Kingdom protista

Kingdom Protista: Characteristics Mostly unicellular, eukaryotic cells Reproduce asexually or sexually by conjugation Exhibit all three modes of nutrition Photosynthesis Ingestion Absorption Ultimately spawned all multicellular kingdoms Very diverse kingdom Difficult for taxonomists to agree on classification Diverse Modes of Nutrition Use diverse modes of nutrition IngestfoodAbsorb nutrients from surroundings Photosynthesis Protists that ingest food are typically predators Use extensions of cell membrane called psuedopods to surround and engulf prey item Diverse Modes of Nutrition

Protists that absorb nutrients directly from the surroundingenvironmentcan be Free-living types in the soil that decompose organic dead matter Parasites that live inside the bodies of other organisms, sometimes harming the host Diverse Modes of Nutrition Some protists have photosynthetic organelles called chloroplasts Photosynthetic protists are abundant in oceans, lakes, and ponds Free floating Mutually beneficial associations with other organisms: solar energy captured by the protist is used by host, which shelters and protects the protist Diverse Modes of Nutrition

Photosynthetic protists are collectively known as algae Single-celled, non-photosynthetic protists are collectively known as protozoa Diverse Modes of Reproduction Most protists reproduce asexually by mitotic cell division Some also reproduce sexually Two individuals contribute genetic material to an offspring that is genetically different from either parent Occurs during certain time of year or circumstances (e. g. a crowded environment or a food shortage) Protist Reproduction Asexual Sexual (a) (b) Effects on Humans

Positive impact - ecological role of photosynthetic marine protists (algae) capture solar energy and make it available to the other organisms in the ecosystem release oxygen gas Negative impact - many human and plant diseases are caused by parasitic protists Major Groups of Protists Protist classification is in transition Genetic comparison reveals evolutionary history of organisms Genetic, instead of physical features now separate protist species into different lineages Some physically dissimilar species are now placed in a common lineage The Excovates Lack mitochondria

Two major groups Diplomonads: have two nuclei and move about by means of multiple flagella Parabasalids: live inside animals Parabasalids Mutually beneficial relationships with other species Parabasalid inhabits gut of termite Termite delivers food to parabasalid, which digests and releases nutrients to termite Parabasalids Harms host species Trichomonas vaginalis causes the sexually transmitted disease trichomoniasis Trichomonas inhabits urinary and reproductive tracts, using flagella to move through them Causes vaginal itching and discharge in females The Euglenozoans

Have distinctive mitochondria Two major groups Euglenids Kinetoplastids Euglenids Single-celled, fresh-water protists Lack a rigid outer covering Best known example is Euglena Moves by whipping single flagellum Photosynthetic Some euglenids photosynthetic, others absorb/engulf food Euglenids Photoreceptor (eyespot) found in some euglenoids Provides for a way to sense location of light source Useful for photosynthetic euglenoids in maximizing photosynthesis Euglena : a Representative Euglenoid Flagellum Eye Spot Contractile Vacuole Stored Food Nucleus Nucleolus Chloroplasts Kinetoplastids

All species have one or more flagella Can be used for propulsion, sensing, or food gathering Many are free-living in soil and water Kinetoplastids Some species live in a symbiotic mutualistic association within another organism Some species digest cellulose in termite guts Trypanosomes live within tsetse flies and cause African sleeping sickness in fly-bitten mammals Trypanosomes infect the blood causing African sleeping sickness Trypanosomes in Blood The Stramenophiles Have fine, hair-like projections on flagella Mostly single-celled but some multicellular

Some are photosynthetic species Major stramenophile groups Water molds Diatoms Brown algae Water Molds Also known as oomycetes Long filaments aggregated into cottony tufts Many are soil and water-based decomposers Water Molds Profound economic impacts caused by water molds Late blight attacks potato plants (caused Irish potato famine in 1845) One species causes downy mildew (nearly destroyed French wine industry in 1870s) A Parasitic Water Mold Downy mildew on grapes Diatoms Found in both fresh and salt water Photosynthetic Produce shells of silica that fit together

Diatomaceous earth is deposits of diatom shells (mined and used as an abrasive) Diatoms Part of floating phytoplankton community Important in absorbing CO 2 and producing O 2 Phytoplankton perform 70% of all photosynthesis Diatoms are important as food in marine food webs Herbivorous organisms “ graze” on these “ pastures of the sea” Brown Algae Form multicellular aggregates (seaweeds) Superficially similar but not closely related to plants Contain brownish-yellow and green (chlorophyll) pigments producing brown/olive appearance Brown Algae Nearly all marine

Found along rocky shores of temperature oceans Includes giant kelp Several species use gas-filled floats to support body Giant kelp forests provide food and shelter for sea animals Diverse Brown Algae Fucus sp. Giant Kelp The Alveolates Single-celled protists with small cavities beneath cell surface (alveoli) Comprise a distinct lineage Nutritional modes include photosynthetic, parasitic, and predatory The Alveolates Major alveolate groups Dinoflagellates Apicomplexans Ciliates Dinoflagellates Mostly photosynthetic Two whip-like flagella

Most species live in salt water Some species bioluminescent Certain specialized dinoflagellates live within coral, clam, and other protistan hosts Cell wall resembles armored plates Dinoflagellates & Red Tide Red Tide Dinoflagellates Nutrient-rich water causes population explosion called “ red tides” Substantial fish kills result from oxygen depletion and clogged gills Oysters, mussels, and clams benefit from large food supply but may accumulate nerve poison Lethal paralytic shellfish poisoning in humans may result from eating these shellfish

Apicomplexans Also known as sporozoans All members are parasitic Form infectious spores Spores transmitted between hosts by food, water, or insect bites Apicomplexans Complex life cycle (e. g. Plasmodium- malarial parasite) Parasite passed to human by Anopheles mosquito Plasmodium develops in liver, makes spores in red blood cells (causing fever upon release) New mosquitoes acquire parasite while feeding on blood Plasmodium quickly evolves resistance to drugs Ciliates Inhabits both fresh and salt water

Highly complex unicellular organization Specialized organelles Cilia that propel cells through water at 1 mm/s Ciliates Examples of ciliate complexity

Paramecium (contractile vacuoles, nervous system) Didinium (predator of other microbes) Paramecium has vacuoles and cilia The Complexity of Ciliates Macronucleus Micronucleus Food Vacuole Oral Groove Contractile Vacuole Cilia Food Vacuole forming The Cercozoans Cercozoans have thin, threadlike psuedopods, which extend through hard shells in some species Cercozoans include

Foraminifera Radiolarians The Cercozoans Foraminiferans produce elaborate calcium carbonate shells with holes Deposits of fossilized foraminiferans form chalk Radiolarians have silica shells Heliozoans The Amoebozoans Amoebozoans move by extending finger-shaped pseudopods, also used for feeding Inhabit aquatic and terrestrial environments Generally do not have shells The major groups of amoebozoans are Amoebas Slime molds The Amoebozoans Amoebas Found in freshwater lakes and ponds Predators that stalk and engulf prey

One species causes amoebic dysentery The Amoebas The Slime Molds Distinctly unique lineage among protists Physical form blurs distinction between a colony versus an individual The Slime Molds Two-phase life cycle Mobile feeding stage Stationary, reproductive stage forming a fruiting body Two main types Acellular Cellular Acellular Slime Molds Also known as plasmodial slime molds Composed of a thinly spread cytoplasm with multiple diploid nuclei Plasmodial mass feeds on bacteria and organic matter by engulfing them Acellular Slime Molds

Can form bright yellow or orange masses Dry conditions or starvation stimulate fruiting body formation Haploid spores produced Spores disperse and germinate into a new plasmodium The Acellular Slime Mold Physarum

(a) (b) Cellular Slime Molds Live in soil as independent haploid cells Pseudopodia surround and engulf food (like bacteria) Cellular Slime Molds Food scarcity creates a pseudoplasmodium Individual cells release chemical signal if food is scarce Dense, slug-like aggregation of cells forms Slug" crawls towards light, forms a fruiting body Haploid spores produced are dispersed to form new single-celled individuals The Life Cycle of a Cellular Slime Mold Single, amoeba-like cells emerge from spores, crawl, and feed. When food is scarce, cells aggregate into slug-like mass called pseudoplasmodium. Pseudoplasmodium migrates toward light, forms fruiting bodies; produces spores. fruiting bodies spores nucleus The Red Algae Multicellular, photosynthetic seaweeds Pigments combined with chlorophyll produce bright red to black appearances Found exclusively in marine environments

The Red Algae Very common in deep, clear tropical waters Red pigments absorb deeply penetrating blue-green light Can therefore live deeper than other seaweeds The Red Algae Diversity of forms and uses Some species deposit calcium carbonate Some species harvested for food Energy captured by red algae important in food chains Products extracted from red algae include: Carrageenan (stabilizing agent) Agar (substrate for bacteria in petri dishes) The Red Algae Multicellular, photosynthetic seaweeds, ranging in color from bright red to nearly black Live in clear tropical oceans

Some species deposit calcium carbonate, which contributes to the formation of reefs Red Algae The Green Algae All species photosynthetic Both multicellular and unicellular species Found in both freshwater and marine environments Some form long filamentous chains of cells (e. g. Spirogyra)

Spirogyra: A Green Algae The Green Algae Some form colonies of clustered cells (e. g. Volvox) Mostly microscopic forms but Ulva (sea lettuce) is a multicellular leaf-sized green algal seaweed The Green Algae Green algae are closely related to plants

The earliest plants may have been similar to today’s multicellular green algae Protists and Life Marine phytoplankton: 70% of all photosynthesis Diatoms - abrasive products and oil reserves Sarcodines and limestone deposits Protists and disease Water molds - downy mildew, late blight of potato Dinoflagellates and " red tide," shellfish poisoning Zooflagellates - African sleeping sickness, Giardia Sarcodines - amoebic dysentery Sporozoans - Plasmodium and malaria Giardia: the Curse of Campers