain elaborate tails, elephant seals (top right) fight over territories, fruit flies perform dances, and some species deliver persuasive gifts. After all, what female Mormon cricket (bottom right) could resist the gift of a juicy sperm-packet? Going to even more extreme lengths, the male redback spider (bottom left) literally flings itself into the jaws of death in order to mate successfully.

Sexual selection is often powerful enough to produce features that are harmful to the individual's survival. For example, extravagant and colorful tail feathers or fins are likely to attract predators as well as interested members of the opposite sex. What happens to the genes of an individual who lives to a ripe old age but never got to mate? No offspring means no genes in the next generation, which means that all those genes for living to a ripe old age don't get passed on to anyone! That individual's fitness is zero.



Selection is a two-way street

Sexual selection usually works in two ways, although in some cases we do see sex role reversals:

- **Male competition**
  Males compete for access to females, the amount of time spent mating with females, and even whose sperm gets to fertilize her eggs. For example, male damselflies scrub rival sperm out of the female reproductive tract when mating.
- **Female choice**
  Females choose which males to mate with, how long to mate, and even whose sperm will fertilize her eggs. Some females can eject sperm from an undesirable mate.[1]

3. AFFIRMATION

- Teach the naturally-occurring diversity of gender and sexuality in human and nonhuman species.
- Celebrate diversity as a valuable asset for surviving and thriving in societies and among scientists.

➔ **TASK 3a**

Using the principle of AFFIRMATION, discuss the issues that arise in this example. Consider:

- ➔ What assumptions can be made about the goals of sex and life after reading these passages? Do they apply to all experiences with fertility and adulthood?
- ➔ Are there any examples here of animals that do not fit a binary sex role or "conventional" sexual practices?
- ➔ What other assumptions about sex, gender, and biology are implicitly stated here? What groups are particularly harmed by these assumptions?

[1]Source: UC Berkeley website "Understanding Evolution," a commonly-used resource in middle and high school biology classrooms. Available at https://www.evolution.berkeley.edu/evolibrary/article/evo_28.

3b. ADAPTING AND EXPANDING - sexual selection strategies

Directions: Review the examples below, then discuss the guiding questions in the Task to reflect on our teaching practice.

All female **hyenas** (*Crocuta crocuta*) have functional penises they use to pee, mount, & give birth. Erect penises are a sign of submission in the matriarchal society of hyenas. [*Ed. note: Author defines "penis" in this discussion as something the animal can pee through.]* The female hyena without the erect penis is the dominant leader of the entire pack.

The first scientific investigation in 1939 showed that a spotted hyena makes only one-size gamete throughout its life, either as an egg or sperm. The females have a phallus 90% as long and the same diameter as a male penis. The labia are fused to form a scrotum containing fat and connective tissue resembling testicles. The urogenital canal runs the length of the clitoris, rather than venting from below. The animal can pee with the organ, making it a penis. Completing the picture, the female penis contains erectile tissue (corpus spongiosum) that allows erections like those of a male penis.[2]

Caption: A bonobo group hug.

Chimpanzees (*Pan troglodytes)* **& bonobos** (*Pan paniscus)* are the closest relatives to humans, and though they share many traits, they also interact very differently. In chimpanzee society, the biggest and strongest males rule. In bonobo society, the physically weaker females overrule the physically stronger males by working together and using sex to control their aggression.

In general, when tension is rising, two bonobos will have sex to reinforce their social bonds. For example, if two males want the same female, instead of fighting and risking injury or death, they will have sex with each other to reinforce friendship. Or, when a female hits a baby, the baby's mother will chase her off, but afterwards, they will rub their clitorises together to make up. For bonobos, sex is very casual, but in chimpanzees, have the "wrong" kind of sex can mean death.

80% of gay swan couples successfully raise their young, but only 30% of straight swan couples successfully raise their young.[3] **Swans** (*Cygnus atratus*) also form stable male-male pairs that last for many years. Gay swans may even raise offspring together as a couple. A female may temporarily associate with a male-male pair, mate with them, and leave her eggs with them. The male couple then parents the eggs and is reported to be more successful than a male-female couple because together they access better nesting sites and territories, sharing the workload more equally than between-sex couples.

3. AFFIRMATION

- Teach the naturally-occurring diversity of gender and sexuality in human and nonhuman species.
- Celebrate diversity as a valuable asset for surviving and thriving in societies and among scientists.

➔ TASK 3b

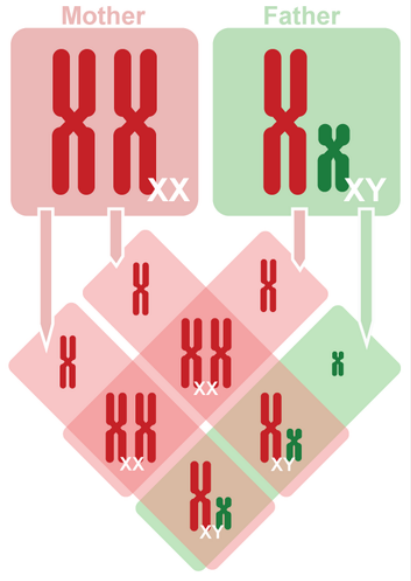
Using the principle of AFFIRMATION, discuss the issues that arise in this example. Consider:

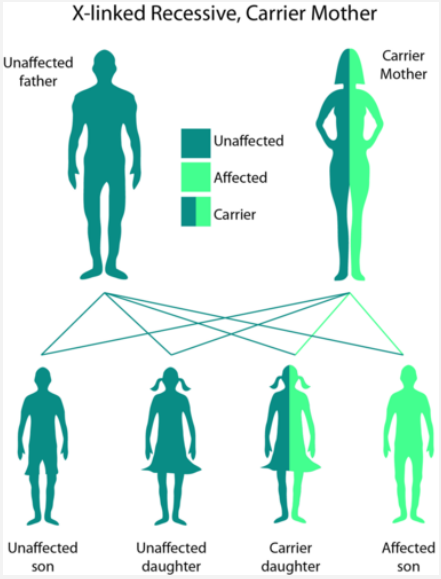
- ➔ How could these be included in a lesson on sexual selection?
- ➔ What students, in particular, would be helped by an addition or expansion of these concepts?
- ➔ What else could be included to create a fuller picture of the diversity of life in general?

[2] See https://tinyurl.com/**hyenaintersex**.
[3] See https://tinyurl.com/**gayswansaregooddads**.

4a. ANTI-OPPRESSION - Sex-Linked Traits

Directions: Review the excerpt below, and discuss the guiding questions in the Task to reflect on our teaching practice.





Traits controlled by genes located on the sex chromosomes (X and Y) are called sex-linked traits. Remember, females have two X chromosomes and males have a X and a Y chromosome. Therefore, any recessive allele on the X chromosome of a male will not be masked by a dominant allele. X-linked traits include hemophilia and color blindness.

Hemophilia is the name of a family of hereditary genetic illnesses that impair the body's ability to control coagulation. Color Blindness, or color vision deficiency, in humans is the inability to perceive differences between some or all colors that other people can distinguish.

Inheritance of Sex Chromosomes. Mothers pass only X chromosomes to their children. Fathers always pass their X chromosome to their daughters and their Y chromosome to their sons. Can you explain why fathers always determine the sex of the offspring?

Source: CK12 Foundation website "Sex-Linked Traits," a commonly-used resource in middle and high school biology classrooms.[4]

4. ANTI-OPPRESSION

- Practice using science explanations and data to analyze & challenge the status quo.
- Invite discussions about what voices are present and absent in scientific inquiry and explanation.
- Examine how science has been used as a tool to fight oppression.

➔ **TASK 4a**

Using the principle of **ANTI-OPPRESSION**, discuss the issues that arise in this example. Consider:

➔ What types of family structures are highlighted in the passage, and which are absent?

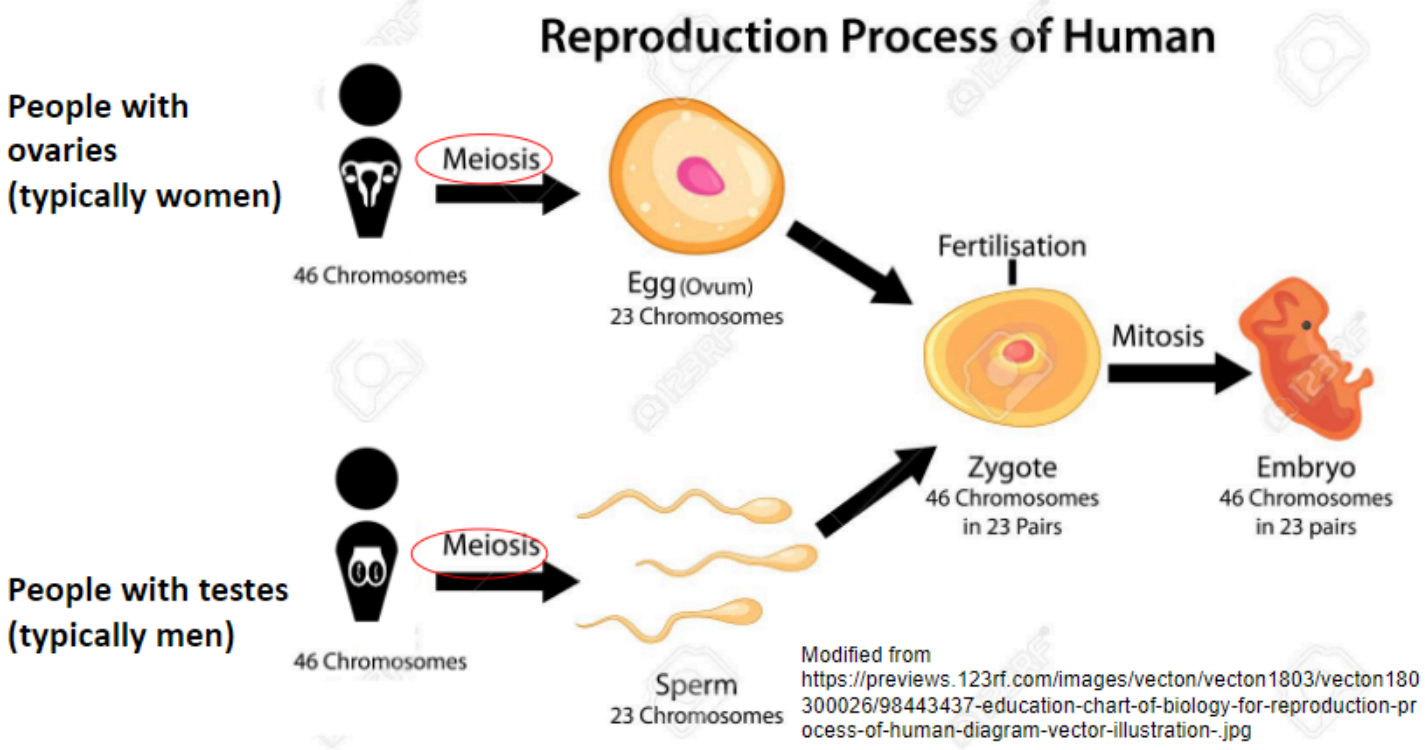
➔ What does the passage assume about the connection between an individual's chromosomes and the people they call "mother" and "father"?

➔ What other assumptions about sex, gender, and biology are made through choice of language and visuals in this passage? What groups are particularly harmed by these assumptions?

[4] Source: https://www.ck12.org/book/CK-12-Biology-Advanced-Concepts/section/7.18/

4b. ANTI-OPPRESSION - Genetic Inheritance

Directions: Review the image below, then discuss the guiding questions in the Task to reflect on our teaching practice.



4. ANTI-OPPRESSION

- Practice using science explanations and data to analyze & challenge the status quo.
- Invite discussions about what voices are present and absent in scientific inquiry and explanation.
- Examine how science has been used as a tool to fight oppression.

➔ **TASK 4b**

Using the principle of **ANTI-OPPRESSION**, discuss the issues that arise in this example. Consider:

➔ What messages are reinforced by the language and design choices?

➔ What students, in particular, would be helped by this image?

➔ What else could be included to create a more anti-oppressive picture of genetic inheritance?

4c. ANTI-OPPRESSION - Family Diversity

Directions: Review the image below, then use the guiding questions in the Task to reflect on our teaching practice.

Source: Gayby Baby School Action Toolkit, Australia's comprehensive education resource to represent same-sex parented families.

4. ANTI-OPPRESSION

- Practice using science explanations and data to analyze & challenge the status quo.
- Invite discussions about what voices are present and absent in scientific inquiry and explanation.
- Examine how science has been used as a tool to fight oppression.

➔ **TASK 4c**

Using the principle of **ANTI-OPPRESSION**, discuss the issues that arise in this example. Consider:

➔ What other kinds of families could be included in the graphic?

➔ What language could be used in a biology class to differentiate families, which can take on diverse structures, from the individuals who pass down their DNA to a child?

5. STUDENT AGENCY

Directions: Read the scenario below, and use the guiding questions in the Task to reflect on our teaching practice.

1. Language creation: Every year, when C teaches about genetics, pregnancy, and birth, her students create language together about something that English doesn't really have a specific word for yet: "the people that made the sperm and egg that become you."

Classes discuss why even using the word "genetic parent" or "birth parent" is problematic - both, because parent has a specific meaning that isn't connected to genetics, and the latter because the person who made the sperm or egg don't always carry the pregnancy!

Some examples that students have come up with so far are: "storks," "genetic givers" (GGs for short), and "biological gene transmitters" (BLTs for short). It's really fun, especially since so often in biology class kids are being told lots of words they have to learn and don't get to give input on!

2. Crew example: Many students at L's school participate in regatta and rowing, something specific to his school's culture. When planning the unit on the musculoskeletal system, he used a phenomenon that centers cis women crew athletes to highlight something relevant to students' lives. (He also connected the unit to systemic sexism and cissexism in anthropology and biology - ask him about it!)

3. Overhearing students talking about health class: In the hallway, a teacher overhears students complaining about the way that gender and sexuality in the required health class. The teacher goes over to talk with the students about the needs they have that aren't being met and help them create a clear list of requests for future classes. They then go to the source and meet with the teacher and the students to discuss their concerns directly.

4. Classroom Assessment Tool: At the end of each unit, S surveys his students about a number of classroom-related tasks. Then, in the next class, he shows data from the survey and opens up a 20-30 minute conversation for students to provide their feedback as a group and brainstorm ways to make the class better. This process of visibly engaging students in creating the classroom they want allows them to be braver in giving feedback in the future, and also collects amazing ideas that S would not come up with on his own.

5. STUDENT AGENCY

The last principle of the framework for creating a gender-inclusive biology curriculum is about including and engaging students in the process of creating a classroom culture and curriculum that meets the needs of your community.

- Students give input and feedback about lessons, language, & classroom culture.
- Teachers know their students' interests and plan lessons that are relevant to their experiences.
- Students make their own topic choices for research projects and case studies.

➔ **TASK 5**

Using the principle of **Student Agency**, discuss the issues that arise in this example. Consider:

- ➔ What are the advantages and disadvantages of soliciting student input and feedback in your classroom practices?
- ➔ How might students be impacted by the Classroom Assessment Tool that addresses feedback?
- ➔ What are examples of things in your curriculum that should not be open to student feedback, if there are any?
- ➔ How can we navigate protecting vulnerable students (trans and intersex students, students with disabilities or genetic diseases, students of color, and others) from needing to speak for their communities while centering their experiences in the room?