BIOL 3340 Ecology Study Guide for Exam 2: Lecture 12: Parasitism

Source: the lecture slides (text, figures and slide notes). No textbook.
Each heading is one Study Lab objective. [L13 s08] = Lecture 13, slide 8.
(teal italics) = plain meaning of the word before it. ⚠ **Do not mix up = a look-alike pair to keep apart.** **Amber dotted words** = names printed on the figure beside them.

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Click a line to jump to it. The PDF side panel (bookmarks) has the same parts.

L12.1 Parasitism vs predation and other interactions

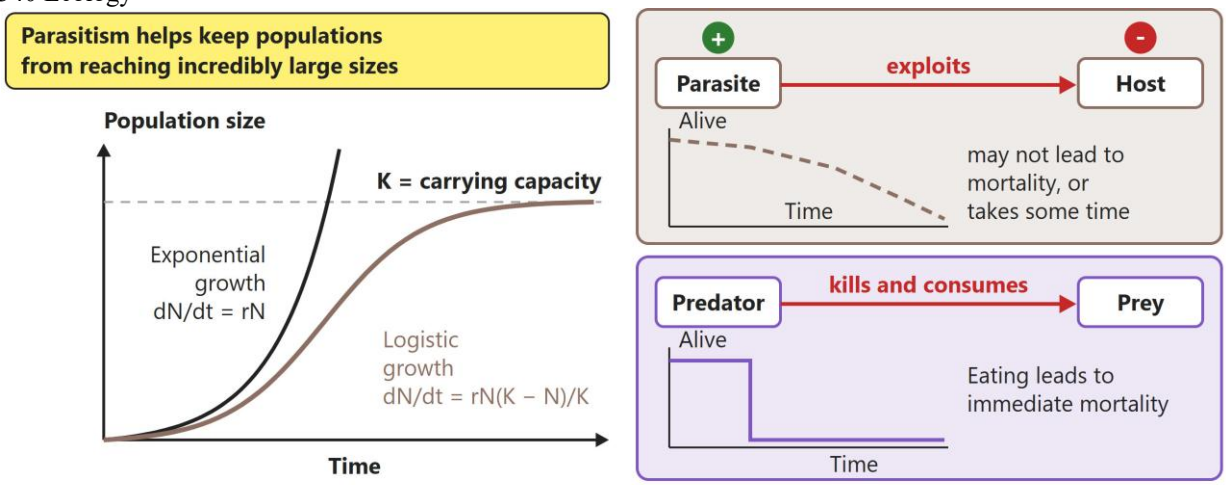
⚠ **Do not mix up: Parasitism is NOT predation: parasites exploit hosts, while predators kill and eat prey.** [L12 s10]

Community ecology *(study of many species living together)* covers multiple species interactions. [L12 s05]
Community: what factors influence the number of species in an area? [L12 s05]
Community: the assemblage *(group)* of many populations living in the same place at the same time. [L12 s06]



Levels of ecological organization from individuals up to the biosphere [L12 s05]
On the figure: Individuals · Population · Interaction · Community · Ecosystem · Landscape · Region · Biosphere

Level order: **individuals**, **population**, **interaction**, **community**, **ecosystem**, **landscape**, **region**, **biosphere**. [L12 s05, L12 s06]
Parasitism (+/-): the **parasite** gets nourishment from its **host**, which is harmed in the process. [L12 s08]
All pathogens *(disease-causing organisms)* fall into the parasitism category. [L12 s08]
Parasitism is one of the things that can prevent populations from reaching incredibly large sizes. [L12 s09]



Exponential and logistic growth, parasite exploiting a host, predator killing prey [L12 s09]

On the figure: Exponential growth · Logistic growth · parasite · host · predator · exploits

Exponential growth: dN/dt = rN. [L12 s09]
Logistic growth: dN/dt = rN(K - N)/K; it levels off at K. [L12 s09]
Parasitism: the **parasite exploits** the **host**, which is affected adversely. [L12 s10]
Predation: the **predator** kills and consumes the host. [L12 s10]
Predation leads to immediate mortality. [L12 s10]
Parasitism may not lead to mortality, or at least takes some time for mortality to occur. [L12 s10]
Microparasite examples are bacteria and viruses. [L12 s11]
Macroparasite examples are multicellular eukaryotes *(many-celled organisms with a nucleus)*. [L12 s11]
Parasitoid examples are often larva developing inside hosts. [L12 s11]
The table title says body size, growth rate, and host fatality **increase** from microparasite through predator. [L12 s11]
Careful: cells do not rise evenly; macroparasite fatality (usually mild) is below microparasite. [L12 s11]

Parasite to predator continuum

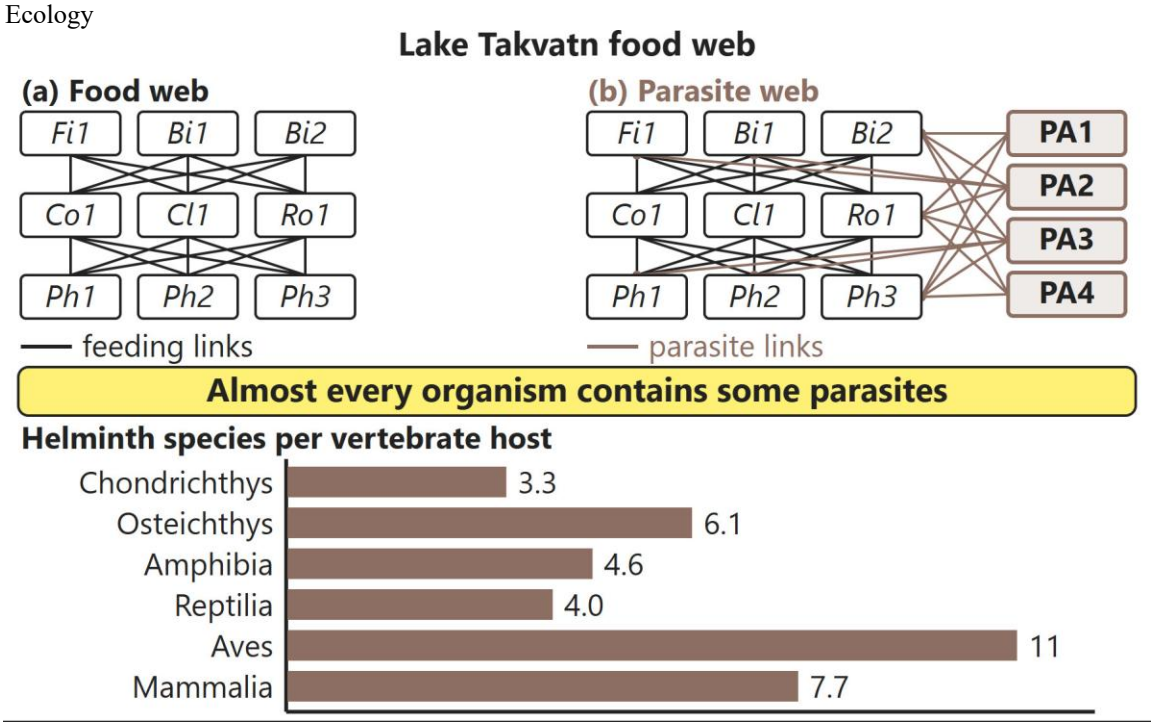
Trait	Microparasite	Macroparasite	Parasitoid	Predator
Body size	Microscopic	Smaller than host	Similar in size (wasp and moth)	Often larger than prey unless social hunter
Intrinsic rate of population growth	Rapid	Faster than hosts	Comparable to host	Comparable to but often slightly slower than that of prey
Number per host	One host usually supports populations of several different species	One host supports a few to many individuals of different species	One host usually supports one, but can support many	Each predator eats many prey individuals
Fatality to host	Mild to severe	Usually mild	Eventually fatal	Immediately fatal
Stability of the interaction with the host	Intermediate	High	Intermediate	Usually low
Ability to regulate host population	Moderate to high	Low	Moderate to high	High

Table source: [L12 s11]

L12.2 How common parasitism is

⚠ **Do not mix up: Parasitism is NOT a rare oddity: it is VERY common and includes pathogens.** [L12 s12]

Parasitism is VERY common, and this includes **pathogens** *(disease-causing organisms)*. [L12 s12]
Almost every organism contains some parasites. [L12 s12]
Most species are parasitized by many different species. [L12 s12]
Parasitism is often overlooked because of modern medicine and animal husbandry *(livestock care)* practices. [L12 s12]
Parasitism still takes a toll on humans and agriculture. [L12 s12]
Disease ecology *(study of disease in nature)* is a large and growing subfield within ecology. [L12 s12]



Lake food web without and with parasite links, and helminth species per vertebrate host [L12 s13]

On the figure: Lake Takvatn · Parasite web · Helminth · Chondrichthys · Aves

> **Parasite web**: a food web that includes the parasite links. [L12 s02]
>
> **Lake Takvatn pelagic food web** *(open-water food web of a lake)*: studied without, then with, parasite-related links. [L12 s03, L12 s13]
>
> Adding the parasite links makes the food web much denser. [L12 s03, L12 s13]
>
> **Helminth** *(parasitic worm)* species per vertebrate host differ by host group. [L12 s15]
>
> Birds (**Aves**) have the most helminth species per host; mammals are second. [L12 s15]
>
> **Chondrichthys** has the fewest helminth species per host. [L12 s15]

L12.3 Microparasites

⚠ Do not mix up: Rinderpest spread from cattle to many grazers, but zebra were NOT affected. [L12 s18]

Rinderpest virus: about **80%** mortality in cattle across Africa, late **1800**s. [L12 s18]

The virus spread from cattle to **buffalo**, **wildebeest**, giraffe, warthog, and other grazers. [L12 s18]

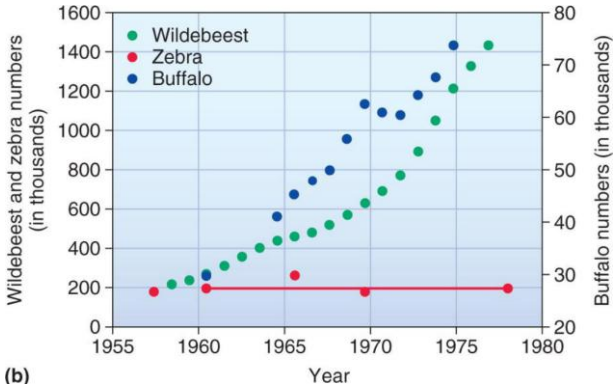
Cattle were vaccinated, and buffalo and wildebeest populations rebounded. [L12 s18]

Zebra was not affected by rinderpest. [L12 s18]

Plants are also attacked by viruses and bacteria, but fungal infections can be especially common. [L12 s19]

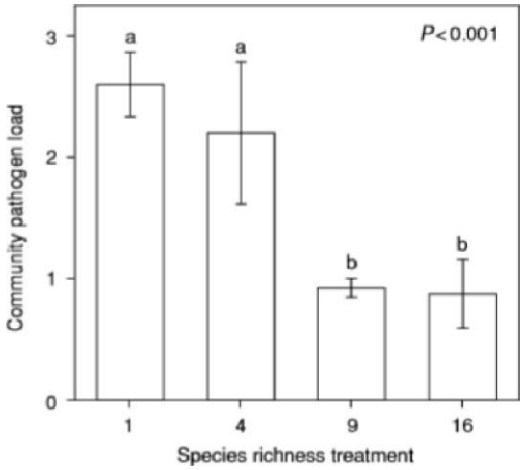
Infections are less common as the density of an individual species declines. [L12 s19]

Higher plant diversity means lower density per species, and less infection. [L12 s19]



Wildebeest and buffalo rise after vaccination while zebra stay flat [L12 s18]

On the figure: wildebeest · buffalo · Zebra



Pathogen load falls as plant species richness rises from 1 to 16 [L12 s19]

On the figure: pathogen load · species richness

Plant diversity and pathogen load: load is percent of leaf area infected. [L12 s19]

Pathogen load falls as plant **species richness** rises. [L12 s19]

Pathogen load is lower at **9** and **16** plant species than at **1** or **4.** [L12 s19]

Microparasite traits

Trait	Microparasite
Body size	Microscopic
Intrinsic rate of population growth	Rapid
Number per host	One host usually supports populations of several different species
Fatality to host	Mild to severe
Stability of the interaction with the host	Intermediate
Ability to regulate host population	Moderate to high

Table source: [L12 s17]

L12.4 Macroparasites and parasitoids

⚠ **Do not mix up: Endoparasites live INSIDE the host; ticks, leeches, and fleas are ectoparasites.** [L12 s21, L12 s24]

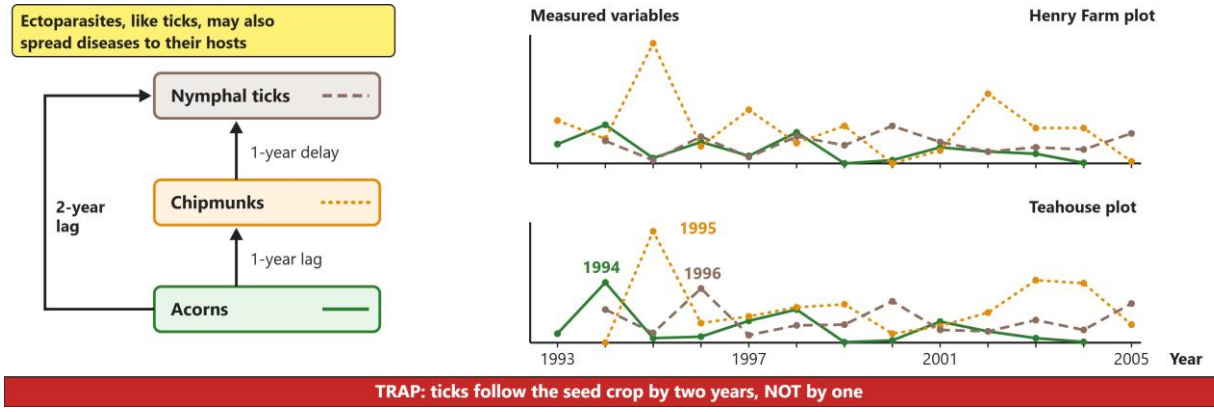
Macroparasite: one host supports a few to many individuals of different species. [L12 s20]

Ectoparasites *(parasites on the outside)* include ticks, leeches, and fleas. [L12 s21]

Ectoparasites often have more potential hosts (less specialized) than macroparasites that live inside the host. [L12 s21]

Ectoparasites and endoparasites are both kinds of macroparasite. [L12 s21, L12 s24]

Ectoparasites, like ticks, may also spread diseases to their hosts. [L12 s22]



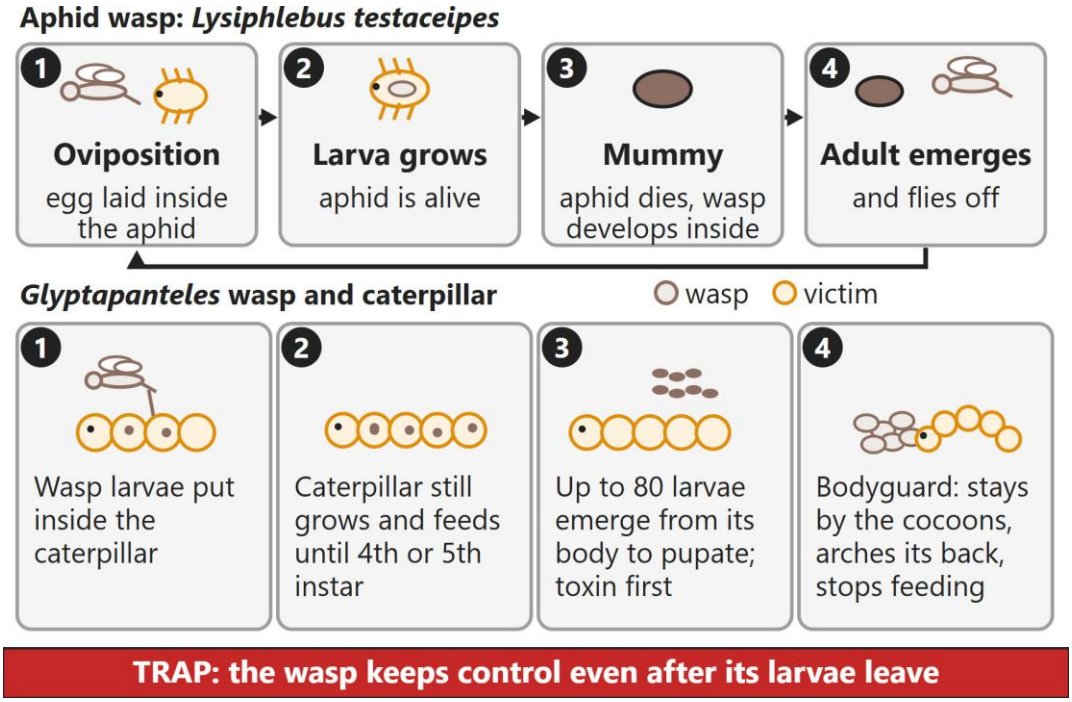
Acorns lead to chipmunks then nymphal ticks, with one and two year lags [L12 s23]

On the figure: Acorns · chipmunks · nymphal ticks · Ectoparasites

Acorns, chipmunks, and nymphal ticks (DON) were tracked at two plots. [L12 s23]

Macroparasites that live inside the host are **endoparasites** *(inside parasites)*. [L12 s24]

Endoparasites generally specialize on one or a few host species. [L12 s24]
Endoparasites often have **intermediate hosts** *(extra hosts in the life cycle)*. [L12 s24]
Endoparasite examples: roundworm, hookworm, fluke, tapeworm, nematode. [L12 s24, L12 s15]
Mystery of limb malformations in frogs *(deformed legs)*: frogs with abnormal limbs. [L12 s25]
Many endoparasites have complex life cycles with multiple hosts. [L12 s26]
Example hosts in one life cycle: a snail, a frog, and a heron. [L12 s26]
Parasitoid: similar in size to the host (example: wasp and moth). [L12 s27]
Parasitoid population growth is comparable to the host. [L12 s27]
One host usually supports one parasitoid, but can support many. [L12 s27]
Parasitoid effect on the host: eventually fatal. [L12 s27]
Stability of the interaction is intermediate; ability to regulate the host population is moderate to high. [L12 s27]



Aphid wasp life cycle and the Glyptapanteles wasp that makes its caterpillar a bodyguard [L12 s28]
On the figure: Aphid wasp · Lysiphlebus testaceipes · Glyptapanteles · instar · bodyguard

Aphid wasp life cycle (**Lysiphlebus testaceipes**) forms a loop. [L12 s28]
Glyptapanteles wasps control their caterpillar prey. [L12 s29]
Wasp larvae are deposited in the caterpillar, which keeps growing and feeding normally. [L12 s29]
At the **4**th or **5**th **instar** *(growth stage)*, up to **80** fully grown larvae emerge to pupate. [L12 s29]
Just before emerging, the larvae produce a toxin. [L12 s29]
The toxin makes the caterpillar act as a **bodyguard** until the larvae **pupate** *(turn into pupae)*. [L12 s29]
The caterpillar sits near the cocoons, arches its back, and stops moving and feeding. [L12 s29]
It sometimes spins silk over the pupae and thrashes violently when disturbed. [L12 s29]
A parasite no longer in the host induces the behavior. [L12 s29]

Macroparasite traits

Trait	Macroparasite
Body size	Smaller than host
Intrinsic rate of population growth	Faster than hosts
Number per host	One host supports a few to many individuals of different species
Fatality to host	Usually mild
Stability of the interaction with the host	High
Ability to regulate host population	Low

Table source: [L12 s20]

Acorn to chipmunk to tick chain

Link	Organism	Lag
1	Acorns	start
2	Chipmunks	**1**-year lag after acorns
3	Nymphal ticks	**1**-year lag after chipmunks
Acorns to nymphal ticks	Nymphal ticks, two steps after acorns	**2**-year lag

Table source: [L12 s23]

Endoparasite life cycle with multiple hosts

Step	Stage
1	Eggs
2	Snail
3	Swimming larvae
4	Tadpole
5	Young frog
6	Adult frog
7	Heron holding a frog, then eggs again

Table source: [L12 s26]

Aphid parasitoid life cycle

Step	Label
1	Oviposition *(egg laying)*: adult wasp lays an egg in the aphid (*(greenbug)* on later steps)
2	Growth of parasite larva; greenbug alive
3	Greenbug dies; parasite pupates; result is mummy
4	Adult parasite emerges
5	Adult parasite (winged adult, loop closes at oviposition)

Table source: [L12 s28]

L12.5 Parasitism and global change

⚠ Do not mix up: More warming is NOT always better for pathogens: it can exceed their upper thermal tolerance. [L12 s31]

Predicted pathogen responses to climate change: three patterns. [L12 s31]

Effect of warming depends on the metric of disease risk and the temperature curve shape. [L12 s31]

It also depends on projected temperature **increase**, optimal temperature value, and baseline temperature. [L12 s31]

Vectorial capacity or R0 *(ability of disease carriers to spread disease)* rises to an optimum temperature, then falls. [L12 s31]

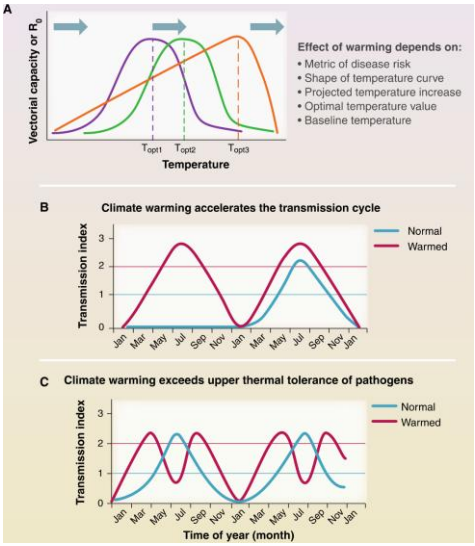
Pathogens differ in optimal temperature (**Topt1**, Topt2, Topt3), so warming affects them differently. [L12 s31]

Climate warming accelerates the transmission cycle: the warmed transmission rises earlier and higher. [L12 s31]

Climate warming can **exceed the upper thermal tolerance** of pathogens. [L12 s31]

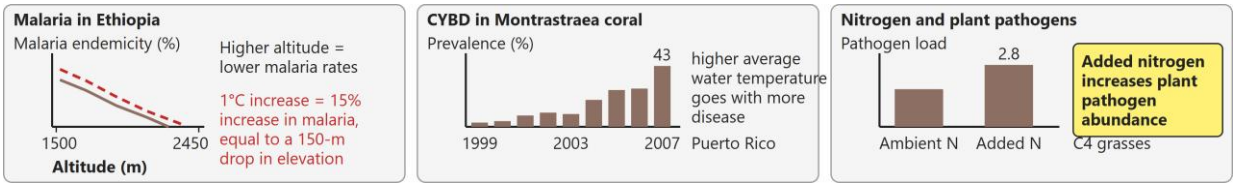
Past that tolerance, warmed transmission peaks early, dips in mid-summer, then rises again. [L12 s31]

Many parasites do better under warmer temperatures. [L12 s32, L12 s33]



Vectorial capacity peaks at an optimum temperature; warming speeds or overshoots transmission [L12 s31]

On the figure: vectorial capacity · Topt1 · climate warming accelerates the transmission cycle · upper thermal tolerance



Malaria by altitude, coral disease by year, and added nitrogen raising pathogen load [L12 s32]

On the figure: Malaria in Ethiopia · CYBD · Montrastraea · Nitrogen and plant pathogens · Ambient N

Malaria in Ethiopia: higher altitude means lower malaria rates. [L12 s32]

Malaria endemicity *(how common malaria is)* is shown as percent spleen enlargement. [L12 s32]

1 degree C warmer = **15%** more malaria, equal to a **150**-m drop in elevation. [L12 s32]

Coral disease CYBD *(Caribbean yellow banding disease)*: prevalence rose from **1999** to **2007** in **Montrastraea** coral off Puerto Rico. [L12 s33]

Higher average water temperature goes with higher mean prevalence of the disease. [L12 s33]

Increased nutrient availability can also **increase** pathogen abundance. [L12 s34]

Nitrogen and plant pathogens: added nitrogen **increases** plant pathogen abundance. [L12 s34]

C4 grass pathogen load was higher with added N than with **ambient N**. [L12 s34]

Increased nutrients can also **increase** pathogen abundance in the ocean and freshwater. [L12 s34]

Eutrophication *(nutrient enrichment of water)* affected amphibian infections by Ribeiroia trematodes *(parasitic flatworms)*. [L12 s35]

More parasite input means more infection: no input stays at **0,** high input rises most. [L12 s35]

Review question 1: two ways predators differ from parasites. [L12 s36]

Answer **1**: predation leads to immediate mortality; parasitism may not kill the host, or takes time. [L12 s36, L12 s10]

Answer **1,** second way: predators are often larger than prey; macroparasites are smaller than the host. [L12 s36, L12 s11]

Answer **1,** third way: each predator eats many prey. [L12 s36, L12 s11]

Answer **1,** fourth way: one host supports a few to many macroparasites. [L12 s36, L12 s11]

Answer **1,** fifth way: predation is immediately fatal; macroparasites are usually mild. [L12 s11]

Answer **1,** sixth way: predator stability is usually low; macroparasite stability is high. [L12 s11]

Review question 2: amensalism involves a (+/-/0) and a (+/-/0) interaction. [L12 s36]

Answer **2**: amensalism is - for one species and **0** for the other. [L10 s06]

Review question 3: how parasite population growth is affected by host population growth. [L12 s36]

Answer **3**: infections are less common as host density declines. [L12 s36, L12 s19]

Answer **3,** lag example: nymphal ticks follow chipmunks by a **1**-year lag. [L12 s36, L12 s23]

Review question 4: apply the red-queen hypothesis to host-parasite interactions. [L12 s36]

Red queen hypothesis: it takes all the running you can do to stay in place. [L11 s20]

Cheetah and gazelle: both became faster, and gains in one were generally matched by the other. [L11 s21]

Plants and herbivores are also in an evolutionary arms race, much like the red queen hypothesis. [L11 s36]

Answer **4**: like cheetah and gazelle, host gains would be matched by parasite gains. [L12 s36, L11 s21]