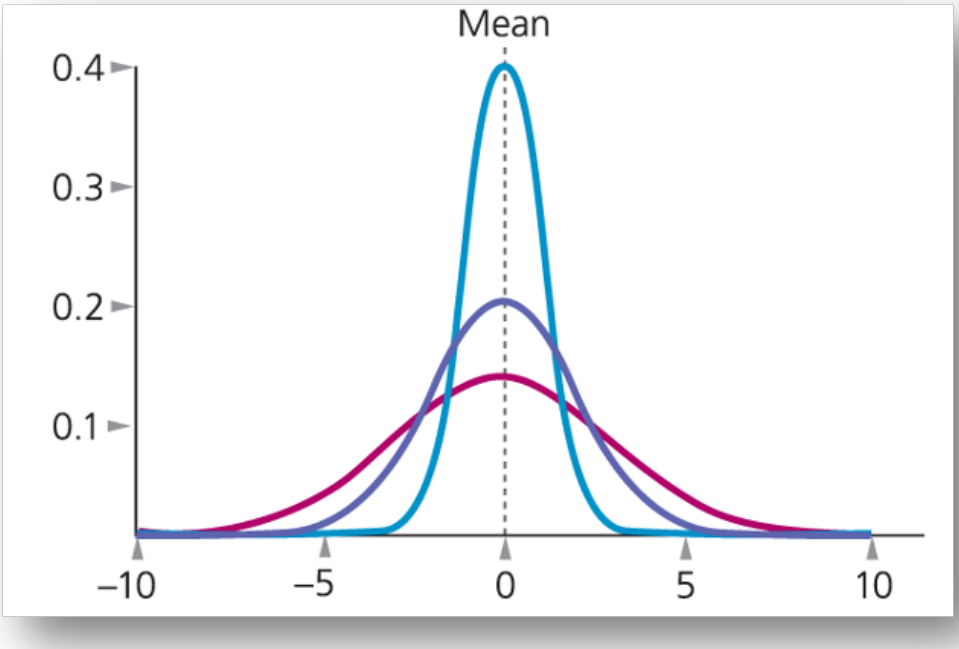
# 2. Variation in Biology

Anatomical features in animals are very variable and most variations are functional, and there is no reason to expect that sexual features would be any different. Why is variation always expected in phenotypic features? Building and growing a body relies on interconnected and ongoing conversations between genes, the proteins they produce, and the environment. As genes are expressed, they change their environment and as the environment changes, gene expression is also influenced.  This results in endless variation that is critical for evolution.  Variation helps cope with the unexpected in biology.  Therefore, variation is not only a natural outcome of the interactions between genes and the environment, but also is necessary for species survival in the face of uncertainty. In Biology, we often rely on statistical tools to refer to averages, but in casual conversation the necessity for averages to be attached to a measure of variance or standard deviation (the “spread” of the data) is lost. To understand variation we need to understand not only the average, but the spread of values around that average as illustrated below.  The higher the variance in a trait, the flatter the distribution curve will look (pink), the lower the variance, the narrower the distribution (blue), so more individuals are closer to the mean.  However, there are no quantitative traits related to the sexual phenotype that have a single value, and none of them are binary, not even the gamete category that is often touted as such, as explained below. They either fall as distributions and therefore represent a range of values, or are non binary character states (sperm, eggs, none or both).

Fig 2. Trait distributions with the same average or mean value but with different variances.



Created 2026-10-04 23:07:31 UTC by Ramanda
Updated 2026-10-04 23:09:01 UTC by Ramanda