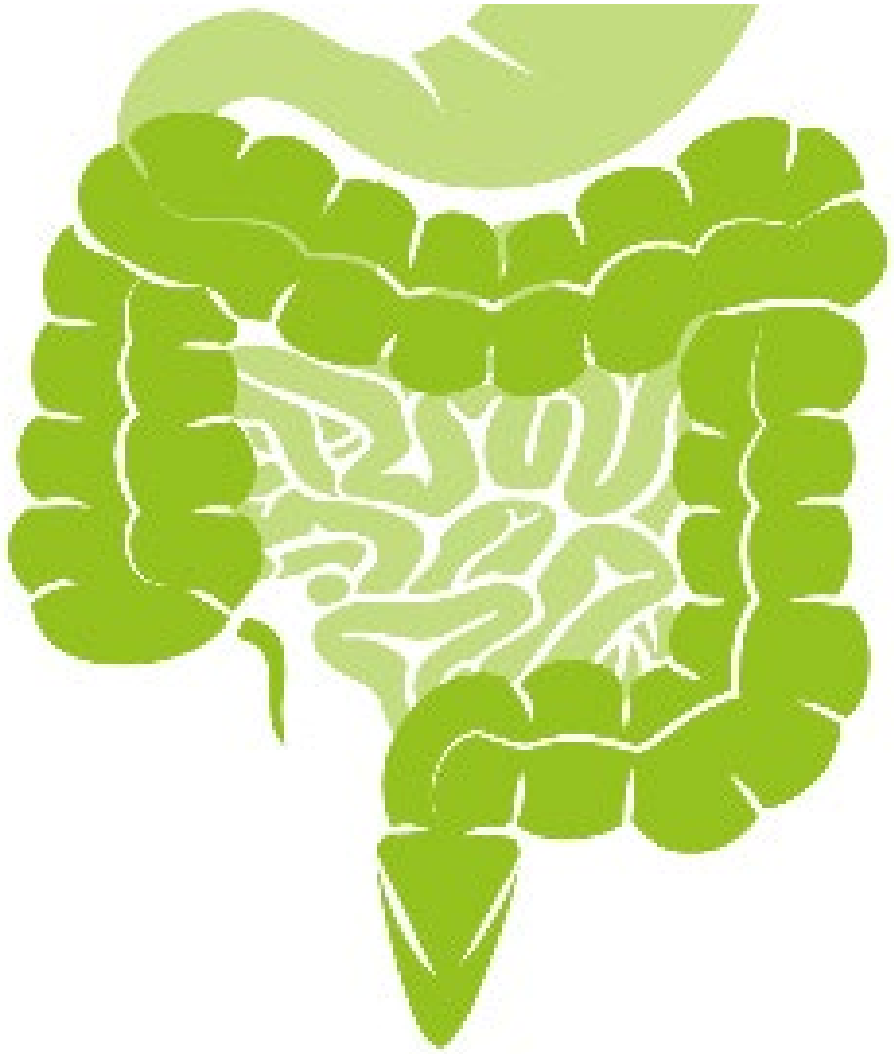
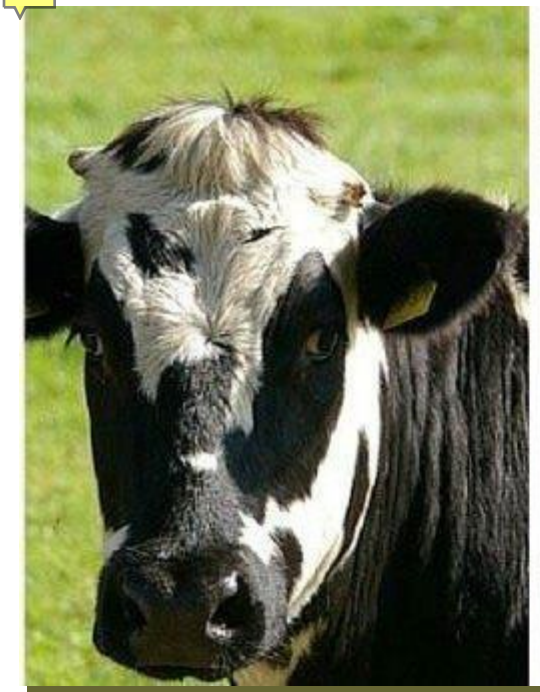


Coccidia Part 2 (intestinal apicomplexans)

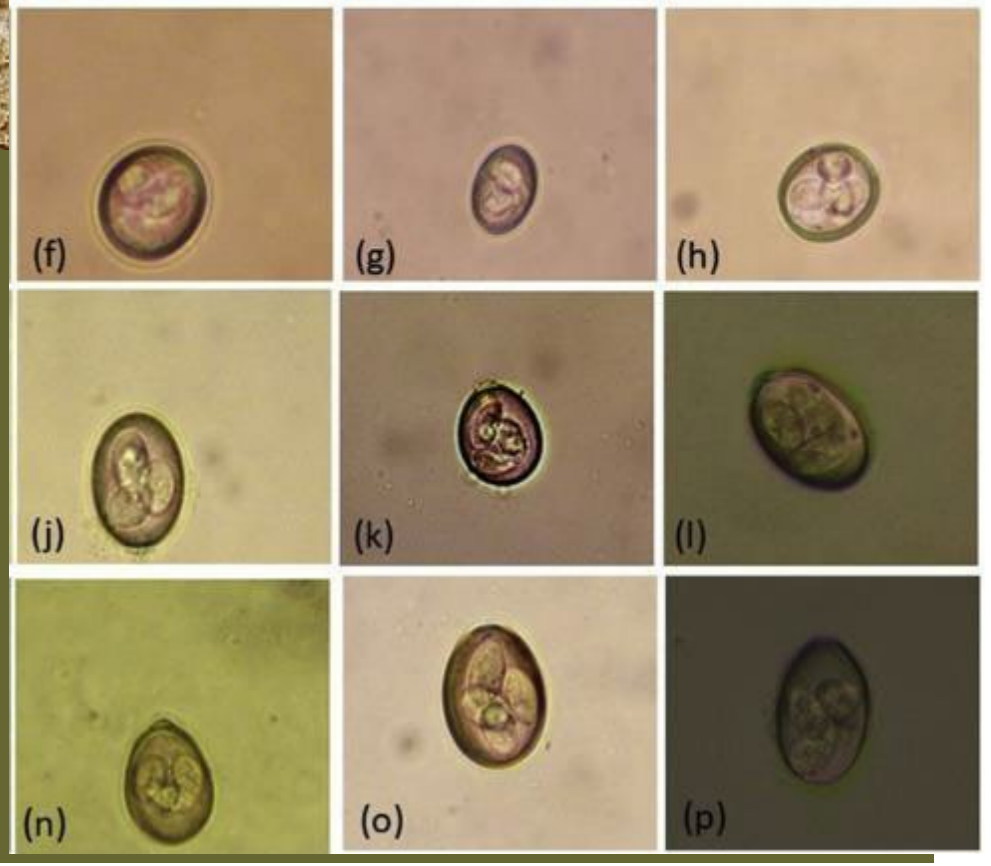
Eimeria spp.

(coccidia of hooved stock and poultry)




Eimeria spp. (Coccidiosis)

- Common coccidia of hooved stock and poultry
- Direct Life Cycle
- Intracellular parasites of enterocytes…**diarrhea!**
- Many *Eimeria spp.* with very high host specificity



Learning Objectives: *Eimeria* spp.

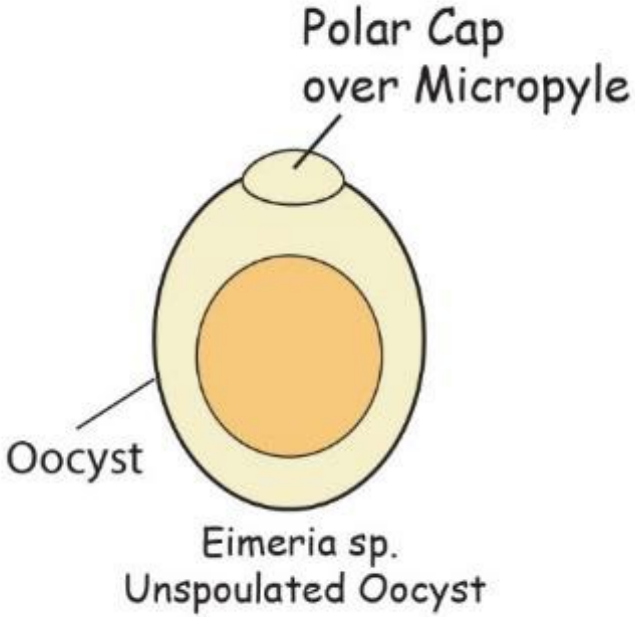
1. Life cycles: understand it uses a Direct Life Cycle
2. Transmission: understand routes of transmission
3. Pathogenesis: understand the specified methods of pathology and factors that affect severity of disease
4. Clinical signs: understand the clinical signs and what you might seen in both an individual animal or in a herd or flock of animals
5. Diagnosis: understand the specified ways to diagnose coccidiosis and that you should rule out other causes of diarrhea even if you identify *Eimeria*.
6. Treatment: understand the main reason you would use anticoccidials and specified warnings
7. Control: know the practices to control *Eimeria*
8. Zoonosis: know *Eimeria* is not zoonotic, its host specificity and risk factors

"FYI" will not be on the test

Eimeria Morphology

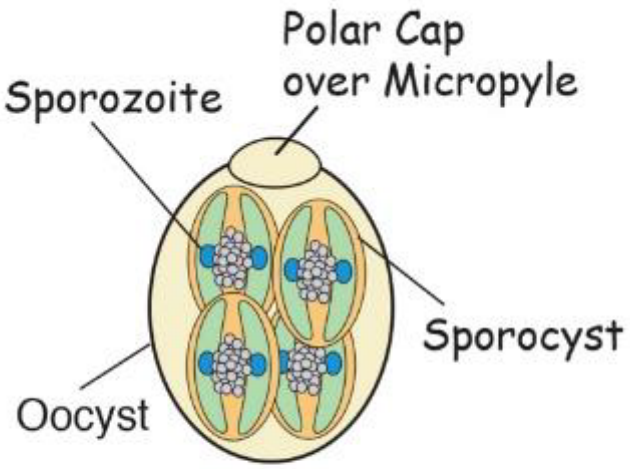
Which one of these oocyst is infective?

Unsporulated



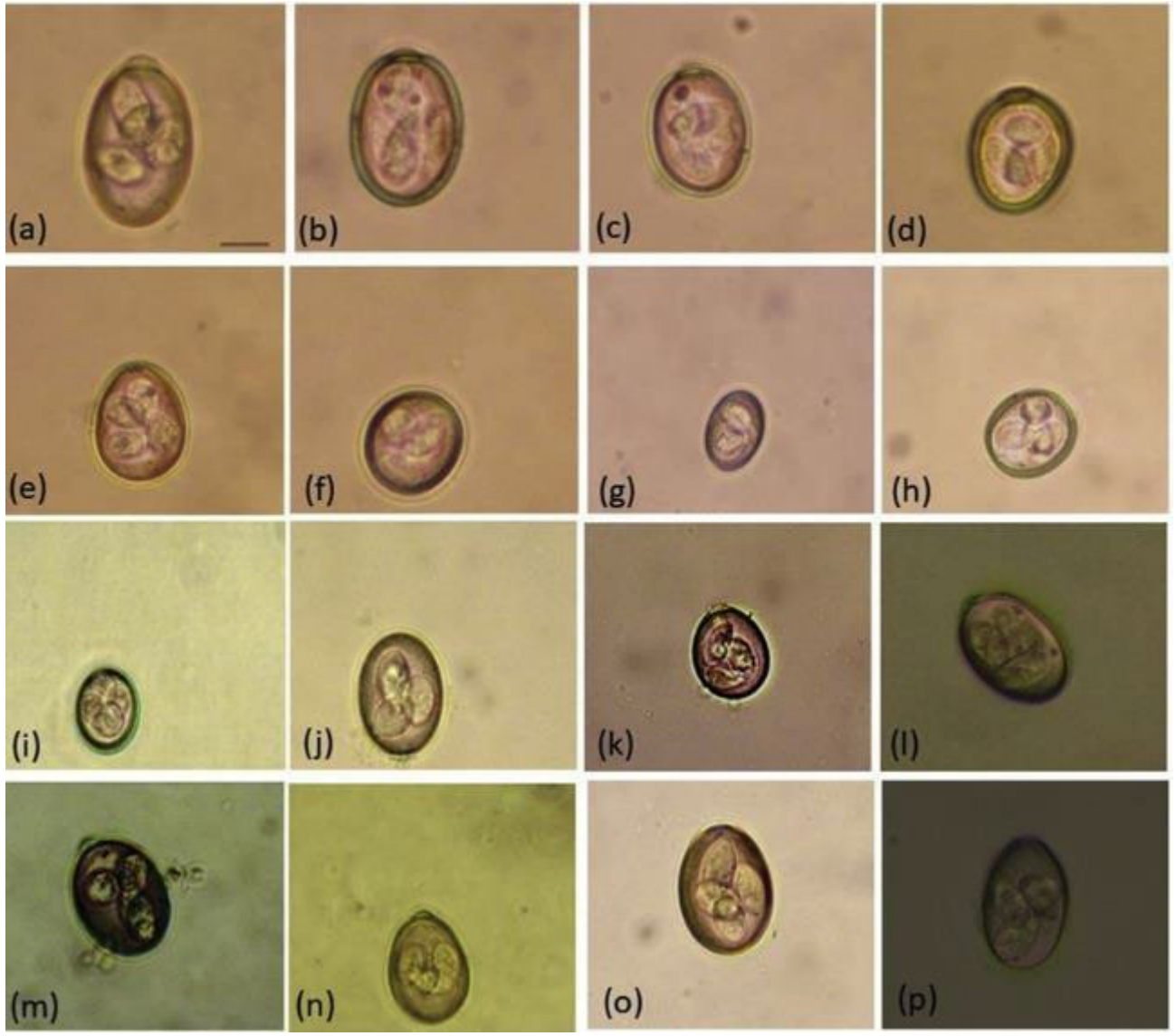
Eimeria sp.
Unspoulated Oocyst

Sporulated



Eimeria sp.
Sporulated Oocyst
with 2 Sporozoites in
each of 4 Sporocysts

Eimeria Morphology



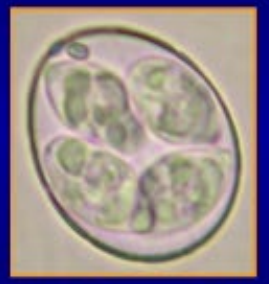
Oocyst Species-specific

de Macedo, Lucia Oliveira, et al. "Morphological and epidemiological data on Eimeria species infecting small ruminants in Brazil." *Small Ruminant Research* 171 (2019): 37-41.

Oocyst morphology

Eimeria of domestic fowl

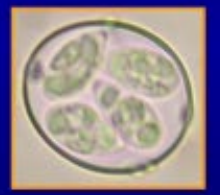
E. maxima



E. brunetti

E. tenella

E. praecox



E. necatrix

E. acervulina

E. mitis

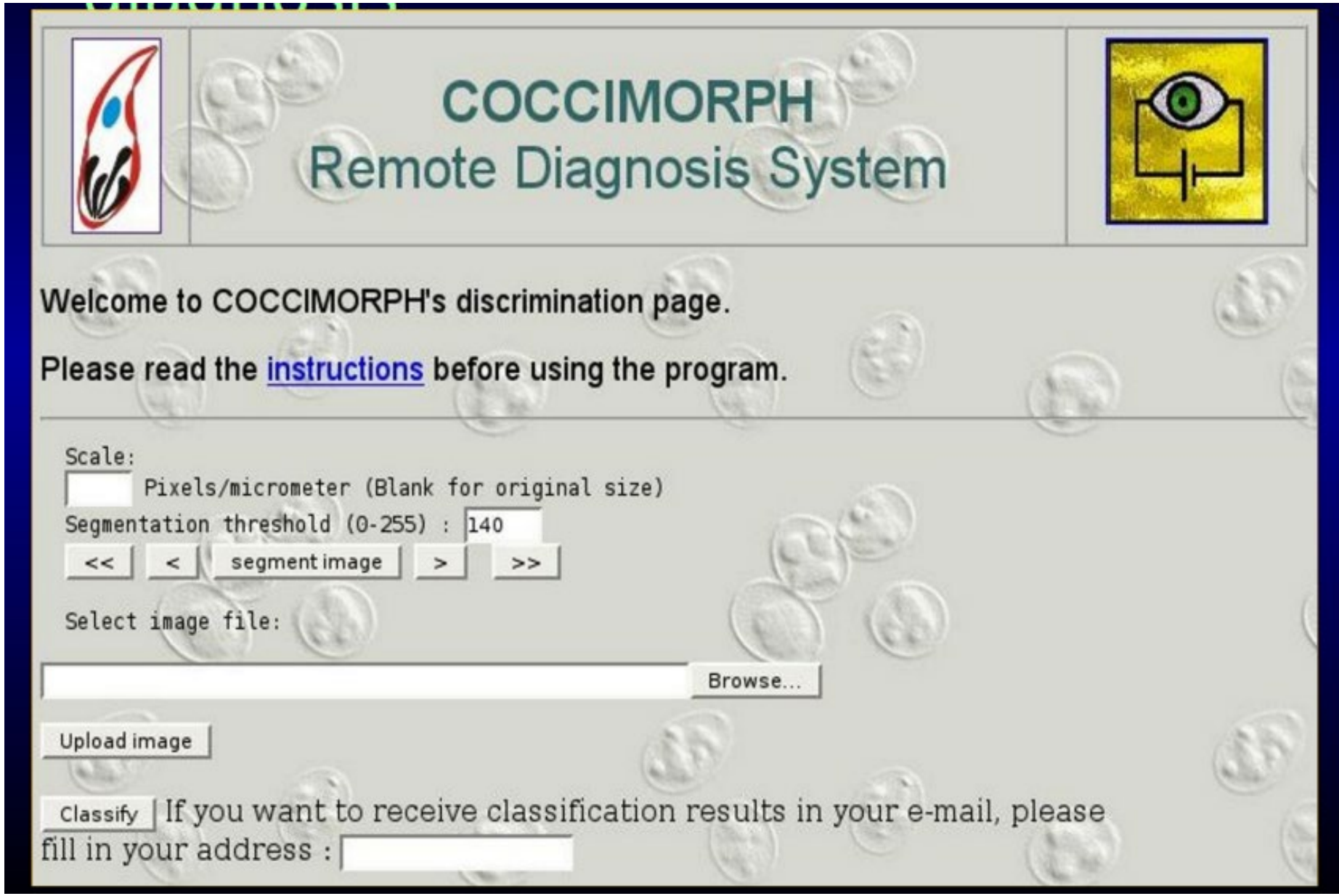
FYI

AG-ICB-USP

FYI

COCCIMORPH is a collaborative research work developed by the Laboratory of Molecular Biology of Coccidia at the Departament of Parasitology of the Institute of Biomedical Sciences in São Paulo, and the Cybernetic Vision Research Group, at the Institute of Physics in São Carlos, University of São Paulo.

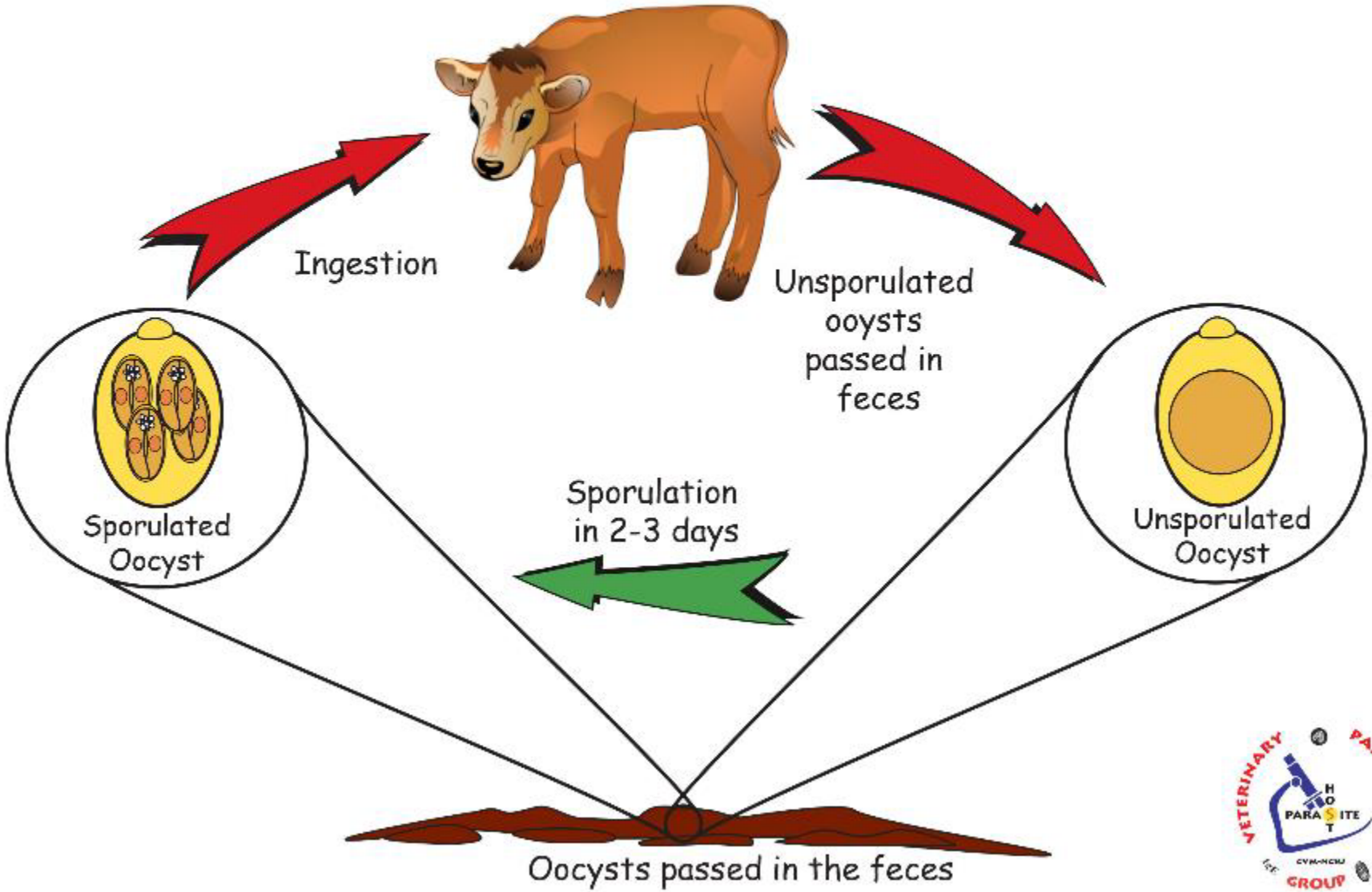
For fowl and rabbits



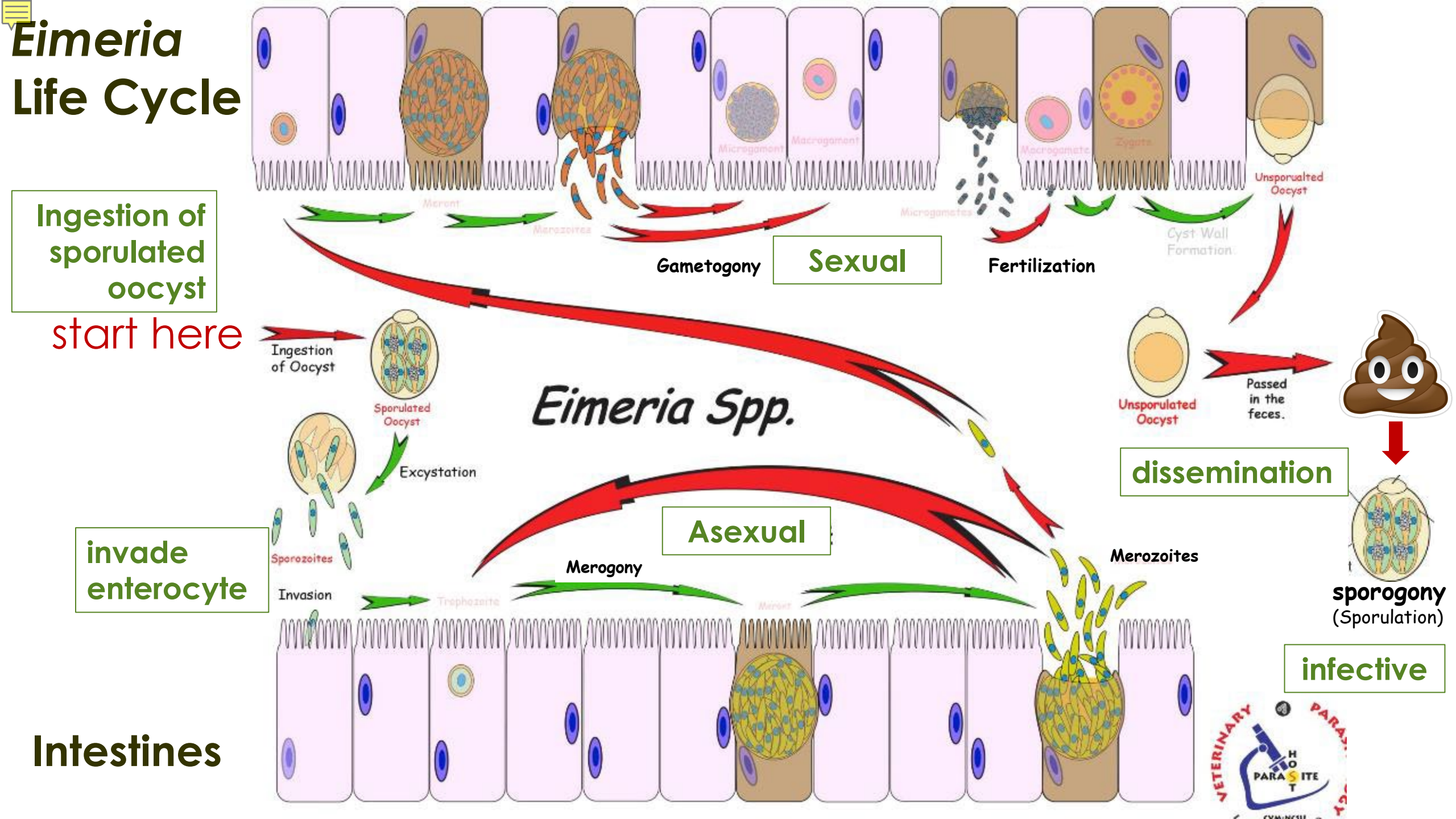
NC STATE UNIVERSITY

Direct Life Cycle

Coccidia *(Eimeria bovis)*



Eimeria Life Cycle

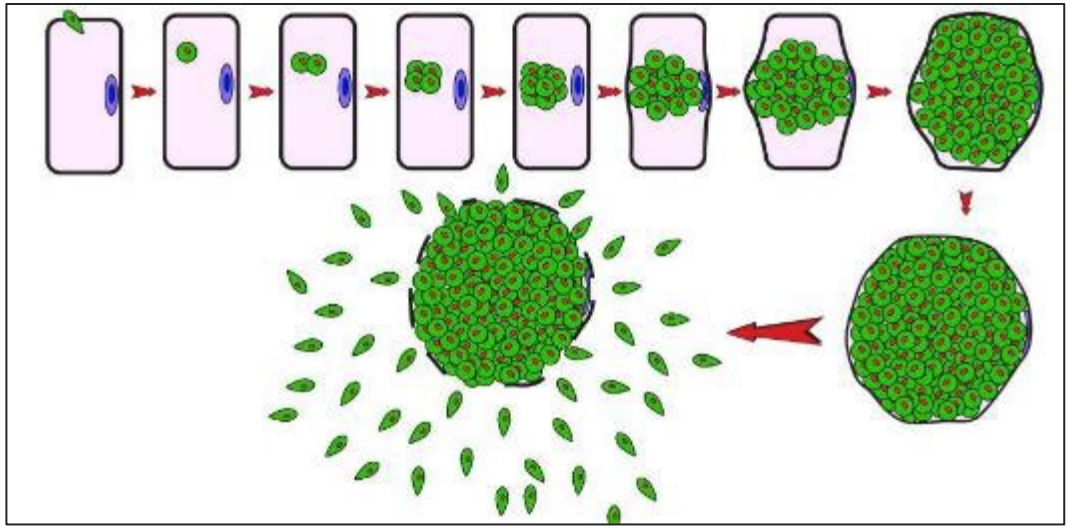


Eimeria Life Cycle (cont)

- **Sporogony** (= Sporulation)
  - **Sporogony occurs in the environment.**
    - Appropriate temperature, moisture, and oxygen required
    - Some species can take as little as 1 day to sporulate in optimal conditions
  - **After sporulation, the oocyst is infective and ready for transmission to the next host**.

Eimeria Pathogenesis

Direct destruction of enterocytes with each asexual (merogonic) cycle.



Destruction of epithelial lining causes:

- Hemorrhagic ulcers = may produce **blood** (hemorrhagic enteritis)
- ↓ absorption (no enterocytes!) = malabsorption
- Traumatic permeability = loss of fluids and blood into the gut lumen
- Inflammation = ↑ permeability and ↑ secretion = fluid loss

Degree of pathogenicity varies; depends on many factors:

Eimeria spp., dose of pathogen, host health status (young animals more susceptible), immunological competence

Eimeria Clinical Disease

Mild to severe diarrhea

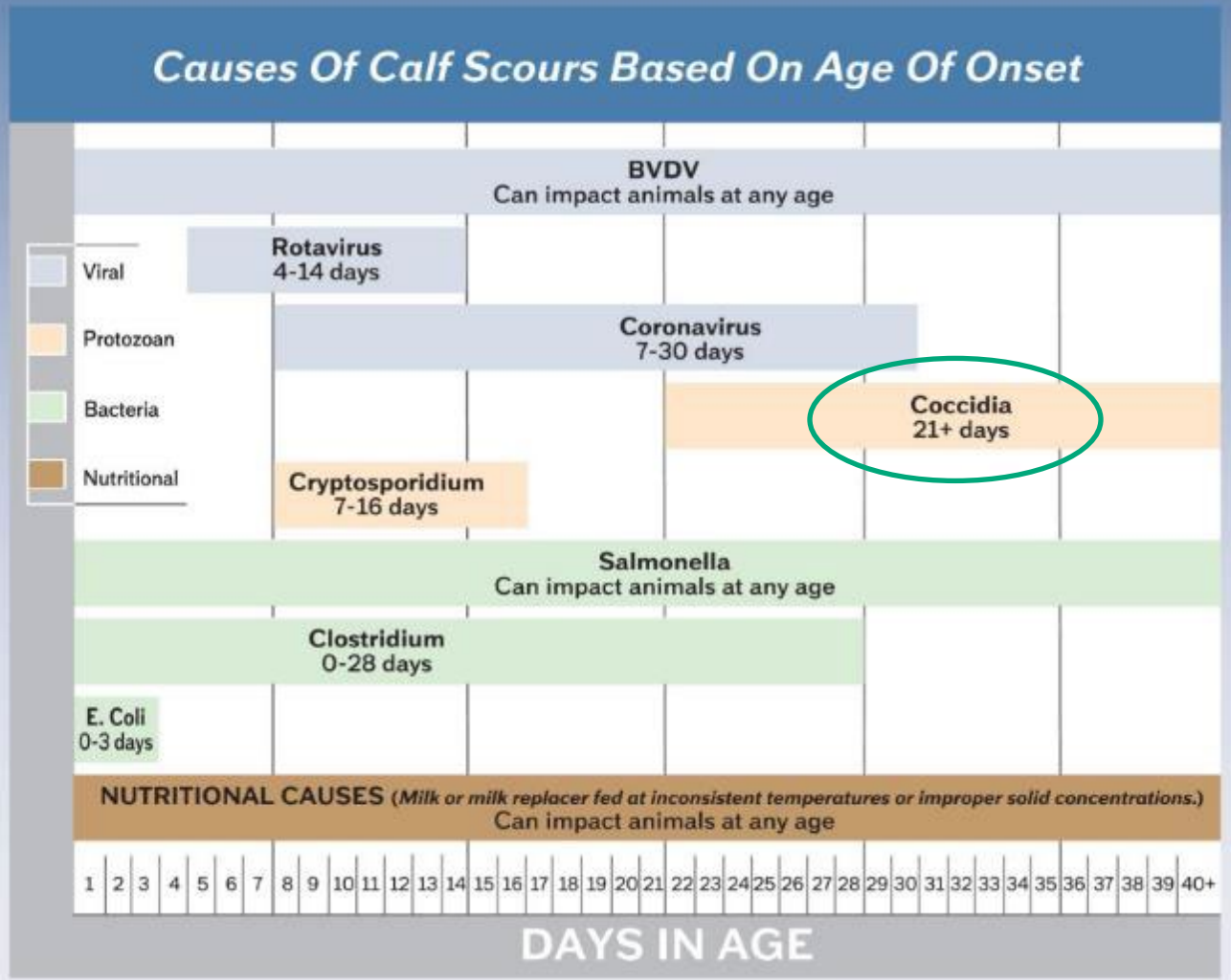
- bloody, mucoid, or watery
- most often reported in young or naïve animals.

www.vetent.co.nz/dairy-disease-management/coccidiosis.html

Differential Diagnoses
"Calf Scours"

***Cryptosporidium* 7-16 days**
Coccidia (e.g. *Eimeria*) 21+ days
Rotavirus
Coronavirus
Bovine viral diarrhea virus (BVDV)
Salmonella
Clostridium
E.coli
Nutritional causes

FYI: this chart



GOALS WHEN TREATING SCOURS

1. Maintain caloric intake. Keep the calf on its normal feeding schedule.
2. Restore hydration status.
3. Stabilize the intestinal tract.

http://crystalcreeknatural.com/causes-of-calf-scours-based-on-age-of-onset/

Eimeria Clinical Disease

Coccidiosis clinical disease is primarily a herd disease

- **Individual animal** –different manifestations
  - **Non-clinical, but large numbers of oocysts in feces**
  - **Acute, severe, fatal, bloody diarrhea**
    - oocyst may not be in feces if prior to patency (patency = time oocysts are shed)
  - **Disease caused by**
    1) An overwhelming dose of oocysts OR
    2) a moderate dose + stress (immunocompromised)
- **Herd or flock**
  - **Regularly recurring diarrhea issues with each successive cohort of young animals**

Eimeria Diagnosis

- **Fecal Float Centrifugation**
  - If no oocysts present may be prior to patency
  - Multiple fecal samples over several days ↑ SE

- **There are a lot of nonpathogenic *Eimeria* sp. so… diarrhea + oocysts doesn't always = coccidiosis disease**
  - Consider clinical signs (blood?), which *Eimeria* sp.
  - *Eimeria* sp. identification important (let sporulate to help ID)

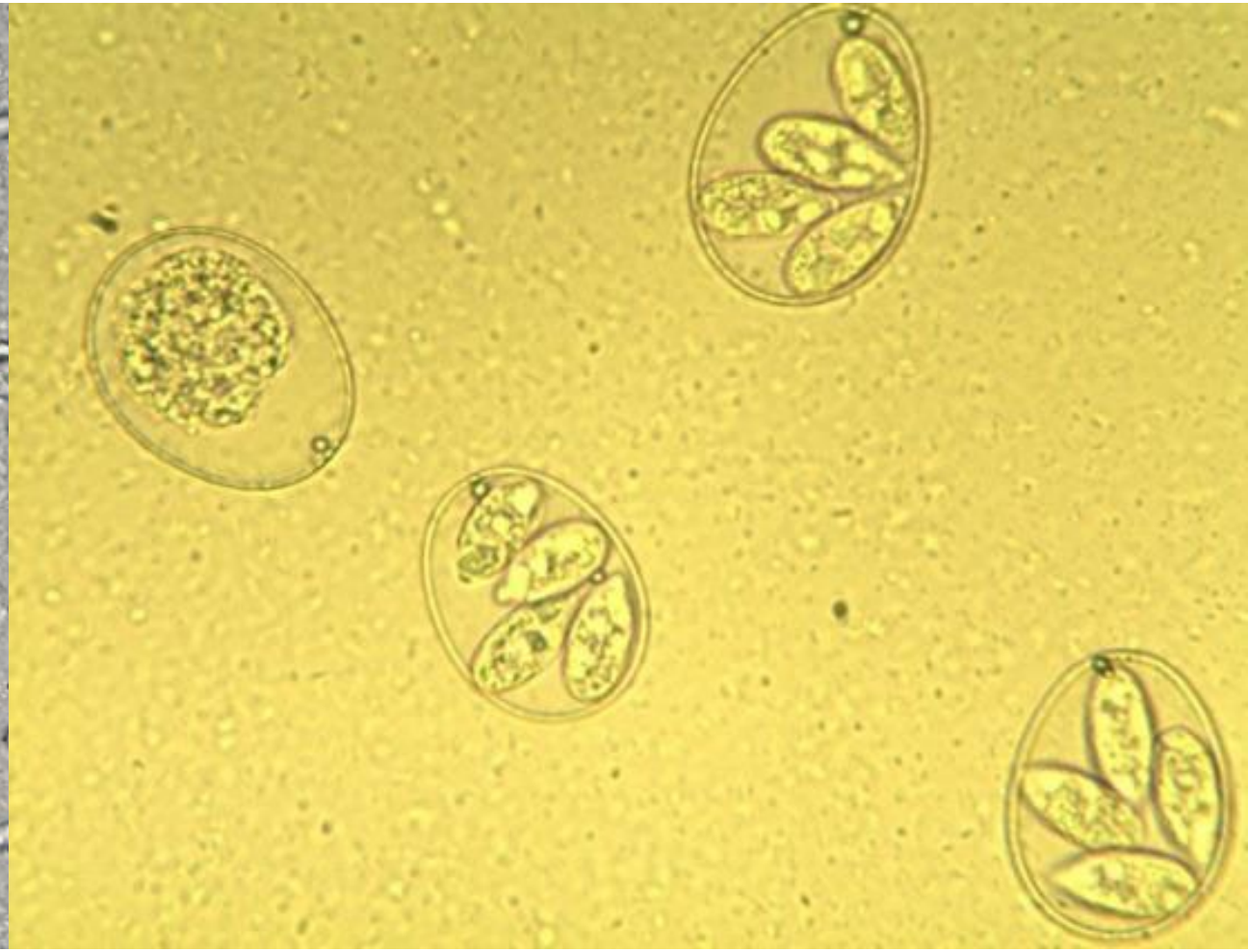
Why not just treat any Eimeria infection?

- Regular episodes of diarrhea in successive groups of animals?
- Molecular techniques (yes, but practical for routine use?)

Eimeria Oocysts on Fecal

Unsporulated

Sporulated



Eimeria Treatment

Anticoccidial Drugs, Supportive care

- Ionophores (Monensin, Lasalocid, etc.) – coccidiocidal **(Toxic to Horses)**
- Sulfonamides (Sulfadimethoxine, Sulfadiazine, etc) – coccidiostat

- Treatment is mainly effective against reinfection and facilitates recovery.

- **Isolate animals showing disease** for treatment & therapy
- **Give supportive fluid-therapy for symptoms (most important!)**
- **Treat prophylactically for control – medicated feed or water with coccidiostats for entire herd**

Eimeria Control

Protect young and naïve animals (sanitation/monitoring)

- **Dry environment** (direct sunlight / dryness = best disinfectants).
- **Separate age groups** or hutches
- **Prevent fecal contamination** (raise the food, water, decon. boots and trucks between farms)

- **Reduce stresses** (weaning, sudden food changes, shipping)
- **Prophylactic coccidiostats or -cidals**

Eimeria Control-Anticoccidials

- Coccidiostats or coccidiocidals act to limit the number of successful coccidial organisms, especially in young hosts

- Inhibit most entering organisms, but not all
  - **Development of immunity without disease "natural vaccine"**

- Extremely important in systems of intensive and / or confinement rearing of poultry, ruminants, swine.

Goal: limit infections in newly exposed host to allow immunity to develop, without clinical disease

Eimeria Control-Anticoccidial (cont.)

- **Use as prophylaxis** (specific names FYI)
  - Decoquinate (Deccox),
  - Monensin (Rumensin)- coccidiocidal
  - Lasalocid (Bovatec)-coccidiocidal
  - Amprolium (Corid),

- Rotate coccidiostats to slow the development of resistance to a single coccidiostat

- **WARNING -- some anticoccidials are highly toxic to horses** (IONOPHORES like Monensin, Lasalocid (Bovatec), ETC.)

WARNING Horses, accidental exposure 2018

FDA Issues Warning After Six Horses Die From Monensin Poisoning In Minnesota

by Paulick Report Staff | 07.30.2018 | 1:02pm

The FDA inspection of the facility found that cattle feed containing monensin was mixed on the same day as the special mix equine feed purchased by the horse owner, and that the ***machinery was not adequately cleaned*** *out to remove the monensin before mixing the horse feed.*

Eimeria Control Summary

(coordinated control strategy)

PREVENTION

- **Coccidiostats**
- **Sanitation**
- **Good Nutrition/Low stress (especially young/naïve)**
- **Don't mix age groups**

MITIGATE DAMAGE (At first sign of disease)

- **Separate sick animals (reduce exposing others)**
- **Supportive care**
- **Begin treatment of whole herd / flock.**

Eimeria Control Poultry Vaccines

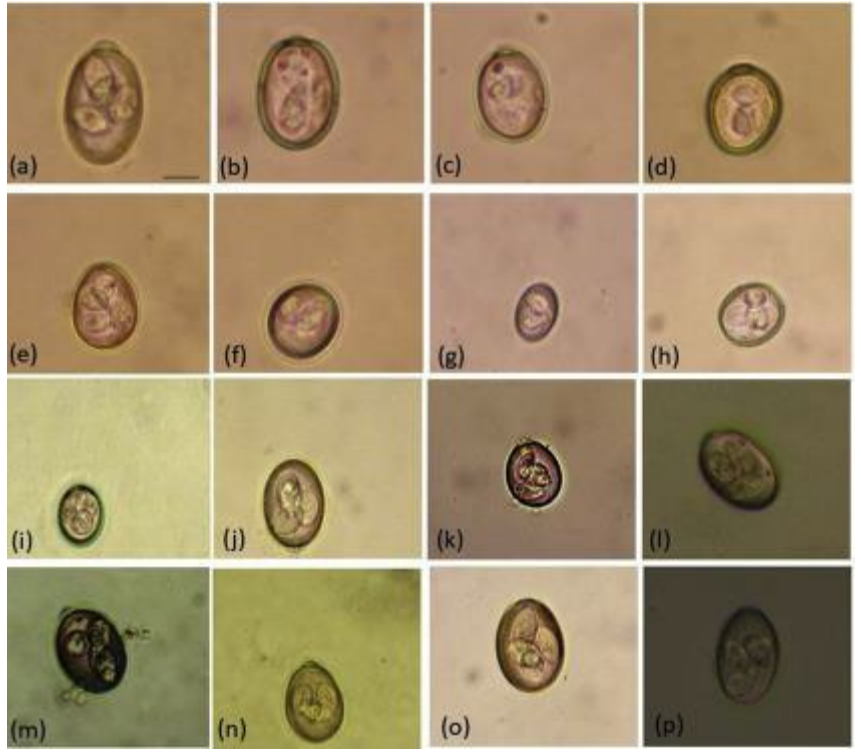
- **Vaccines**
  - Used in Poultry coccidiosis
  - FYI: Oocyst cocktails, irradiated, mutated
    - ex. Inovocox vaccine

Eimeria Epidemiology

- Ubiquitous

- Each host species may have many *Eimeria* species, but few are pathogenic

- **Very host specific**
  - no cross-species infection or zoonosis



Eimeria Epidemiology

Host Risk Factors

- **Immunodeficient: young, stressed, poor nutrition**
- **Immunologically naïve: young, new import**.

Immunity is coccidian-species specific.

- Ex. *E. bovis* infection does not confer protection against *E. zuernii*

Immunological experience provides incomplete or complete protection

- *Incomplete = reinfection usually leads to asymptomatic shedding of oocyst.*

Eimeria Epidemiology

Environmental risk factors

- **Moist, warm to cool** (60s-70s)habitats promote sporulation of oocysts
  - Spring, Fall -- higher risks
- **Crowded conditions**
  - Increases stress → decrease immune-competence
  - Environ. can quickly become highly contaminated with oocysts

pathology proportional to infecting dose

We will discuss specific pathogenic *Emeria* spp. and their hosts.

Bovine Coccidiosis

- ***Eimeria zuernii, E. bovis***

- Once oocysts appear in feces, it is too late *(to stop infection)*

- Chronic or subclinical
  - **Unthrifty, some scours w/ watery diarrhea, +/- blood**

- Severe coccidiosis (more systemic signs)
  - **Thin, bloody diarrhea, fever, anorexia, depression, dehydration, weight loss.**

Bovine Coccidiosis

http://www.farmersjournal.ie/coccidiosis-common-cause-of-blood-scour-167382

http://www.nadis.org.uk/bulletins/coccidiosis-in-cattle.aspx

Sheep & Goat Coccidiosis

- **Sheep** -- *Eimeria ovinoidalis*
  - **Associated with stress**
- **Goats** -- *Eimeria arloingi, E. ninakohlyakimovae*
  - **More susceptible to coccidiosis**

- **Diarrhea**
- **Dehydration**, weakness, anorexia, weight loss, death
- **Secondary concerns**: Fly Strike & Bacterial enteritis
- **Lambs & Kids: 1-6 months** old most vulnerable

Sheep Coccidiosis

http://www.nadis.org.uk/bulletins/coccidosis-in-lambs.aspx

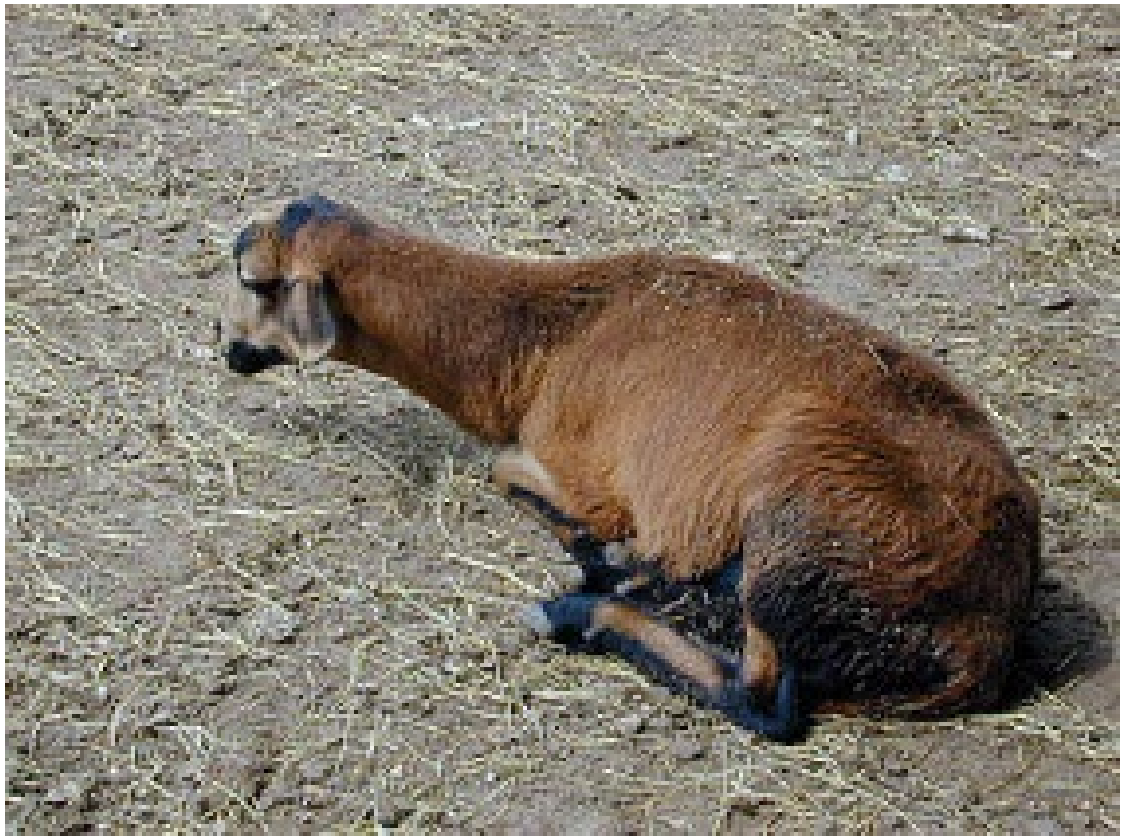
Coccidia assisted Fly-Strike

http://hartslock.org.uk/blog/?page_id=103

https://seedstockcentral.com.au/2016/03/31/sheep-producers-urged-to-monitor-flocks-for-fly-strike/

https://teara.govt.nz/en/photograph/17443/fly-strike

Goat Coccidiosis

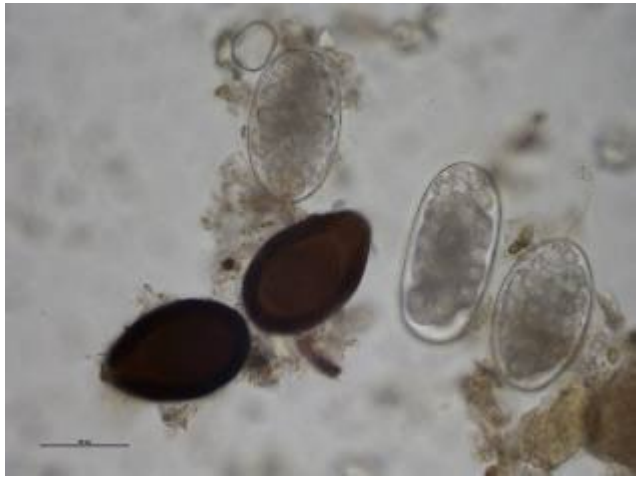


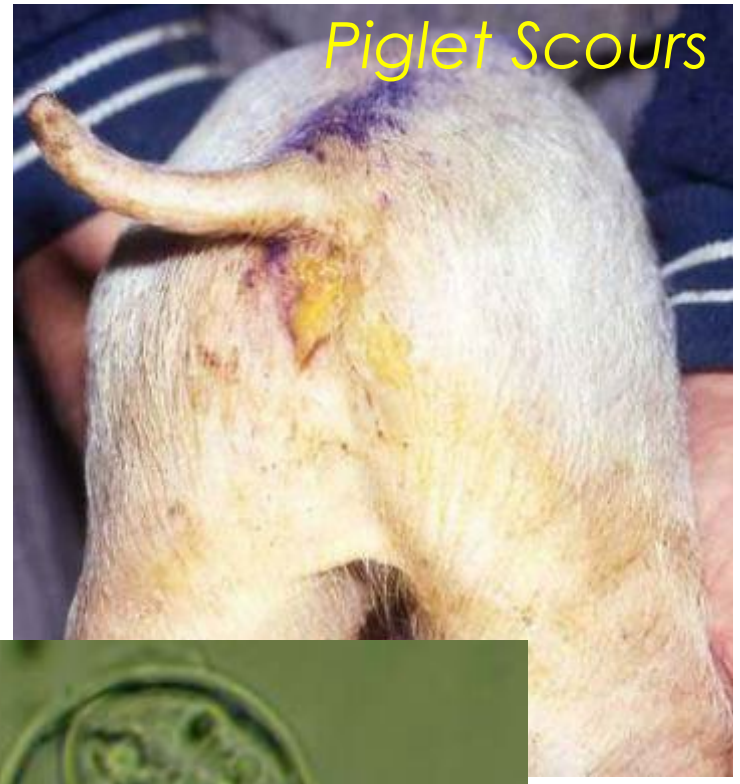
https://www.sheepandgoat.com/coccidiosis

Swine & Horse Coccidiosis

(low pathogenicity)

- **Swine**
  - 8 *Eimeria spp.* but low pathogenicity
  - (*Cystoisospora suis* is more important)
- Horse
  - *Eimeria leuckarti*
    - non-pathogenic





Teaser for NEXT Lecture!!

Poultry Coccidiosis

- **Poultry**
  - Massive destruction of epithelial cells - **hemorrhage, malabsorption**.
    - often prior to patency (before shedding oocyst)
    - **young birds at greatest risk**
  - Can be self-limiting or high mortality
    - What are two factors that may influence the severity of disease?
  - Huge economic loss –poor weight, reduced egg production

Chickens -- *E. tenella* (<4wk old), *E. necatrix* (>6wk old), *E. acervulina*, *E. maxima*, *E. mivati,* and *E. brunetti*.
Turkeys -- *E. adenoides, E. meleagrimitis*

Quiroz-Castañeda, Rosa Estela. "Avian Coccidiosis, New Strategies of Treatment." *Farm Animals Diseases, Recent Omic Trends and New Strategies of Treatment* (2018): 119.

Poultry Coccidiosis

Clinical Signs

- +/- high mortality
- **+/- bloody feces**
- **Pale combs**
- Ruffled feathers
- Lack of appetite
- Coagulated blood in ceca on necropsy and other intestinal lesions
  - vary based on *Eimeria* sp.

https://www.chickenheavenonearth.com/cecal-coccidiosis-signs-symptoms--treatments-chicken-health-chicken-heaven-on-earth.html

http://www.bhwt.org.uk/information/coccidiosis-in-chickens/

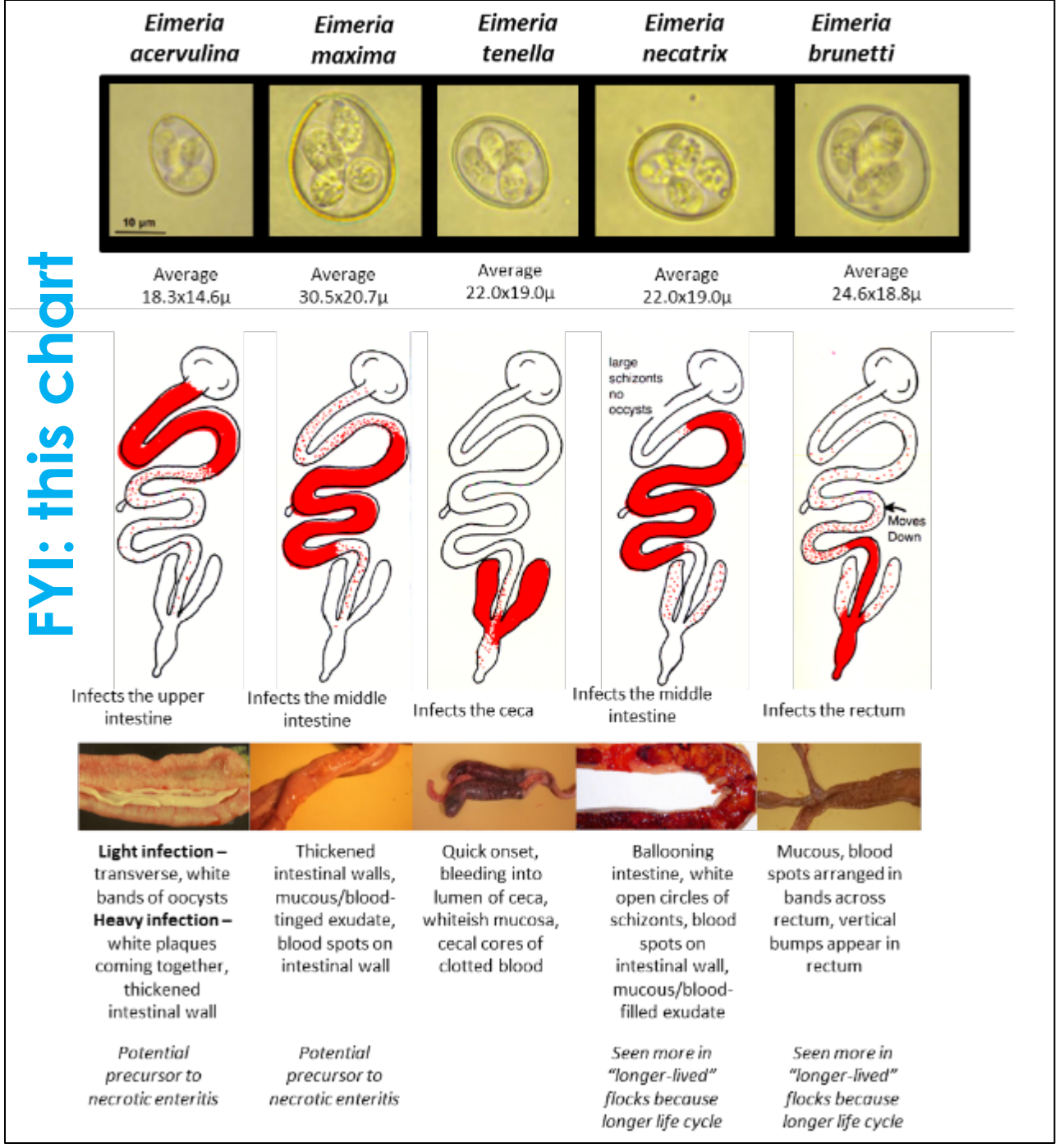
Poultry Coccidiosis

Different *Eimeria* spp. infect different regions of GIT

Eimeria tenella infects the ceca

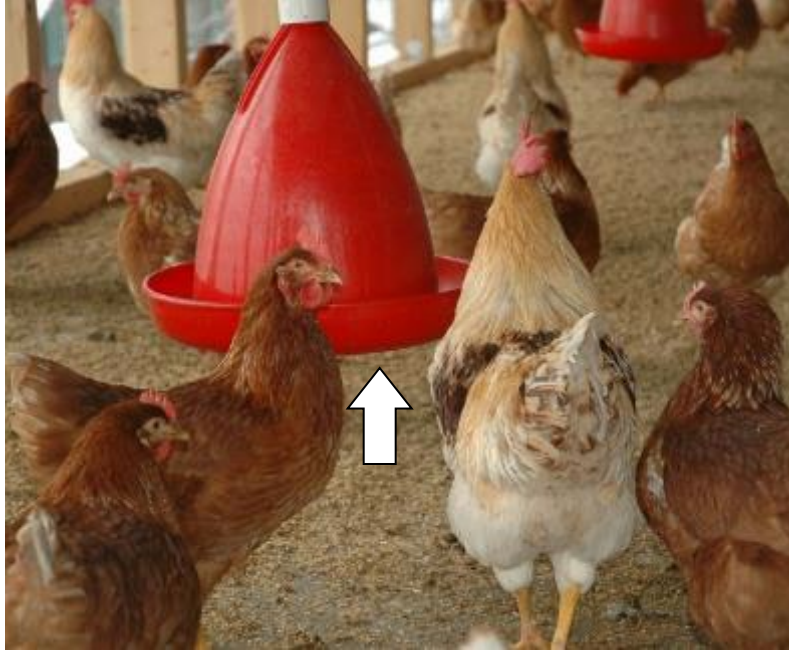
https://fieldcasestudy.com/2017/05/01/coccidiosis/

FYI: this chart



http://www.uoguelph.ca/omafra_partnership/ktt/en/johnbarta/Monitoring-for-success---Lesion-Scoring.asp

Cocciosis Management in Poultry



Farm management

-raised floor, dry surroundings, direct sunlight, raised water and food

-sanitation can be difficult (resistant to chemicals)

- thin liter (deep liter system promotes oocyst sporulation)

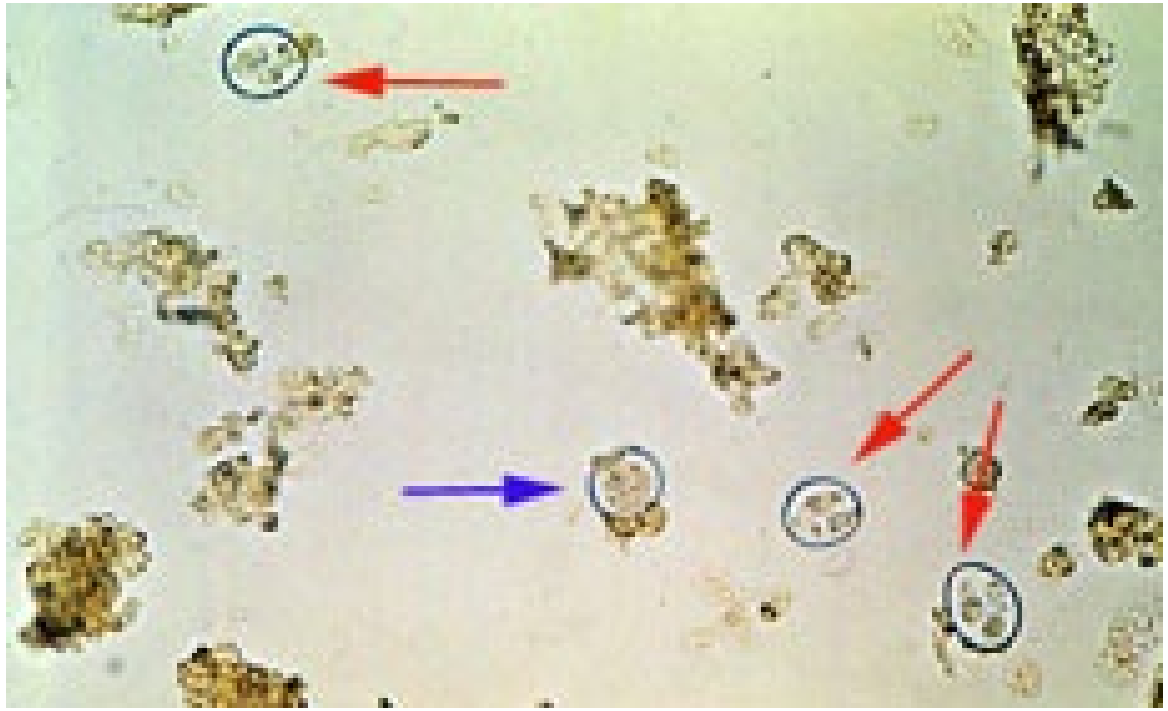
- keep young birds separate

Use of **coccidiostats** (rotation of drugs b/c of resistance issues) or **vaccines**.

If one chicken is sick, treat the flock

Diagnosing Poultry Coccidiosis

- Speciate by location of intestinal lesions, size of oocyst
- GI mucosa smear to identify schizonts
- Fecal Floatation to identify oocysts
- PCR



http://cal.vet.upenn.edu/projects/parasit06/website/lab2.htm

E. tenella oocysts from chicken feces: blue arrow = unsporulated; red arrows = sporulated

Eimeria Take Home Points

1. Direct Life Cycle, fecal-oral transmission
2. Direct destruction of the enterocytes causes diarrhea
3. Primarily disease of young (21+ days old), immunocompromised animals
4. On a fecal oocysts with 4 sporocyst, +/- a polar cap
5. Herd disease (if one infected, all infected)
6. Treat the dehydration
7. Prevention is key!
8. Very host specific (not zoonotic)

Have Questions?

baquroll@ncsu.edu

Illustration by Allie Brosh, http://hyperboleandahalf.blogspot.com/