5.5 Genitalia

External genitalia in amniote vertebrates (all vertebrates except fish and amphibians) share a deep homology in early development, meaning its evolutionary history is shared by all amniote vertebrates as these organs evolved deep in time before the amniotes diversified. In all amniotes, two bumps from the cloacal wall known as the phallic bodies protrude from the cloacal lip in early development. They continue to grow and merge to form a single structure in the midline of the body in all groups, except squamates (snakes and lizards) that end up with 2 separate penises. Where the two phallic bodies merge, the urethral groove or the sperm channel forms. In mammals, this urethra will be enclosed and form a tube sometimes. At this stage, if individuals get a surge of DHT (dihydrotestosterone), the phallus becomes a penis, and if not, the phallus becomes a clitoris. All amniotes have a clitoris, and a penis, except in most birds where the penis has been lost, although the status of the clitoris is unknown.

Genitalia are often thought of as a binary sexual trait, and in humans, we use genitalia to assign sex at birth, but sometimes (1:2,000-5,000 births) no sex can be assigned because the complexity inherent to genital development can result in ambiguous genital morphologies, and while often the position of the urethra relative to the phallus can help categorization, sometimes it does not.

Sometimes, genital examination suggests one sex, but further examination reveals another, a type of genital variation that we also classify as intersex. In snakes, intromittent genitalia are called hemipenes as there are two of them, kept inside out in the cloaca, and corresponding homologous paired structures in females called hemiclitores. In pythons and rattlesnakes, some individuals have well developed hemipenes and testes, and also a vaginal pouch. The frequency of intersex can be extremely high as it is the case of the golden lancehead snake (Bothrops insularis) where many individuals have well developed vaginas and ovaries, as well as very large hemiclitores, that closely resemble the hemipenes, while others have much smaller hemiclitores.

In vertebrates, the development of genitalia is often a life-long process, where final differentiation will occur only when individuals are ready to become reproductive. Before then, genitalia can be inconspicuous and undifferentiated, making it impossible to ascertain from external examination alone whether that individual is a male or a female given its phallus morphology. Often, a vaginal closure membrane will be present, so there is no vaginal opening either. In some species, this non-reproductive state can last a lifetime, and some organisms may die never having produced any offspring because they are reproductively suppressed by larger or older group members. Naked mole rats and meerkats are good examples of these reproductively suppressed species. In naked mole rats for example, the external genitalia are completely undifferentiated in non-reproductive individuals, so examining the genitalia of a non-reproductive adult, would not reveal much about its sex.

Just as it is the case with gonads, gametes and hormones, the genital phenotype is also plastic and it changes in response to the social environment. For example in ducks, males that were kept in high competition groups either grew a longer penis for a longer period of time when they had to compete against other males, or a dominant male reproductively suppressed smaller males, and kept them from growing a large penis. Again more evidence that even genitalia are not fixed or immutable. This phenomenon is also known in barnacles, where proximity to potential mates determines the length of the intromittent organ. If potential mates are far away, the intromittent organ can grow to prodigious lengths to reach into their body cavity.

Finally, usually we think of penises as intromittent organs that enter the vagina -or terminal portion of the oviduct that interacts with the penis-, to deposit sperm close to eggs and facilitate internal fertilization. However, in some species like Brazilian cave flies and sea horses, the egg-bearing individuals have the intromittent organs, and deposit their eggs inside the vagina or the uterine pouch of the males for fertilization to take place. Sometimes, as is the case with 97% of all birds, there is no penis at all, even when individuals make sperm; internal fertilization without intromission and without a penis.

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