

Science & Technology 7: Physiology of Love

Aim/Rationale¹

Students will be introduced to topics in neurophysiology including neurotransmitters and brain pathways that influence addiction and attraction. They will gain insight into the physiological responses to sexual stimuli. Also, students are encouraged to think critically about new scientific research and form their own scientific and ethical opinions based on prior knowledge.

Trigger warning

Discussion of addiction

Competencies

- 1) *Seeks answers or solutions to scientific or technological problems.*
- 2) *Makes the most of their knowledge of science and technology.*
- 3) *Communicates in the languages used in science and technology.*

Materials

- Computer with projector

¹ Note that the use of gendered terms like, "male" or "female" in this lesson plans refers to anatomy and physiology and not a person's gender identity.

Hook

Show YouTube video “Chemical Love” by a boy singing about the chemicals involved in falling in love with a girl. It introduces the neurotransmitters dopamine, and connects this chemical with feelings of attraction. <http://www.youtube.com/watch?v=WAigCKiqYvw>

1. Pose some warm-up questions:

- What is love?
- What is difference between love and attraction, or is there one?
- When people are attracted to each other, why do we say they have “chemistry”?
- How do you feel about love be reduced to chemical activity in the brain?
- What does the expression “love is a drug” mean to you?

Development/Teaching Methods

Part 1: Attraction by Pheromones (15 minutes)

Definition (from the Oxford English Dictionary):

A chemical which is secreted and released into the environment (typically in minute amounts) by an animal, esp. a mammal or an insect, and which produces a specific physiological or behavioural response when detected by another individual of the same (or a closely related) species.

There are pheromones that induce many different behaviours in different species. We will focus on sex pheromones, which attract mates of the same species. **Gypsy Moths:** Male antennae pick up pheromones released by females. Males can pick up traces of pheromones in very small quantities from very far away, and seek out the source of the smell. The hormone can be used as non-pesticide pest control by using traps which contain some of the pheromone. The males are attracted and then get stuck in the trap. Another method used to kill flies is to spray the pheromone over a large area. The flies fly around, trying to locate the female and eventually die of exhaustion.

Rapeseed Flies: These flies use an anti-pheromone. The males cover the females in a pheromone called methyl salicylate after they have mated so that other males will not attempt to mate with that female.

Dogs: The female emits a sex pheromone called para-hydroxymethylbenzoate. When female dogs are in heat, they emit a lot of pheromones. Male dogs have an excellent sense of smell, which has been likely been evolutionarily adapted for reproductive success, and they are able to locate fertile females.

Pigs: In this species, the male emits the sex pheromone called **androstenol**. Females are attracted to the male pig and have a keen sense of smell. Female pigs have been used for centuries to find truffles (mushrooms used in fine cuisine which grow underground). It turns out that these mushrooms have a very similar scent to the hormone emitted by male pigs.

Humans: Male sweat contains the same pheromone that male pigs emit (androstenol). Studies have been done to determine whether this pheromone really attracts human females. In a study in England, certain cinema seats were sprayed with the pheromone, and it was observed that more females sat in those seats. Perfumes are available that contain **androstenol** to attract members of the opposite sex. However, we know that attraction between humans is much more complex than smelling a pheromone.

Dorm Room Myth and the “First Human Pheromones”:

The field of science that studies love and attraction between humans is relatively new compared to other fields of science. There is rapid growth and change within this field. Please remember this throughout the remainder of this lesson, and look at this example of a phenomenon that was falsely attributed to the exchange of pheromones:

Have you ever heard that when women live together, their menstrual periods become synchronized? In a 1971 paper published in *Nature* (a very reputable science journal) by Martha McClintock, she observed in college dorms that by the end of the school year, all of the girls menstrual cycles were more aligned than in October. This was widely known as the **first evidence of pheromones in humans**.

Since then, several studies have been done on women living together. These studies have come to disprove the pheromone hypothesis and the original study has been found to be faulty.

Since menstrual periods vary in length and are not always consistent, it is more likely based on chance that the periods of the girls were more closely aligned in April. *Though this hypothesis has since been proven incorrect, this does not mean that human pheromones do not exist! Rather, it illustrates that we must continually review and challenge ideas to better our knowledge of science.*

Part 2: Making Love - The Body Response to Sexual Stimuli (10 minutes)

Attraction between humans (like animals) often leads to sexual arousal and sexual encounters. Many body changes occur during sexual arousal.

Teacher may make chart on board to contrast physiological responses to arousal for men and women (as always, remember that there are exceptions to every rule/category). Allow students to try and fill in the chart with their ideas first.

- Sexual desire may come before arousal.
- Arousal may be caused by genital stimulation prior to feelings of sexual desire.
- The central reward pathways in the brain are activated during arousal, which connect sex with pleasure as opposed to solely for reproduction. (This is covered in more detail in part 3)
- Brain output centres in the hypothalamus send signals to genitals through the spinal cord.
- Heart rate, respiratory rate and blood pressure increase for both sexes during arousal.

Women	Men
<ul style="list-style-type: none">• Tactile (touch) and verbal stimuli are more powerfully arousing for women• Clitoral response<ul style="list-style-type: none">◦ Relaxation (dilation) of smooth muscle leads to increased blood flow which causes swelling of parts of the vulva including the clitoris• Vagina expands in diameter and becomes lubricated• Nipples become erect• Orgasm: Fast contractions of pelvic muscles expel blood from the area	<ul style="list-style-type: none">• Visual stimulation more powerfully arousing for men than women• Genital stimulation leads to arousal faster than in women• Erection<ul style="list-style-type: none">◦ Relaxation (dilation) of smooth muscle tissue in the penis allows blood flow in, making the spongy tissue of the penis rigid. Veins are compressed so the blood does not escape and the erection can be maintained

<p>releasing the pressure and sexual tension (internally - blood is not expelled outwards). Often a whole body sensation.</p> <ul style="list-style-type: none"> • Resolution period: External organs return to un-aroused state • It is possible for women to have multiple orgasms immediately after the first, there is no resting period 	<ul style="list-style-type: none"> • Elevation of testes and scrotal tightening • Orgasm: Ejaculatory contractions of the seminal vesicles and prostate gland expel semen into the urethra where they are followed by urethral contractions which expel the semen. Often a whole body sensation • Resolution period: External organs return to un-aroused state • Men have a resting period after ejaculation where they cannot orgasm for a certain length of time (varies from person to person)
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Part 3: Falling in Love and Being in Love—The Brain Response (10 minutes)

Some science indicates that there are three brain systems involved in human pair-bonding and mating. These states of attraction, arousal and attachment do not always occur in this order. For example, people may have sex and then fall into romantic love, or old friends with emotional attachment may develop sexual interest in each other.

1. Sex Drive:

- In ALL humans, the chemicals responsible for sex drive are androgens (particularly testosterone).
- Libido (sex drive) is highest in men around age 20 when testosterone levels are highest.
- Women have stronger sex drives when ovulating because testosterone levels are higher in their bodies.
- The sex drive may motivate humans to engage with a range of partners.

2. Romantic Love:

- Motivates humans to be with a preferred mating partner, conserving energy that would be used trying to find a partner.
- Romantic love is often associated with intense energy, happiness, emotional dependency, mood swings, cravings for closeness with the person, sexual possessiveness and obsession.
- This pathway activates the dopaminergic **reward system** of the brain.
- **Dopamine**: A neurotransmitter (chemical that sends signals within the brain) that is associated with the reward system of the brain. Dopamine is released during rewarding activities (such as eating, sex and drug highs). Dopamine may have a role in experiencing pleasure, and motivates people to repeat certain rewarding activities.
- High levels of dopamine can induce the release of testosterone, promoting sex drive.
- The reward area of the brain, which is activated during sex and love, is also associated with chemical addictions.

3. Attachment:

- Associated with emotional union, long-term mating partner and security.
- Likely evolved out of the biological necessity to remain pair-bonded long enough to raise offspring.
- Hormones associated with this pathway are oxytocin and vasopressin.
- **Oxytocin**: A hormone released with a mother nurses her infant, which promotes attachment

and feelings of connection and bonding. It is also released during hugging, touching, sex and orgasm and produces the same feelings of attachment between partners (it is released differently in the brains of male and female bodies).

- **Vasopressin:** In both humans and prairie voles (a small mammal), this hormone has been found to be important in pair-bonding and monogamy. Blocking the vasopressin receptors in prairie voles significantly decreases tendency toward monogamy.

Part 4: Independent Reading, Critical Thinking and Conclusion (20 minutes)

Allow students to independently read the article *Love: Neuroscience Reveals All* from the journal Nature. Ask students to underline or highlight important points to be referenced in a class or group discussion.

Class or group discussion starters:

- Do you think we can compare human love to love between animals?
- Why do we use research on other animals to make inferences about human love?
- What do you think about the possibility of scientifically creating drugs that could make you fall in love, or love vaccines (drugs that would prevent you from falling in love)?
- Revisit the question, “How do you feel about love be reduced to chemical activity in the brain?”



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