Phylum Rotifera

(Rotifers, Wheel Animals)

2200 living species

very few fossils have been found – since few hard parts

a group of microscopic animals discovered when microscopes were first being developed

1st described in 1696 by Rev John Harris as "an animal like a large maggot which could contract itself into a spherical figure and then stretch itself out again; the end of its tail appeared with a forceps like that of an earwig."

von Leewenhoek himself describe a few species in the early 1700's

"wheel bearers" = characteristic ciliated crown = **corona**; resembles rotating wheels

of all invertebrates, the rotifers are most characteristic of **freshwater** habitats

most species are common in freshwaters

some (<5%) are found in other habitats:

marine or brackish waters

a few are terrestrial, in moist soils & damp mosses & lichens

most aquatic forms are **benthic** or **interstitial** fauna

some are **planktonic**

some are epizoic or **parasitic**

a few are **sessile**, living inside tubes or gelatinous secretions

a few rotifers are **colonial**

most rotifers are 0.1-0.5 mm; but some up to 3 mm long

some even smaller than some protozoa

most are transparent, a few are brightly colored

great diversity in shape within the phylum

→ somewhat correlated with their mode of life:

floaters	→ globular and saclike
creepers & swimmers	→ elongated and wormlike
sessile	→ vaselike

some species are cosmopolitan with a worldwide distribution

others with very restricted ranges

Body Form

body consists of: **head**, **trunk**, and **foot**

head

ciliated **corona (or crown)**

gives impression of spinning wheel

often with **sensory bristles** or **papillae**

used both for feeding

draws a vortex of water into mouth for feeding

mouth is inside corona

corona can also be used for locomotion

trunk

the trunk forms the major part of the body

encloses most of the internal organs

often elongated or sac-like

often has sensory antennae

often with false segmentation visible

in some: cuticle is very thick, caselike, fibrous layer

= **lorica**

foot

narrow, often tapered, with 1 to 4 toes

often arranged in plates or rings

often teloscopically retractile (external segmentation)

foot is an attachment organ

toes contain cement glands (=pedal glands)

pedal glands secrete adhesive material

used by both sessile and creeping forms

foot reduced in pelagic forms

many species secrete a wide variety of protective **tubes** in which they live:

gelatinous

constructed of small pieces of debris

sometimes colored yellow, green or brown

eutely as in nematodes

Body Wall

syncytial epidermis (= hypodermis)

secretes thin flexible **cuticle**

in some species some or all of the cuticle is thickened into a rigid casing (= **lorica)**

bands of muscles below epidermis

some circular; some longitudinal

body cavity a fluid filled **pseudocoelom**

amoeboid cells circulate in fluid

Movement

some swim using coronal cilia which pull the animal through the water when unattached

some with creeping or leechlike movement

some sessile and remain attached to the substrate

Feeding & Digestion

most rotifers are omnivores

eating anything small enough to fit in their mouths

many are carnivores: feed on protozoa and small animals

some are cannibalistic

others feed on dead organic matter

most feed by sweeping particles into mouth with corona

can filter 100,000 x's its own volume/hr

→ rotifers are sometimes used in fish tanks to clear up water clouded by organic particles

some are **predatory** and seek out their prey; probably by touch or chemical stimuli

complete digestive tract

inside mouth food is directed to a uniquely modified **pharynx** called a **mastax** that is constantly working back and forth

lots of variation in size & shape

operated by bands of muscles

contains hard chitinous jaws (=**trophi**) that suck in and grind up food

the pharynx leads to the esophagus which opens into the stomach

both digestion and absorption occurs in the stomach

short intestine leads from stomach to anus in foot

some species of rotifers have symbiotic zoochlorellae within the cells of the stomach wall

Respiration

rotifers have no specific organs for respiration

→their small size allows them to exchange respiratory gasses by diffusion across their body wall

rotifers have a relatively high metabolic rate conpared to other aquatic invertebrates

generally have high O_2 requirements

others are capable of withstanding anaerobic or near anaerobic conditions for extended periods

eg some live in anoxic mud or in sewage treatment plant filters

Excretion

pair of protonephridial tubes with **flame cells**

tubes empty into **bladder**, then to **cloaca**

Nervous System

bilobed brain dorsal to mastax

sends pairs of nerves to sense organs and viscera

senses:

eye spots (up to 5)

sensory bristles especiall around the corona (touch)

sensory pits lined with cilia in head region

papillae

usuall 2 pairs of short dorsal **antennae**

Life Cycle

rotifers are notable in that they have a much faster metabolism than many other cold blooded invertebrates

they can grow and reproduce very quickly

they can grow from an egg to a reproducing adult in 18 hrs

rotifers can have up to 40 generations/yr

in some species, females undergo **cyclomorphosis**

=a cyclical change in form of offspring throughout the year

rotifer species are also noted for variations in size and appearance in different habitats

many rotifers are quite tolerant to drying or desiccation (=**anhydrobiosis**)

under harsh conditions some can cease metabolism and dehydrate

some rotifer eggs can also withstand drying

can survive for years (up to 9) and then be rehydrated and active within a few hours

some can form true **cysts** that are even more resistant to extreme cold and heat

Reproduction

asexual reproduction does not play a major role in this phylum as it does in most other animal phyla

rotifers even have poor ability to regenerate parts

sexual reproduction predominates

rotifers are **dioecious**

however, females predominate in most populations

in some species males are unknown

males, when present, are minute, degenerate and/or short-lived

commonly only ~1/3rd as long as females

in some species males are only found for a few weeks each year

in others males are degenerate (no digestive tract)

males are ready for mating within an hour after hatching

rotifers have internal fertilization

the male uses sensory receptors on its corona to find a female

the male attaches its penis to the coronal region of the female and transfers sperm in to her body cavity

the male dies soon afterwards

in some species the males are unknown

→ females can reproduce by parthenogenesis

recent research has shown that the DNA of these rotifers is loaded with genes from bacteria, fungi and plants

this apparently provides adequate mutations to shuffle genes as an alternative to sexual reproduction

in some species, females can produce different kinds of eggs:

amictic eggs:

diploid eggs produced by parthenogenesis

produced during most of the year

mictic eggs:

haploid eggs

capable of being fertilized by male sperm

produced only at certain times of the year

if a female with mictic eggs is not impregnated she immediately lays the eggs and they hatch as males

resting (winter) eggs:

heavy and thick shelled

overwinter on sediment

extremely resistant to drying and extreme temperatures

in some rotifers, the eggs are retained in the female until they hatch (ovoviviparous)

→ rotifers bear live young

Ecology

rotifers are an important part of aquatic foodchains

particularly planktonic food chains

→ reproduce quickly into large populations

important as food for larger zooplankton and fish in aquatic ecosystems

rotifers affect the species composition of algae in ecosystems through their choice in grazing

they also compete for the same food sources of microcrustaceans common in the same habitats

also many species contribute to the decomposition of organic matter in the soil

Evolutionary Relationships

while rotifers are typically considered with the pseudocoelomate phyla, new molecular evidence indicates that they are more closely related to coelomates than pseudocoelomates