Avian Reproduction: Anatomy & the Bird Egg

Reproductive Anatomy:

- Gonads - paired testes in males & usually a single ovary in females
- Ovary
    - most birds have only a left ovary
- Testes & follicles increase dramatically in size as the breeding season approaches.

Photoperiods Circadian Rhythm in Parrots

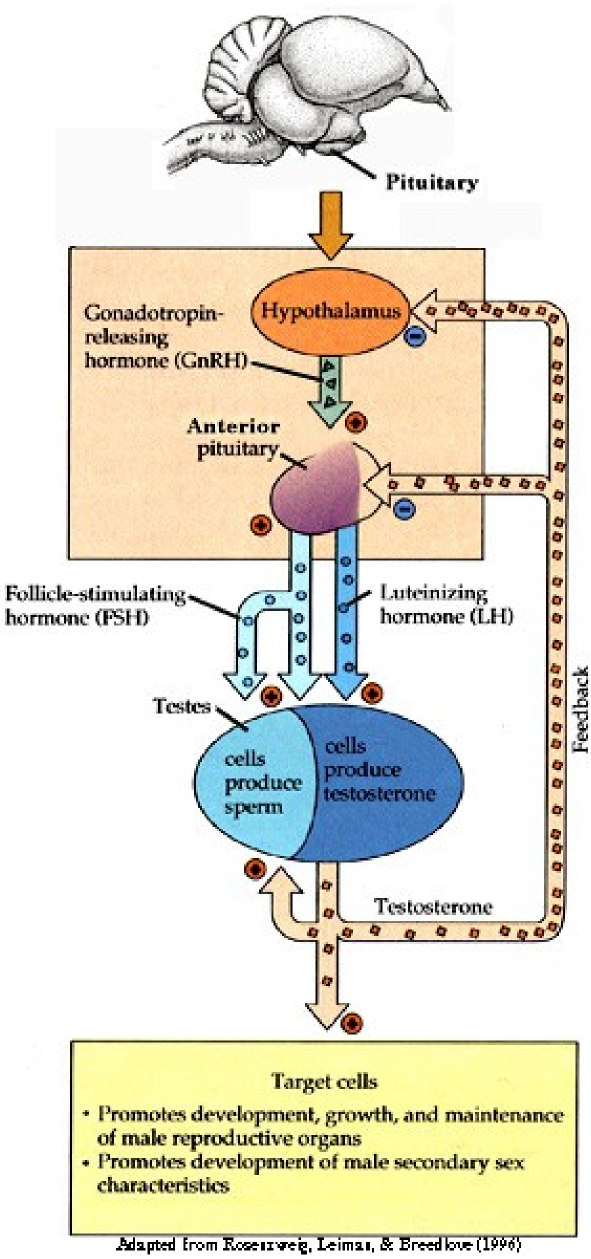
Photoperiodic means that their life 'periods' (as in seasons like the breeding season, moulting season, migrating season, resting season, etc) are governed by light (photos in Greek means light). It's the principle on which the avian circadian (about one day) and circannual (about one year) cycles and all biorhythms (life cycles) are based.

The entire bird body and its functions are 'managed' by different hormones secreted by different glands at various times. The 'master' gland (the one that sends the 'signal' to other glands) is called the pituitary gland, which is deep inside the brain (there is a close relationship with the hypothalamus). The pituitary gland's hormones (the 'signal') are 'turned on and off by light. The presence or absence of light sets their 'internal clock' (circadian and circannual cycles), so their body knows what it is supposed to do and when.

Birds have photoreceptors deep in their brains, and their cranial bones are so very thin that light goes through them and reaches the photoreceptors in the brain, activating them (this is why just because a bird is asleep, it doesn't mean that his endocrine system is not 'activated' if there is light in the room. Many people say their parrots are fine because although they stay up at night, they take naps during the day, but this doesn't do anything for the endocrine system.

The other big difference in birds' endocrine system is that they do not produce sexual hormones all the time or every predetermined number of days, weeks or months (like mammals do); they only produce them if conditions for breeding are good. If conditions are propitious (suitable for breeding), the gonads (sexual organs) (Male Gonads (Testes) and Female Gonads (Ovaries)) become active and grow; if conditions are not good, the gonads go dormant and shrink. These 'conditions' are called 'breeding triggers', and there are three: light, food, and weather.

The problem is that, in captivity, it's always good weather inside a house, and food is always rich and plentiful. Still, the good news is that ALL birds, even the ones that live smack on the equator where there is only a 20-minute difference of light hours between the seasons, are photoperiodic and would revert to using light as their primary trigger for their breeding cycle (there are studies on this).



Adapted from Rosenzweig, Leiman, & Breedlove (1996)
From: Akins and Burns (2001)

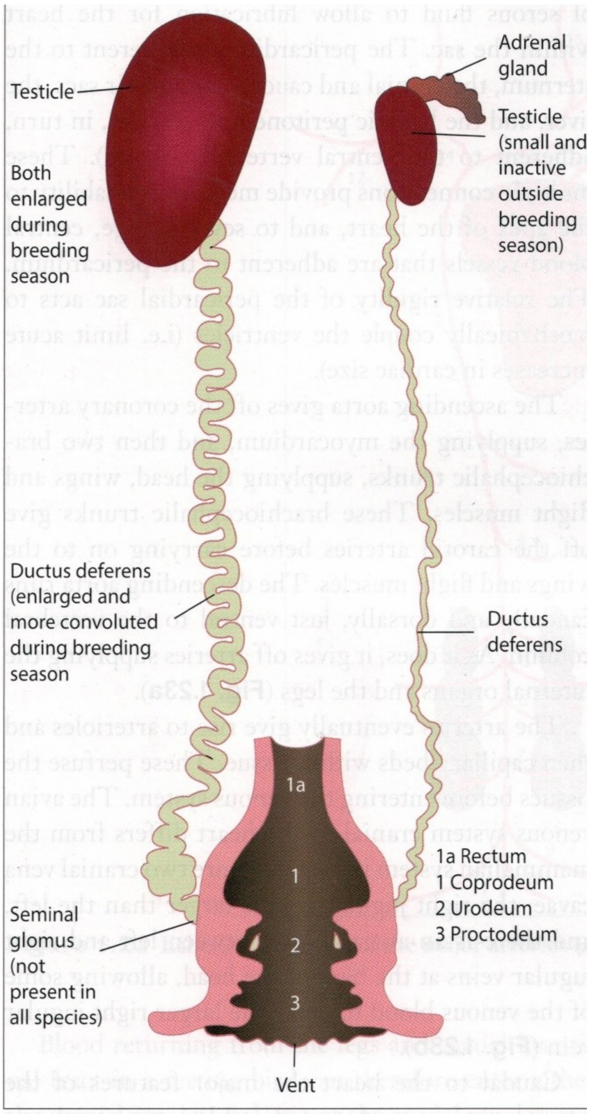


Figure 1.22 Schematic diagram of the male reproductive tract viewed ventrally.

Egg production

- Most birds have only one ovary and one oviduct. In the early stages of embryonic development, each female bird has two ovaries; only the left one develops into a functional organ. The right ovary and oviduct usually develop in some birds, such as hawks. A mature ovary looks like a cluster of grapes. It may contain up to 4,000 small ova, which can develop into mature ova.
- With fertilization, the ovum (egg) becomes a developing embryo. The embryo passes through the oviduct; it typically takes about 24 hours (for passerines & most other birds)

- The demand for calcium to make the eggshell is very high. So, birds' circulating blood calcium levels are significantly elevated compared to mammals, typically twice as much.

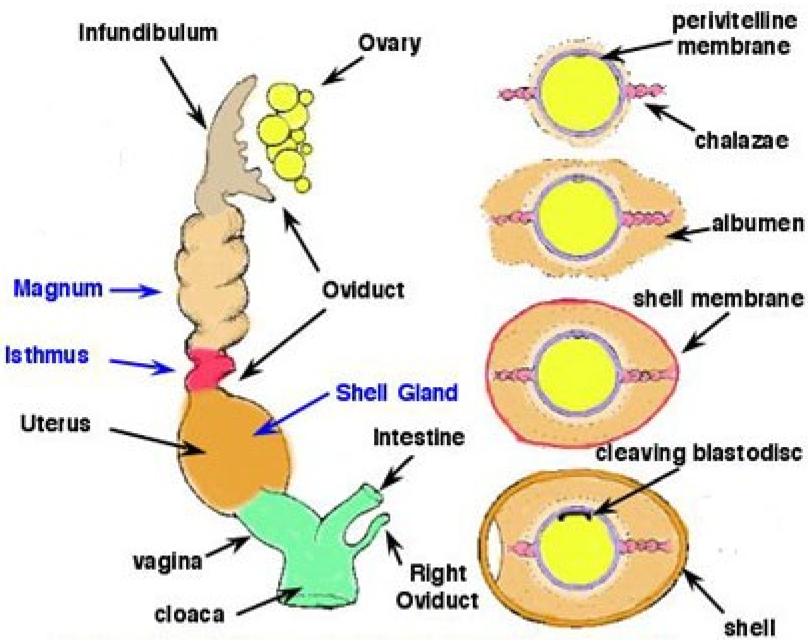
Avian Ovary
(Source: http://www.ksvea.com/birds.html)

Source: ulisse.cas.psu.edu/4hembryo/female.html

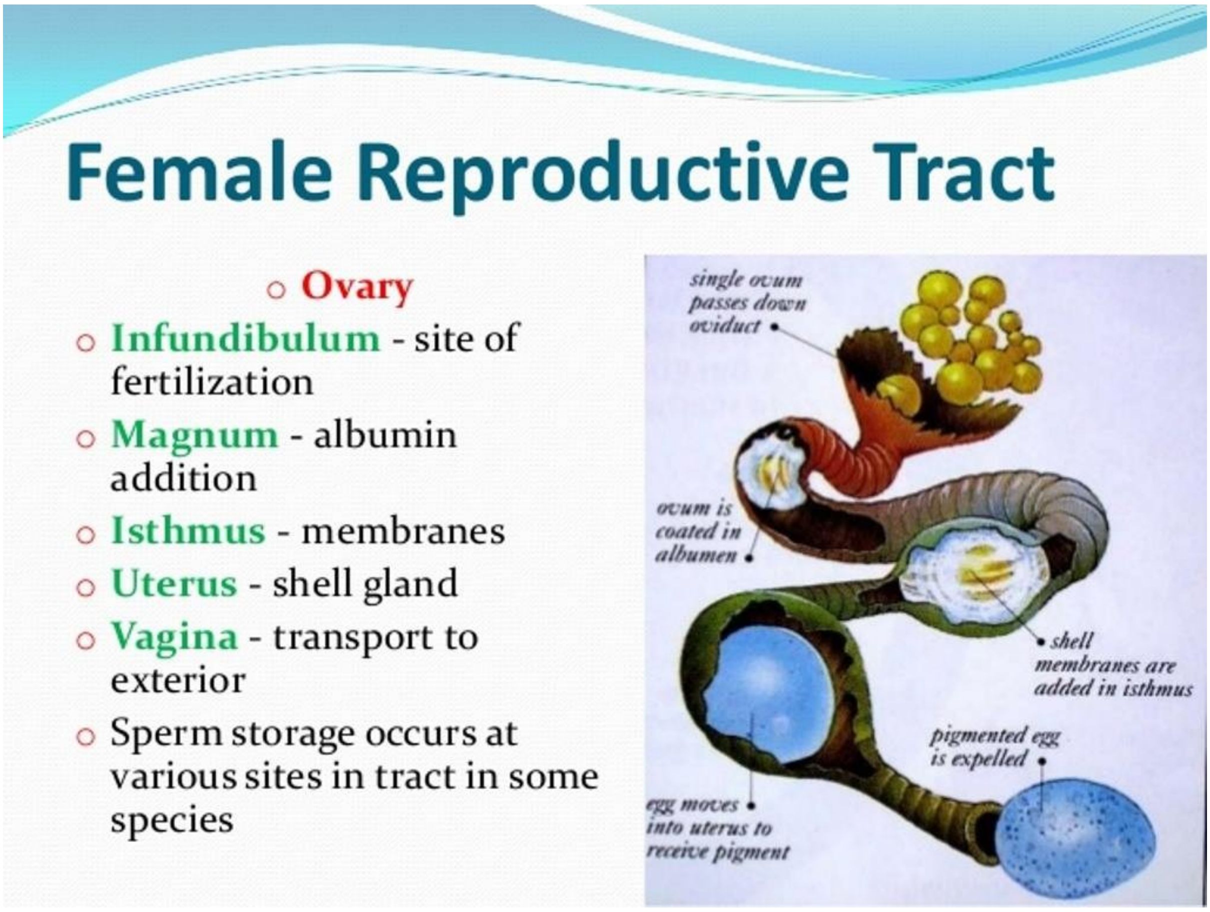
Ovary,oviduct, & egg with shell
Source: ulisse.cas.psu.edu/4hembryo/female.html

In most birds, only the left ovary and oviduct persist. The ovary enlarges greatly during the breeding season. Active ovaries resemble bunches of tiny grapes -- the developing follicles. The oviduct opens medially to it in a funnel-shaped ostium—ovulation results in the release of an egg from a mature follicle on the surface of the ovary. The egg, with extensive food reserves in the form of concentric layers of yolk, is picked up by the ostium and ciliary currents carry it into the **magnum** region. Over about three hours, the egg receives a coating of albumen.

The egg then passes into the **isthmus**, where the shell membranes are deposited. This takes about one hour. The egg then moves to the **uterus, or shell gland,** where the calcareous shell is added, and, in birds, The egg then passes into the vagina and cloaca for laying.



Source: www.wisc.edu/ansci_repro/lec/lec1/female_hist



Female birds can bias the sex of their chicks.-- Whether a bird is more likely to lay a male or female egg depends on which sex will have the greatest chance of doing well.

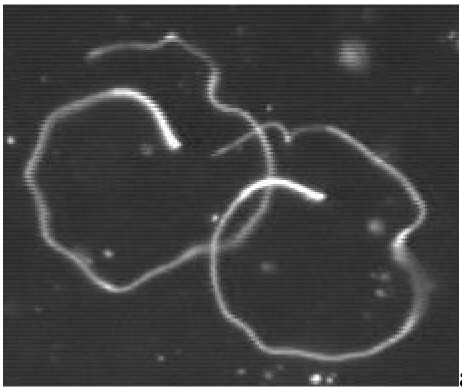
Copulation & fertilization:

- For most birds, copulation involves a 'cloacal kiss', with the male on the female's back & twisting his tail under the female's

- Sperm can also be stored for up to two or three weeks after mating and still be viable.

- Conures & Caiques copulation involves a 'cloacal kiss', but instead of the male on the female's back & twisting his tail under the female's. They mate side by side on the perch or wherever they feel comfortable,

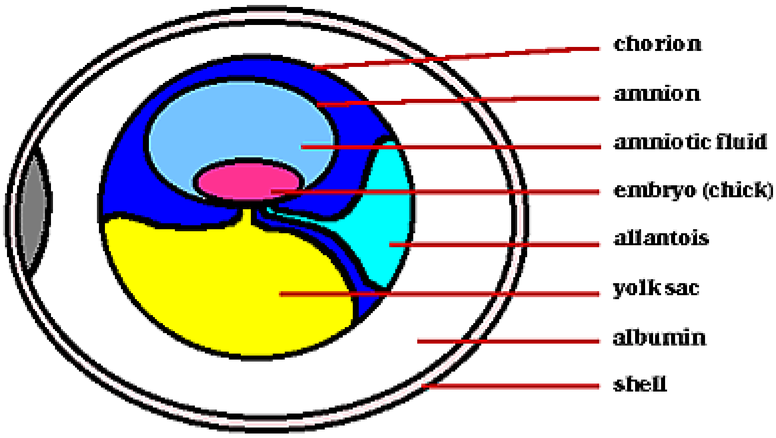
copulation typically lasts just a few seconds


avian sperm

The Avian Egg

Birds' eggs, like the birds themselves, vary enormously in size. The largest egg from a living bird belongs to the ostrich. It is over 2000 times larger than the smallest egg produced by a hummingbird. Ostrich eggs are about 180 mm long and 140 mm wide and weigh 1.2 kg. Hummingbird eggs are 13 mm long and 8 mm wide, weighing only half of a gram. Within the egg, three extraembryonic membranes support the life & growth of the embryo:

- amnion
  - surrounds only the embryo
  - inner layer of cells secretes amniotic fluid in which the embryo floats; fluid keeps the embryo from drying out and protects it
- chorion - surrounds all embryonic structures & serves as a protective membrane
- allantois (or allantoic sac)
  - grows larger as the embryo grows, fuses with the chorion & is called the chorioallantoic membrane
  - works together with chorion to permit respiration (exchange of oxygen and carbon dioxide) and excretion
  - important in the storage of nitrogenous wastes (uric acid)



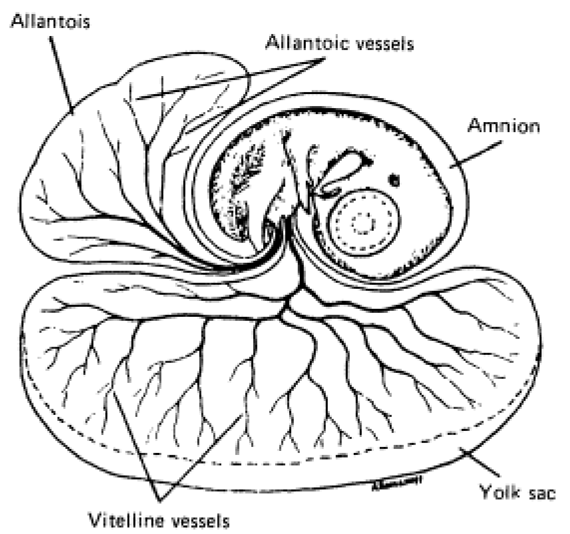
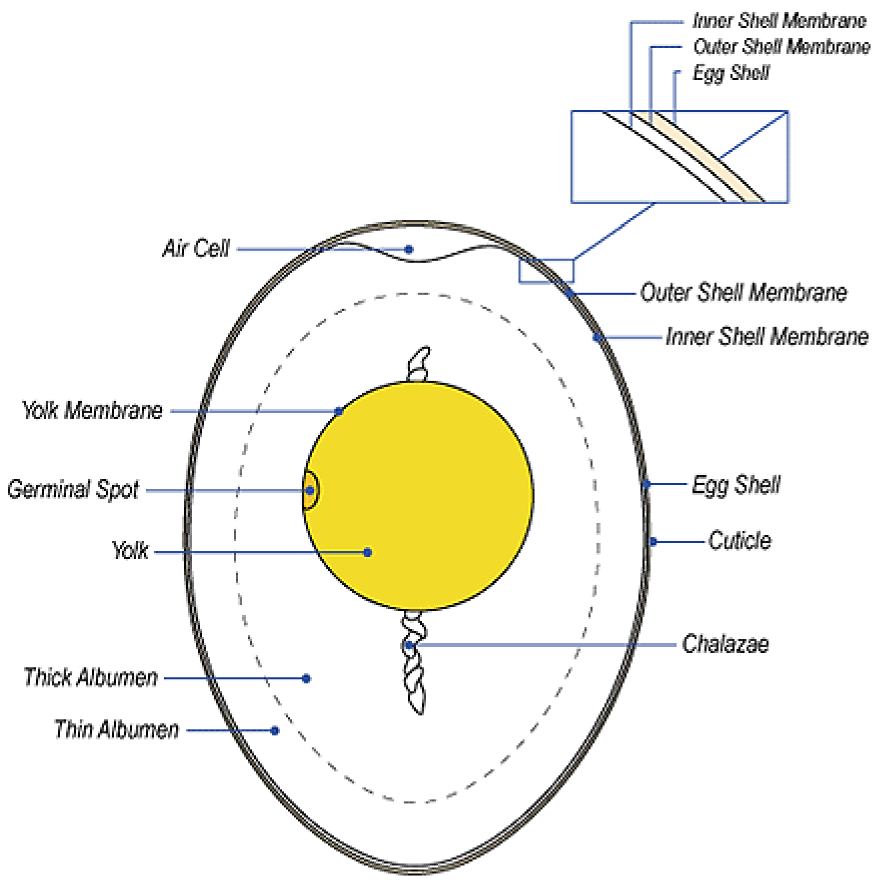


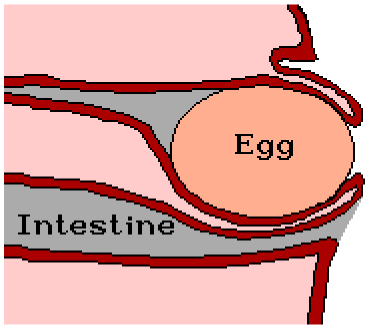
Figure 5. Seven-day-old embryo with its embryonic membranes and embryonic blood vessels.

- Eggs consist of 4 primary components:
  - yolk
    - energy-rich supply of food
    - 21 - 36% lipids & 16 - 22% proteins (with the rest being water)
    - the yolk is suspended in the centre of the egg by twisted strands of protein fibres called chalazae (shown below)



Egg-laying:

"Initially, the female stood motionless in the nest cup. The first sign of approaching egg-laying was usually intensified breathing, occasionally with rhythmic opening and closing of the beak that pointed either horizontally forward or more or less upwards. The head was drawn in, and the body feathers were somewhat fluffed out; the Coal Tit, in addition, raised its crown feathers. The tail was kept horizontal or elevated up to about 45 degrees". Then, the tip of the tail started nodding movements synchronously with rhythmic depressions of the rump. These movements, which were caused by throes of parturition when the egg travelled down the oviduct, were almost invisible to begin with but gathered in strength and ended with a sudden elevation of the rump that marked the moment of egg-laying. Then, the bird "froze" in a motionless posture, termed the "recovery phase." This last rise of the rump indicated that the egg had just been laid.



Source: http://www.afn.org/~poultry/egghen.htm

Female birds turn part of the cloaca and the last segment of the oviduct inside out ("like a glove"). The vent is then everted, and the egg emerges far outside at the end of the bulge. As a result, the egg does not contact the walls of the cloaca and gets contaminated by feces. In addition, the intestine and inner part of the cloaca are kept shut by the emerging egg, and their contents cannot leave when the hen strains to deliver the egg. Therefore, eggs are always clean when laid.