FRESHWATER AQUATIC ECOSYSTEMS

THE AQUATIC FOOD WEB

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VOCABULARY TERMS

APEX PREDATOR - IS A *PREDATOR* AT THE TOP OF A FOOD CHAIN, WITH NO NATURAL PREDATORS. ALSO KNOWN AS AN ALPHA *PREDATOR* OR TOP *PREDATOR*.

CARNIVORE – ANIMALS THAT ONLY EAT MEAT OR OTHER ANIMALS.

ENERGY - ENERGY IS "THE ABILITY TO FUNCTION." EVERY LIVING ORGANISM, PLANT OR ANIMAL, NEEDS ENERGY TO LIVE AND SURVIVE. EATING FOOD GIVES ANIMALS THE ENERGY NEEDED TO LIVE.

ECOSYSTEM - A GROUP OF LIVING ORGANISMS (PLANT AND ANIMAL) THAT LIVE AND INTERACT WITH EACH OTHER IN A SPECIFIC ENVIRONMENT, SUCH AS A FRESHWATER ECOSYSTEM RIVER OR LAKE.

THERE ARE TWO TYPES OF AQUATIC ECOSYSTEMS; **WE WILL FOCUS ON FRESHWATER ECOSYSTEMS.**

- **SALTWATER ECOSYSTEMS –** CONTAIN LARGE AMOUNTS OF SALT IN THE WATER (OCEANS)
- **FRESHWATER ECOSYSTEMS –** CONTAIN VERY LITTLE AMOUNTS OF SALT IN THE WATER (STREAMS, RIVERS, PONDS OR LAKES)

VOCABULARY (CONTINUED)

FOOD CHAIN – AN ORDERED ARRANGEMENT OF SIMILAR PLANTS AND ANIMALS IN WHICH EACH FEEDS ON SMALLER ANIMALS IN THE CHAIN AND EXCHANGES ENERGY IN THE PROCESS. SMALL FISH EAT AQUATIC INSECTS, BIG FISH EAT SMALLER FISH AND OSPREYS EAT THE BIG FISH.

FOOD WEB - A **FOOD WEB** (OR **FOOD CYCLE**) IS THE NATURAL INTERCONNECTION OF MANY FOOD CHAINS AND AN ILLUSTRATED REPRESENTATION OF WHAT-EATS-WHAT IN AN ECOSYSTEM. A FOOD WEB GIVES US A COMPLETE VIEW OF THE FEEDING RELATIONSHIPS IN AN ECOSYSTEM. FOOD WEBS CONTAIN **PRODUCERS** (PLANTS), **HERBIVORES** (PLANT EATERS), **OMNIVORES** (PLANTS AND ANIMAL EATERS) AND **APEX PREDATORS**, OR ANIMALS THAT ARE NOT EATEN BY OTHER ANIMALS.

HABITAT – THE PLACE AND NATURAL CONDITIONS IN WHICH A PLANT OR ANIMAL LIVES. EACH HABITAT IS UNIQUE AND IS HOME TO DIFFERENT LIVING ORGANISMS.

VOCABULARY (CONTINUED)

HERBIVORES – ANIMALS THAT ONLY EAT PLANTS.

MICROSCOPIC – INVISIBLE TO THE NAKED EYE AND CAN ONLY BE SEEN THROUGH A MICROSCOPE.

OMNIVORES – ANIMALS THAT EAT PLANTS OR OTHER ANIMALS.

ORGANISMS – ANY LIVING THING IN THE FORM OF PLANTS AND ANIMALS, REGARDLESS OF ITS SIZE.

PHOTOSYNTHESIS - IS A PROCESS USED BY PLANTS AND OTHER LIVING ORGANISMS TO CHANGE SUNLIGHT INTO ENERGY WHICH FUELS THE ORGANISM AND GIVES IT LIFE.

TROPHIC LEVELS – THE LEVEL OF AN ORGANISM, PLANT OR ANIMAL, AND THE POSITION IT OCCUPIES IN A **FOOD WEB**.

What is an Aquatic Food Web?

FOOD WEBS BEGIN WITH **FOOD CHAINS,** WHICH ARE LINKS BETWEEN SIMILAR PLANTS AND ANIMALS THROUGH FEEDING RELATIONSHIPS. FOR EXAMPLE, AN AQUATIC INSECT EATS MICROSCOPIC PLANTS, THEN A SMALL FISH EATS THE AQUATIC INSECT, AND A LARGER FISH EATS THE SMALL FISH. THE TWO FISH AND THE INSECT ARE LINKED IN THIS AQUATIC FOOD CHAIN.

A **FOOD WEB** IS MUCH MORE COMPLEX THAN A FOOD CHAIN AND INVOLVES MANY MORE DIFFERENT FOOD CHAINS AND TYPES OF PLANTS AND ANIMALS. **THERE ARE FIVE KEY TROPHIC LEVELS IN AN AQUATIC FOOD WEB:**

PRIMARY PRODUCERS - ARE MICROSCOPIC PLANTS THAT FORM THE BASE OF THE AQUATIC FOOD WEB. PRIMARY PRODUCERS USE **PHOTOSYNTHESIS,** THE PROCESS IN WHICH GREEN PLANTS USE SUNLIGHT TO MAKE THEIR OWN FOOD IN ORDER TO SURVIVE.

PRIMARY CONSUMERS - ARE **HERBIVORES,** ANIMALS THAT ONLY EAT PLANTS.

SECONDARY CONSUMERS - ARE **CARNIVORES,** ANIMALS THAT ONLY EAT MEAT AND PREY ON OTHER ANIMALS.

TERTIARY CONSUMERS - ARE **OMNIVORES,** ANIMALS THAT FEED ON BOTH PLANTS AND ANIMALS.

APEX PREDATORS - ARE ANIMALS AT THE **TOP OF A FOOD CHAIN,** WITH NO NATURAL PREDATORS.

MEMBERS OF THE 5 AQUATIC TROPHIC LEVELS

PRODUCERS, DECOMPOSERS AND NUTRIENTS – THIS GROUP INCLUDES MICROSCOPIC ANIMALS THAT EAT DEAD PLANTS TO SURVIVE AND PLANTS THAT REQUIRE THE SUN TO SURVIVE.

- ALGAE, BACTERIA, PHYTOPLANKTON, FUNGI, WILLOW, WILD CELERY, CATTAILS, SEDGES AND MOSS

PRIMARY CONSUMERS – (HERBIVORES) THIS GROUP INCLUDES ZOOPLANKTON, AQUATIC INSECTS, TADPOLES, MUD PUPPIES (LARVAL STAGE TIGER SALAMANDERS), CRAYFISH, SMALL FISH, MUSKRAT AND BEAVERS.

SECONDARY CONSUMERS – (CARNIVORES) THIS GROUP INCLUDES DRAGONFLIES, CRAYFISH, TIGER SALAMANDERS, TROUT, LARGEMOUTH BASS, NORTHERN PIKE, WALLEYE, GREAT BLUE HERON, OSPREYS AND POND FROGS.

TERTIARY CONSUMERS – (OMNIVORES) THIS GROUP INCLUDES COMMON CARP, RACCOONS, COYOTES, RAVENS, SNAPPING TURTLES, RIVER OTTERS, DUCKS, COOTS AND BEARS.

APEX PREDATORS (AQUATIC) – NORTH AMERICAN ALLIGATOR (NOT FOUND IN NEW MEXICO), CATFISH, NORTHERN PIKE, LARGEMOUTH BASS, WALLEYE AND SALMON.

ENERGY AND PRIMARY PRODUCERS

ENERGY – EVERY LIVING ORGANISM, PLANT OR ANIMAL, NEEDS ENERGY TO LIVE AND SURVIVE. **ENERGY IS "THE ABILITY TO FUNCTION."** IT TAKES ENERGY TO RUN, JUMP, THROW AND EVEN TO EAT AND DRINK. ENERGY IS TRANSFERRED BETWEEN ORGANISMS IN FOOD WEBS FROM PRODUCERS TO CONSUMERS AT EACH STAGE OF A FOOD CHAIN.

PRIMARY PRODUCERS INCLUDE MICROSCOPIC BACTERIA, PHYTOPLANKTON AND ALGAE. THESE PLANTS FORM THE LOWEST LEVEL OR THE BASE OF THE AQUATIC FOOD WEB.

PRIMARY PRODUCERS USE **PHOTOSYNTHESIS,** ENERGY FROM THE SUN, TO CREATE THEIR OWN FOOD WITHOUT NEEDING TO EAT. SUNLIGHT IS A VITAL FACTOR IN THE FOOD WEB. **WITHOUT SUNLIGHT, THERE IS NO LIFE.**

FOOD FUELS ENERGY - SECONDARY CONSUMERS ARE ANIMALS THAT CONSUME OTHER ANIMALS. THE ENERGY IS TRANSFERRED FROM THE ANIMAL THAT WAS EATEN TO THE ANIMAL THAT ATE IT. ANIMALS SPEND MOST OF THEIR TIME SEARCHING FOR FOOD WHILE TRYING TO CONSERVE AS MUCH ENERGY AS POSSIBLE. AN EXAMPLE WOULD BE A FISH WAITING FOR FOOD TO COME BY OR A BEAR HIBERNATING WHEN FOOD IS SCARCE.

POND CONNECTIONS: THE FOOD WEB

1. CAN YOU GUESS WHO LIVES IN THIS COMPLEX HABITAT?

PHOTO COURTESY OF NMDGF

THE FOOD WEB

2. THE STARTING PLACE FOR THE FOOD WEB IS SUNLIGHT, WATER, MUD AND AIR, WHICH PROVIDE THE BUILDING BLOCKS FOR PLANT LIFE - THE PRIMARY PRODUCER SPECIES.


Photo: Dan Williams

Sunlight and water


Photo: Martin Perea

Earth

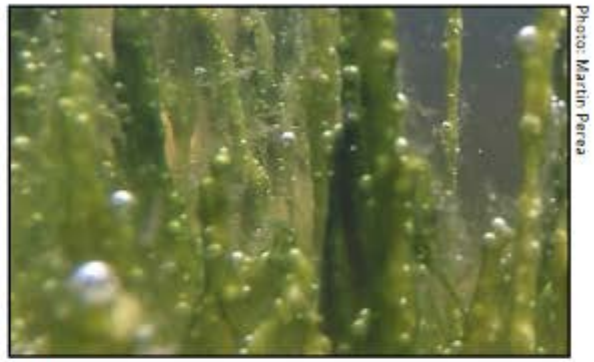


Photo: Martin Perea

Air


Photo: Martin Perea

Algae


Photo: Martin Perea

Cattails


Photo: Martin Perea

Hornworts

THE FOOD WEB

3. THE FIRST WEB THREADS ARE THE POND'S PLANTS WHICH PROVIDE FOOD FOR MANY CREATURES

- THE <u>HERBIVORES- AQUATIC INSECTS, BIRDS AND ANIMALS THAT EAT PLANTS ONLY.</u>


Photo: Colleen Welch

Pond snail


Photo: J.N. Stuart

Mallard duck


Photo: Brian Lang

Mosquito larvae (Primarily Herbivore)


Photo: J.N. Stuart

Tadpoles


Photo: Brian Lang

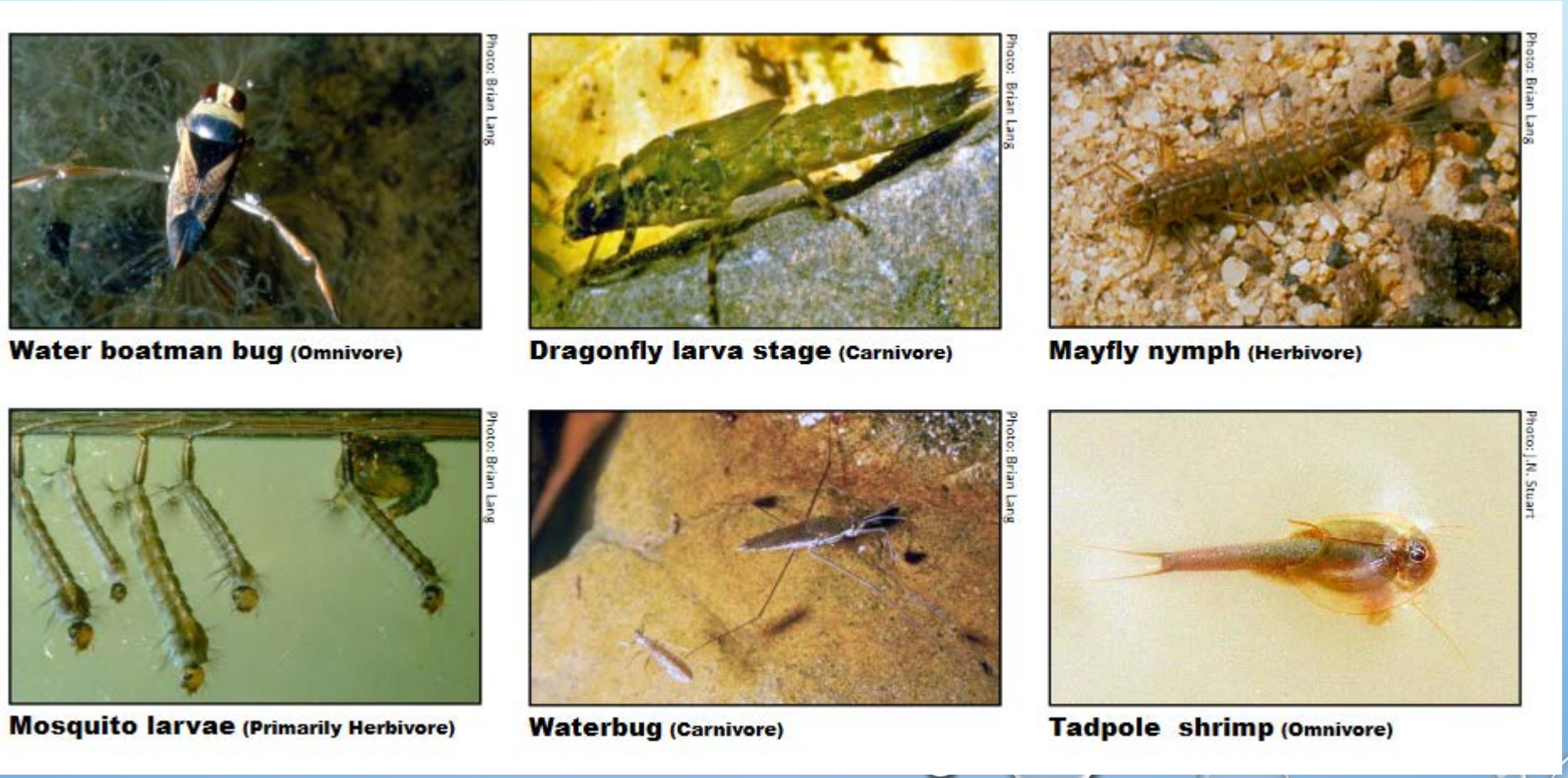
Mayfly nymph


Photo: J.N. Stuart

Muskrat

THE FOOD WEB

4. THE FOOD WEB IS A COMPLEX NETWORK IN WHICH MANY ANIMALS INTERACT, CONSUMING (EATING) PLANTS OR OTHER ANIMALS. SOME MACROINVERTEBRATE AQUATIC INSECTS EAT MICROSCOPIC PLANTS OR OTHER AQUATIC INSECTS.



THE FOOD WEB

5. ENERGY MOVEMENT. THROUGHOUT THE WEB, SMALL AQUATIC INSECTS AND FISH PROVIDE FOOD FOR LARGER CREATURES SUCH AS FISH, BIRDS, TURTLES, FROGS AND SALAMANDERS.

Snapping turtle

Tiger salamander

Northern leopard frog

Bluegill

Crayfish

Rough-wing swallow

THE FOOD WEB

6. NEARBY ANIMALS. OMNIVORES AND CARNIVORES FROM VARIOUS PARTS OF THE WEB ALSO DEPEND ON POND LIFE. OMNIVORES ARE ATTRACTED TO THE POND BECAUSE OF THE ABUNDANCE OF PLANT AND ANIMAL LIFE, WHILE PREDATORS ARE ATTRACTED TO THE POND TO EAT THE OMNIVORES.

Red-winged blackbird

Great-blue heron

Common raven

Coyote

Raccoons

Wandering gartersnake

THE FOOD WEB

7. HUMAN CONNECTION. PEOPLE ALSO EAT PLANTS AND ANIMALS FROM THE POND. FOR EXAMPLE, HUMANS ENJOY FISHING AND EAT A WIDE VARIETY OF DIFFERENT FISH, CRUSTACEANS AND WATERFOWL.


Photo: J.N. Stuart

Mallard duck


Photo: J.N. Stuart

Bullfrog


Photo: Martin Perea

Cattails


Photo: Aaron Wiley

Willow tree


NMDGF file image

Bluegill


Photo: J.N. Stuart

Crayfish

THE FOOD WEB

8. THE WEB GOES FULL CIRCLE. ANIMAL WASTE AND DEAD AND DECAYING PLANTS AND ANIMALS CALLED **DETRITUS** FORMS ON THE BOTTOM OF THE POND AND IS EATEN BY CREATURES LIVING IN POND MUD, NOURISHING FUTURE GROWTH OF PLANTS WHICH STARTS THE CYCLE AGAIN.


Photo: Brian Lang

Detritus


Photo: Colleen Welch

Pond snail

Illustration: Aaron Wiley

Bacteria


Photo: Matin Perea

DISCOVER NEW MEXICO: WILDLIFE EDUCATION POND CONNECTIONS FACT SHEET

- A POND IS A SMALL BODY OF FRESHWATER SHALLOW ENOUGH FOR SUNLIGHT TO REACH THE BOTTOM TO ALLOW ROOTED PLANTS TO GROW AND FOR MICROSCOPIC AND MACROSCOPIC ORGANISMS TO THRIVE.
- THE NON-LIVING COMPONENTS OF A POND INCLUDE WATER, OXYGEN, CARBON DIOXIDE, SEDIMENTS, MINERALS SUCH AS PHOSPHORUS AND NITROGEN AND OTHER NUTRIENTS.
- ORGANISMS, LIVING THINGS THAT LIVE IN A POND HABITAT INCLUDE: BACTERIA, PHYTOPLANKTON, ZOOPLANKTON, PLANTS, INSECTS, CRUSTACEANS, LEECHES, WORMS, FROGS, FISH AND BIRDS.
- PHYTOPLANKTON ARE MICROSCOPIC, FREE-FLOATING PLANTS.
- FOOD CHAINS DESCRIBE WHO EATS WHAT IN A HABITAT AND ARE TYPICALLY LISTED AS A HIERARCHY. ORGANISMS AT THE TOP OF THE FOOD CHAIN DO NOT GET EATEN BUT DO EAT THE ORGANISMS THAT ARE BENEATH THEM ON THE CHAIN. THESE ORGANISMS, IN TURN, EAT THE ORGANISMS BENEATH THEM ON THE CHAIN AND SO ON.
  - FOR EXAMPLE, BLUE HERONS EAT FROGS WHO EAT WATER SKATERS (AQUATIC INSECT).

DISCOVER NEW MEXICO: WILDLIFE EDUCATION POND CONNECTIONS FACT SHEET

- PRIMARY PRODUCERS ARE PLANTS THAT PRODUCE THEIR OWN FOOD/ENERGY THROUGH THE PROCESS OF PHOTOSYNTHESIS.
- PRIMARY CONSUMERS ARE PREDATORY ANIMALS THAT EAT OTHER ANIMALS.
- DECOMPOSERS INCLUDE BACTERIA AND FUNGI THAT BREAK DOWN NON-LIVING ORGANIC MATTER INTO SIMPLE MOLECULES THAT PLANTS CAN USE.
- AQUATIC INVERTEBRATES ARE ANIMALS WITHOUT A BACKBONE THAT LIVE IN THE WATER. EXAMPLES INCLUDE INSECTS (MAYFLIES, DRAGONFLIES AND DIVING BEETLES), CRUSTACEANS (SNAILS) AND WORMS.

STUDENT PAGE

QUESTIONS FOR EACH STUDENT TO ANSWER IN SCIENCE NOTEBOOKS. TEACHERS MAY CHANGE OR ADD ADDITIONAL QUESTIONS:

1. WHICH POND ORGANISMS ARE PRODUCERS?
2. LIST PRIMARY CONSUMERS, SECONDARY CONSUMERS AND TERTIARY CONSUMERS IN A POND ECOSYSTEM AND LIST PREY FOR EACH LEVEL.
3. WHAT WOULD HAPPEN TO THE FOOD WEB IF THE AQUATIC PLANTS DIED OUT BECAUSE OF POLLUTION?
4. WHAT WOULD HAPPEN TO THE FOOD WEB IF THE POPULATION OF GREAT BLUE HERON WAS TO DOUBLE?
5. NEW MEXICO HAS BOTH NATURAL AND CONSTRUCTED PONDS. CONSIDER THE ARIDITY OF THE REGION AND THE LENGTH OF DROUGHTS. DISCUSS WHY CONSERVING PONDS IS IMPORTANT TO BOTH PEOPLE AND WILDLIFE.
6. HOW WOULD THE INTRODUCTION OF THE COMMON CARP (ALSO KNOWN AS ASIAN CARP) AFFECT THE FOOD WEB? CARP CONSUME ZOOPLANKTON, WHICH MANY FISHES TYPICALLY FEED ON IN THEIR JUVENILE STAGE. CARP HAVE NO KNOWN PREDATORS. SEE LESSON CALLED **AQUATIC ALIENS – TOO CLOSE FOR COMFORT.**