Animal Science 434
Reproductive Cycles in the Female

Terminology
- Estrus is a noun.
  – The cow is displaying estrus.
- Estrous is an adjective.
  – The length of the estrous cycle is 21 days.
- Oestrus and Oestrous
  – British and European spellings
- Estrus and Heat are synonymous

Terminology (cont.)
- Anestrus
  – When the female is not having repeated estrous cycles.

Types of Cyclicity
- Polyestrus
  - Queen
  - Cow
  - Sow

Types of Cyclicity
- Seasonally Polyestrus
  - Short day breeders (Fall)
  - Long day breeders (Spring)

Types of Cyclicity
- Monoestrus
  - Dog
  - Wolf
  - Bear
### Average Reproductive Cycles

<table>
<thead>
<tr>
<th>Species</th>
<th>Length of Estrous Cycle</th>
<th>Length of Ovulation</th>
<th>Length of Pregnancy</th>
</tr>
</thead>
<tbody>
<tr>
<td>cow</td>
<td>21 days</td>
<td>18 hr</td>
<td>282 days</td>
</tr>
<tr>
<td>ewe</td>
<td>17 days seasonal (fall)</td>
<td>29 hr near end estrus</td>
<td>148 days</td>
</tr>
<tr>
<td>sow</td>
<td>21 days polyestrus</td>
<td>48-72 hr</td>
<td>115 days</td>
</tr>
<tr>
<td>mare</td>
<td>21 days seasonal (spring) polyestrus</td>
<td>4-8 days 3-6 days of estrus (1-2 days before end of estrus)</td>
<td>335 days</td>
</tr>
</tbody>
</table>

### Average Reproductive Cycles

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<tr>
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<th>Length of Estrous Cycle</th>
<th>Length of Ovulation</th>
<th>Length of Pregnancy</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bitch</td>
<td>6 months</td>
<td>9 days</td>
<td>63 days</td>
</tr>
<tr>
<td>Queen</td>
<td>17 days</td>
<td>9 days Induced</td>
<td>63 days</td>
</tr>
</tbody>
</table>

### Variation in Cycle Types

<table>
<thead>
<tr>
<th>Example</th>
<th>Type of Cycle</th>
<th>Follicular Development</th>
<th>Ovulation &amp; CL Formation</th>
<th>CL Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cow, ewe, sow, mare</td>
<td>Long</td>
<td>Spontaneous</td>
<td>Spontaneous</td>
<td>Spontaneous</td>
</tr>
<tr>
<td>rats, mice, hamsters</td>
<td>Short (4 days)</td>
<td>Spontaneous</td>
<td>Spontaneous</td>
<td>Induced (prolactin)</td>
</tr>
<tr>
<td>rabbit, cat, mink, ferret, otter, alpaca</td>
<td>Induced</td>
<td>Spontaneous</td>
<td>Induced (LH surge)</td>
<td>Induced</td>
</tr>
</tbody>
</table>

### Diagrams

- **CL**: Corpus Luteum
- **Progesterone**: A hormone produced by the CL
- **Estradiol**: A hormone involved in the estrous cycle
- **PGE2**: Prostaglandin E2, involved in CL regression
- **FSH**: Follicle-stimulating hormone
- **LH**: Luteinizing hormone
- **Proestrus**: Pre-ovulatory phase
- **Diestrus**:Post-ovulatory phase
- **Estrus**: Ovulatory phase
- **Metestrus**: Post-ovulatory phase
- **Cyclic**: CL regression
- **Non-cyclic**: CL maintenance

- **CA**: Corpus Albugineum
- **CL**: Corpus Luteum
- **Ovulation**: Release of the egg from the ovary
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Follicular Phase

Proestrus
- Preovulatory follicle enlarges
- Estrogen increases
- Vascularity of the female reproductive tract increases
- Endometrial glands begin to grow
- Estrogen levels peak

Estrus
- Allows male to mount
- Estrogen decreases
- LH surge occurs
- Ovulation 24-48 hr after surge of LH
- Uterine motility high with contractions moving toward oviduct
- Sperm transport is optimal
- Cervical mucus volume increases
Characteristics of Estrous Cycles

<table>
<thead>
<tr>
<th>Characteristics of Estrous Cycles</th>
<th>Cow</th>
<th>Ewe</th>
<th>Sow</th>
<th>Mare</th>
</tr>
</thead>
<tbody>
<tr>
<td>Estrous cycle (days)</td>
<td>21</td>
<td>17</td>
<td>21</td>
<td>21</td>
</tr>
<tr>
<td>Proestrus (days)</td>
<td>3-4</td>
<td>2-3</td>
<td>3-4</td>
<td>2-3</td>
</tr>
<tr>
<td>Estrus</td>
<td>12-18 hr</td>
<td>24-35 hr</td>
<td>48-72 hr</td>
<td>4-8 days</td>
</tr>
<tr>
<td>Metestrus (days)</td>
<td>3-4</td>
<td>2-3</td>
<td>2-3</td>
<td>2-3</td>
</tr>
<tr>
<td>Diestrus (days)</td>
<td>10-14</td>
<td>10-12</td>
<td>11-13</td>
<td>10-12</td>
</tr>
</tbody>
</table>

Hormonal Changes in the Bitch

- **Anestrus**
- **Proestrus**
- **Estrus**

- LH
- Progesterone
Hormonal Changes in the Queen

Queen in Estrus (no mating)

Estrus (9 days)

Proestrus

Mating

Parturition

Pregnancy

Lactation

Queen in Estrus (no mating)

Estrus

Proestrus

Pregnancy

Lactation

Hormonal Changes in the Queen

Queen in Estrus (no mating)

Estrus (9 days)

Proestrus

Mating

Parturition

Pregnancy

Lactation

Hormonal Changes in the Queen

Queen in Estrus (no mating)

Estrus (9 days)

Proestrus

Mating

Parturition

Pregnancy

Lactation

Hormonal Changes in the Queen

Queen in Estrus (no mating)

Estrus (9 days)

Proestrus

Mating

Parturition

Pregnancy

Lactation

Hormonal Changes in the Queen

Queen in Estrus (no mating)

Estrus (9 days)

Proestrus

Mating

Parturition

Pregnancy

Lactation

Hormonal Changes in the Queen

Queen in Estrus (no mating)

Estrus (9 days)

Proestrus

Mating

Parturition

Pregnancy

Lactation

Hormonal Changes in the Queen

Queen in Estrus (no mating)

Estrus (9 days)

Proestrus

Mating

Parturition

Pregnancy

Lactation

Causes of Anestrus

Pregnancy

Presence of Offspring

Season

Pathology

Nutrition

Stress

Gestational Anestrus
**Gestational Anestrus**

- Progesterone during pregnancy
  - negative feedback
- After parturition anestrus continues
  - progesterone exposure during pregnancy
  - hypothalamus
    - Lacks estradiol positive feedback
- allows time for uterine involution

**Seasonal Anestrus**

Horses are long day breeders!

Sheep are short day breeders!

**Estradiol Negative Feedback**

- Increases
- Decreased Negative Feedback
Seasonal Anestrus

- just like entering puberty
- silent ovulation

Silent Ovulation

Lactational Anestrus

Suckling Effect on LH
Lactational Anestrus
- Suckling
- Other offspring factors
  - visual encounter
  - olfactory encounter
  - auditory encounter
- Prolactin
  - inhibits GnRH release
  - major infertility problem in women who are not lactating

Nutritional Anestrus

Menstrual Cycle

- Follicular Phase
  - FSH, LH, Estradiol
  - Recruitment, Selection, Dominance
  - Follicle, Ovulation, Corpus Luteum
  - 9 days

- Menses
  - FSH, LH, Progesterone
  - Ovary, Uterine Endometrium
  - 5 days

- Menses
  - FSH, LH, Progesterone
  - Ovary, Uterine Endometrium
  - 5 days

- Menses
  - FSH, LH, Progesterone
  - Ovary, Uterine Endometrium
  - 6 days
Menstrual Cycle Length

• AGE
  ➢ Length
    - 15 - 19 year olds ➔ 35 days
    - 30 year olds ➔ 30 days
    - 35 year olds ➔ 28 days
  ➢ Variation
    - More in teenagers
    - Less in women in peak reproductive years

Influence of Lactation on Postpartum Menstrual Cycles (US and UK, 1987)

• Not Lactating
  - 50% cycling by 8 months
  - 90% cycling by 12 months

• Lactating (for 24 months)
  - 30% cycling by 12 months
  - 70% cycling by 24 months

Concept Tutor

Rest are extra slides not used in 2007