Remote Learning Packet

Please submit scans of written work in Google Classroom at the end of the week.

May 4-8, 2020

Course: 9 Biology

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Weekly Plan:

Monday, May 4
☐ "The New Biology" - Cooperation p. 99-105

Tuesday, May 5
☐ "New Biology" Q&A
☐ 5-7 questions, quotes, vocab, reasoning, compare to Darwin
☐ Video on Cooperation

Wednesday, May 6
☐ Read and take guided notes over pp. 403-404

Thursday, May 7
☐ Complete the Interspecies Relationships worksheet

Friday, May 8
☐ Attend office hours
☐ Catch-up or review the week's work

Statement of Academic Honesty

I affirm that the work completed from the packet is mine and that I completed it independently.

I affirm that, to the best of my knowledge, my child completed this work independently

_____
Student Signature

_____
Parent Signature

Monday, May 4

Read the attached selection from "The New Biology" by R. Augros.

- Start with the paragraph that begins "The elimination of competition…" on p. 99.
- Stop after "...the paradigm" on p. 105.
- Take a note of any words you don't know, then look them up and write down their definitions.
- Take a note of your QOWs to help you read.

*You will not turn in any materials from today.

Tuesday, May 5

Watch the video "Cooperation" found on Google Classroom. Have your reading with you as you view. Answer the attached reading questions using the text and your notes. Write in complete sentences.
*Include a scan of this document in your packet submission.

Wednesday, May 6

Read and take notes over pp. 403-404 starting with the header "SYMBIOSIS". Your notes should include:

- Bolded vocabulary with their definitions
- Italicized terms in the parasitism section
- Draw an outline of a human body then add labelled examples of an endoparasite and ectoparasite
- Examples of mutualism and commensalism interactions

*You will not turn in any materials from this day.

Thursday, May 7

Complete the Interspecies Relationships worksheet. Follow the directions as listed on the worksheet.
*Include a scan of this document in your packet submission.

Friday, May 8

Use this day to attend office hours, catch up on work from this week, scan your documents, and enjoy the start of your weekend! *You do not need to include notes in your packet submission*, only the documents listed: Interspecies Relationships worksheet, "The New Biology" reading questions.

The zebra, the wildebeest, and the gazelle in their turn are the common prey of five carnivores: the lion, the leopard, the cheetah, the hyena, and the wild dog. These predators can coexist because there are five different "ways which do not directly compete to make a living off three prey species," according to ethologist James Gould. He explains: "Carnivores avoid competition by hunting primarily in different places at different times, and by using different techniques to capture different segments of the prey population. Cheetahs are unique in their high-speed chase strategy, but as a consequence must specialize on small gazelle. Only the leopard uses an ambush strategy, which seems to play no favorites in the prey it chooses. Hyenas and wild dogs are similar, but hunt at different times. And the lion exploits the brute-force niche, depending alternately on short, powerful rushes and strong-arm robbery."[37] And these five predators are far from significantly reducing the three prey species. For there are in East Africa's Serengeti-Mara region alone approximately 170,000 zebras, 240,000 wildebeest, and 640,000 Thompson gazelles.[38]

The elimination of competition by division of the habitat into niches is so universal in the plant and animal kingdoms that it has become a principle of prediction and discovery for field studies. Colinvaux writes: "Whenever we find rather similar animals living together in the wild, we do not think of competition by tooth and claw, we ask ourselves, instead, how competition is avoided. When we find many animals apparently sharing a food supply, we do not talk of struggles for survival; we watch to see by what trick the animals manage to be peaceful in their coexistence."[39]

In a classic study, ecologist Robert MacArthur set out to learn how five species of warbler, similar in size, shape, and diet, could live together in the same coniferous forest of Maine. What factor was "preventing all but one from being exterminated by competition"? After months of painstaking observations, MacArthur discovered that each species had defined a subtle niche for itself based mainly on behavior: "The birds behave in such a way as to be exposed to different kinds of food. They feed in different positions, indulge in hawking and hovering to different extents, move in different directions through the trees, vary from active to sluggish, and probably have the greatest need for food at different times corresponding to the different nesting dates. All of these differences are statistical, however; any two species show some overlapping in

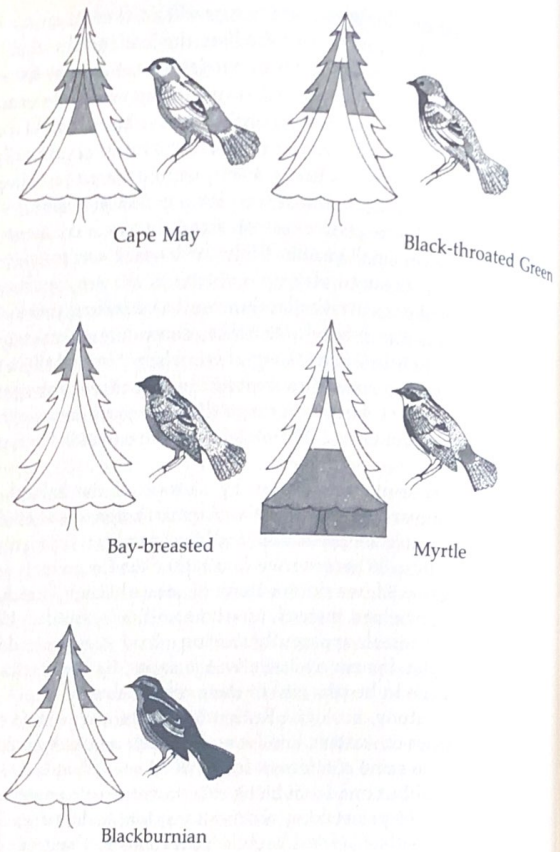

Figure 4.3. Derived from a classic study by ecologist Robert MacArthur, this diagram illustrates how five species of warbler, similar in size and shape, feed on bud worms in the same spruce trees. They avoid competition by occupying subtly different niches. The shaded areas indicate where each species spends more than half its time. The birds also use different methods of hunting. This pattern of noncompetition is typical of naturally coexisting species. (From MacArthur)

all of these activities."[40] (See Figure 4.3.) Colinvaux concludes that "Nature is arranged so that competitive struggles are avoided," and adds that "peaceful coexistence, not struggle, is the rule."[41]

Where food and other necessities are abundantly available many species may coexist in the same area without conflict. Herbert Ross found that six species of leafhopper in Illinois thrive side by side on the same trees without competition.[42] Such aggregations of similar species are called guilds. Hundreds of cases are known of large numbers of similar species coexisting without interference. An investigation of fourteen species of coexisting hummingbirds revealed that the birds feed differently according to flower density, height of flowers, and time of nectar renewal, with small overlap between species.[43] In the same forest log there are diverse niches for seven species of millipede.[44] Ricklefs reports that "The shallow waters of Florida's Gulf Coast can harbor up to eight species of large predatory snails. . . . Lake Malawi in Africa has more than 200 species of cichlid fish, which appear to have similar ecological characteristics."[45] Nature engages all her ingenuity in developing techniques to forestall strife among species. It is not surprising, then, that even careful and experienced investigators trying to document the paradigm of competition come up with disappointing results. Andrewartha and Birch comment on David Lack's paper "Competition for Food by Birds of Prey":[46] "We have discussed Lack's studies of birds in some detail because this work is so well documented. But we are forced to conclude that his interesting results do not in any way demonstrate that 'competition' between birds in nature is at all commonplace or usual. On the contrary, his results seem to show that it hardly ever occurs. Where he finds species together, there is evidence that their food is 'superabundant,' or else they live on different foods. When they are separated, there is no evidence that they do invade one another's territories."[47]

Because each species has its own niche and its own task, fights between animals of different species are exceedingly rare, if they occur at all. Lorenz after many years of studying fish remarks, "Never have I seen fish of two different species attacking each other, even if both are highly aggressive by nature."[48] Lions often steal the kills of cheetah, but there is never a struggle. The cheetah, much too wise to take on an opponent more than double its weight, abandons its prey without a fight.[49] The same prudent retreat occurs if a

monarch eagle intrudes on a smaller eagle's meal of carrion, for instance. The smaller bird withdraws without protest and waits until the monarch eats its fill. As mentioned above, Allee and his collaborators did not know of any "direct mutual harm between species."[50] Colinvaux puts it succinctly: "A fit animal is not one that fights well, but one that avoids fighting altogether."[51]

Predation also is best understood not as a struggle but rather as a kind of balanced coexistence. In natural populations predators do not exterminate prey species. As a particular prey animal becomes more scarce, the predator turns to more abundant substitutes. The wolf does not compete with the caribou but depends upon it. The caribou in its turn does not struggle with the lichens it consumes but depends on them for its livelihood. It is in the predator's interest that the prey thrive. Andrewartha and Birch state flatly, "There is no competition between the predator and its prey."[52] Odum notes that "where parasites and predators have long been associated with their respective hosts and prey, the effect is moderate, neutral, or even beneficial from the long term view."[53] Predation does not benefit the individual that is eaten but it can benefit the rest of the prey population in several ways. After a three-year study of the wolf population on Isle Royale, an island in Lake Superior, L. David Mech writes: "The wolves appear to have kept the moose herd within its food supply, culled out undesirable individuals, and stimulated reproduction. Wolves and moose probably will remain in dynamic equilibrium."[54] After a similar study of the wolves of Mount McKinley National Park in Alaska, Adolph Murie states of the Dall's sheep indigenous to the area: "Wolf predation probably has a salutary effect on the sheep as a species. At the present time it appears that the sheep and wolves may be in equilibrium."[55]

One benefit of predation is that in certain cases more diversity in prey species is allowed than would otherwise obtain because competitive exclusion is prevented. The addition of a single predator can *increase* the number of prey species that can live side by side in a given habitat. For example, biologist David Kirk writes: "One of the most important effects of predator-prey interactions is the reduction of competition between prey species that share a common predator. For example, the sea star *Pisaster* is a major predator on sedentary mollusks and barnacles of the intertidal zone. If the sea

star is excluded from the community, one or two of the sedentary species soon crowd or starve out the other sedentary species because of their competitive advantage in feeding and reproduction. However, if the sea star is allowed access to the simplified community, it removes many individuals in these successful sedentary populations, leaving space for immigration of individuals of several other species. In other words, the addition of a single predator species can lead to an increase in the total number of prey species."[56] L. B. Slobodkin has obtained similar results with different species of hydra in laboratory cultures.[57] In the same way different insects preying on specific seeds and seedlings prevent or reduce tree competition.

The predator is not the enemy of its prey in the sense of hating it or being angry with it. Lorenz clarifies the relation: "The fight between predator and prey is not a fight in the real sense of the word: the stroke of the paw with which a lion kills his prey may resemble the movements that he makes when he strikes his rival, just as a shotgun and a rifle resemble each other outwardly; but the inner motives of the hunter are basically different from those of the fighter. The buffalo which the lion fells provokes his aggression as little as the appetizing turkey which I have just seen hanging in the larder provokes mine. The differences in these inner drives can clearly be seen in the expression movements of the animal: a dog about to catch a hunted rabbit has the same kind of excitedly happy expression as he has when he greets his master or awaits some longed-for treat. From many excellent photographs it can be seen that the lion, in the dramatic moment before he springs, is in no way angry."[58]

Even the unavoidable struggle is minimized. Mech reports that the fifty-one moose kills he examined were composed of the very young, the old, and the diseased. *None* of the animals killed by the wolves was in its prime.[59] A wolf pack sensibly seeks out prey that will offer the least fight. Murie found the same thing with wolf predation of Dall's sheep.[60] Finally, predators do not practice wanton killing, and even the pain seems to be minimized. Rodents attacked by snakes commonly go into shock before being killed and devoured. A wildebeest surrounded by attacking lions does not even resist but falls into shock.

The same principles hold regarding the parasites found univer-

sally among animals and plants. Authorities agree that parasitism is rarely harmful to the host. "It is the exceptional parasite that is deleterious," writes Thomas Cheng.[61] For example, "The Okapi, which lives in the tropical forests of central Africa, harbours at least five kinds of worms simultaneously and some of these may be present in numbers of several hundreds; the host does not seem any the worse for this and can feed itself as well as cater for the fauna it contains," according to parasitologist Jean G. Baer.[62]

Some parasites have intricate life cycles requiring one or more secondary hosts. The larvae of the brain worm that parasitizes the white-tailed deer live in slugs and snails that the deer inadvertently ingest when grazing. The larvae then penetrate the deer's stomach and enter the spinal column, eventually migrating to the spaces surrounding the brain. Here they mate and lay eggs that pass via the bloodstream to the deer's lungs where they are coughed up, swallowed, and passed out with fecal waste to reinfect another snail. But the damage to the host animal is minimal. Ecologist Robert L. Smith remarks, "As with most parasites and hosts, the deer and the brain worm have achieved a mutual tolerance, and the deer does not suffer greatly from the infection."[63]

The host's continued health and well-being are clearly in the interest of the parasite. This is why, as Cheng observes, "recent evaluations of the nature of the host-parasite relationship have intentionally avoided employing 'the infliction of harm' as a criterion in distinguishing parasitism from other categories of symbiosis."[64] Harm results only when parasites are present in excessive numbers. In fact, several controlled experiments have proven that certain parasites enhance the growth and vigor of the host, either by providing nutrients or by modifying the host's metabolism.[65]

Competition can be induced between species artificially in the laboratory. But the experiments of Gause[66] and others prove that such competition cannot persist with stability. Either the two species find subtly different niches and thereby avoid competition or one species replaces the other. This confirms the one species, one niche principle found in nature. Mathematical models, laboratory experiments, and field studies all show that competition between species cannot be sustained. The competition between paramecia in an aquarium, or between flour beetles in a jar is unnatural since migration, the natural means of avoiding competition, is prevented.

Furthermore, these laboratory experiments imply that if all nature were at war, one organism with another, then only one species would survive. If life is not to destroy itself, competition must be avoided. Thus competition is not the paradigm.

Cooperation between Species

A recognition of the peaceful coexistence among animals and plants is only half the story. The Darwinian images of struggle and war have led biologists to seek competition everywhere and to overlook or downplay cooperation. Biologist William Hamilton writes, "Cooperation per se has received comparatively little attention from biologists."[67] Zoologist Robert M. May notes that "mutualism has remained relatively neglected—in field, laboratory, theory and textbooks."[68] And Lynn Margulis writes, "Although they are often treated in the biological literature as exotic, symbiotic relationships abound; many of them affect entire ecosystems."[69] Nature's manner is not merely peaceful coexistence, but cooperation. Kirk declares: "It is doubtful whether there is an animal alive that does not have a symbiotic relationship with at least one other life form."[70] A few examples will give some idea of the magnitude of this mutual interdependence among living things.

One organism can be helpful to another in several ways: by providing food, protection from predators, a place to live, or transportation, or by ridding the other organism of pests, or by preparing some necessary condition for its life or welfare. The innumerable cooperative associations between different species constitute one of the most intriguing subject areas in all natural science. The variety and subtlety of interdependence is astounding.

The simplest service one organism can offer another is providing a place to stay. The sea worm *Urechis caupo* is nicknamed "the innkeeper" because it regularly harbors various fish, mollusks, arthropods, and annelids—up to thirteen species—in the U-shaped burrow it makes in California's coastal mudflats. Though able to live independently, the lodgers reside in the worm's tube for protection, some of them feeding on whatever *Urechis* brings in but does not consume.[71] Certain crabs live within the rectums of sea urchins, others within the shells of live oysters.[72] The horseshoe crab is also host to many guests. Clarke notes, "Anyone who has an oppor-

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GreatHearts Irving

Questions from *The New Biology* - "Cooperation"

1. Define *paradigm*. (use a dictionary).
2. What does Augros say about competition generally, and how does it compare to the following passage from Darwin's *Origin of Species*?

"We can dimly see why the competition should be most severe between allied forms, which fill nearly the same place in the economy of nature; but probably in no one case could we precisely say why one species has been victorious over another in the great battle of life… The forms which stand in closest competition with those undergoing modification and improvement, will naturally suffer most. And we have seen in the chapter on the Struggle for Existence that it is the most closely-allied forms,—varieties of the same species, and species of the same genus or of related genera,—which, from having nearly the same structure, constitution, and habits, generally come into the severest competition with each other."

3. What evidence does Augros give for this understanding of competition?
4. According to the reading, how does nature try to eliminate competition? Does nature succeed?
5. Summarize the results of R. MacArthur's study of how different warblers feed in the same spruce trees.
6. Name two species who interact but do not struggle together, and describe their interaction.
7. Do predators and prey fight? How does Augros describe the predator's instinct to kill?
8. How are competition and stability in an ecosystem related?

Interspecies Relationships

Directions: Complete the following chart with + representing the species receives a benefit from the relationship, - representing the species is harmed by the relationship, or 0 representing the species is unaffected by the relationship. Then provide your own example of each type of interspecies relationship.

Type of Species Interaction	Example	Species 1	Species 2	Student Example
competition	Species 1: blue jay Species 2: robin			Species 1: Species 2:
predation	Species 1: coyote Species 2: desert hare			Species 1: Species 2:
parasitism	Species 1: dog Species 2: fleas			Species 1: Species 2:
mutualism	Species 1: clover Species 2: honey bees			Species 1: Species 2:
commensalism	Species 1: barnacle Species 2: blue whale			Species 1: Species 2:

Choose one of your examples and explain in complete sentences why each species benefits, is harmed, or is unaffected by the interspecies relationship.