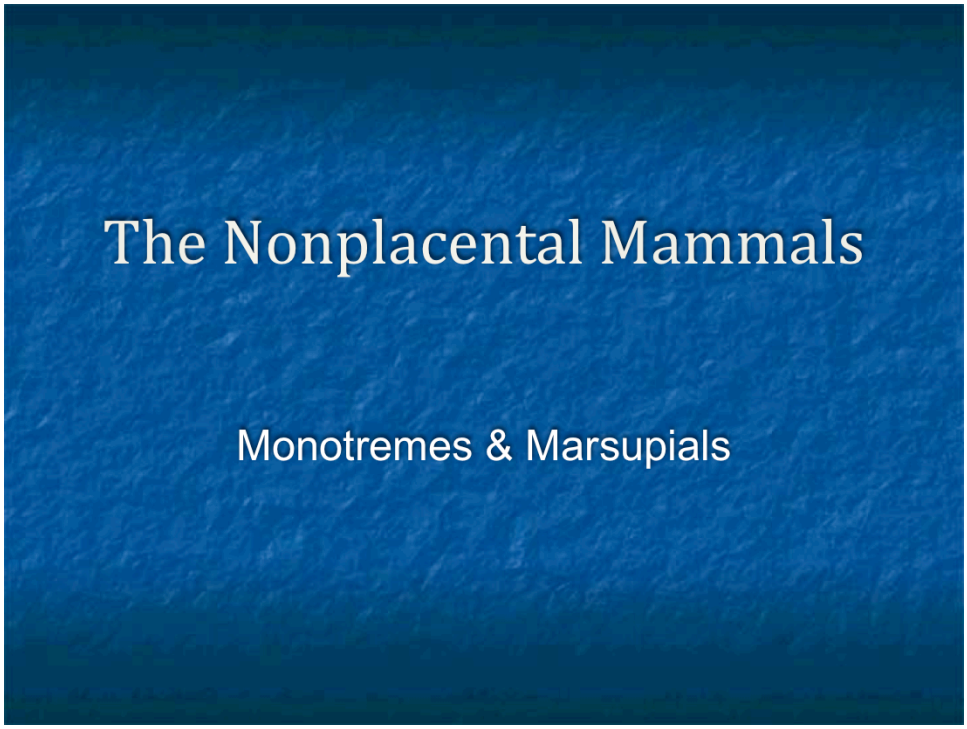
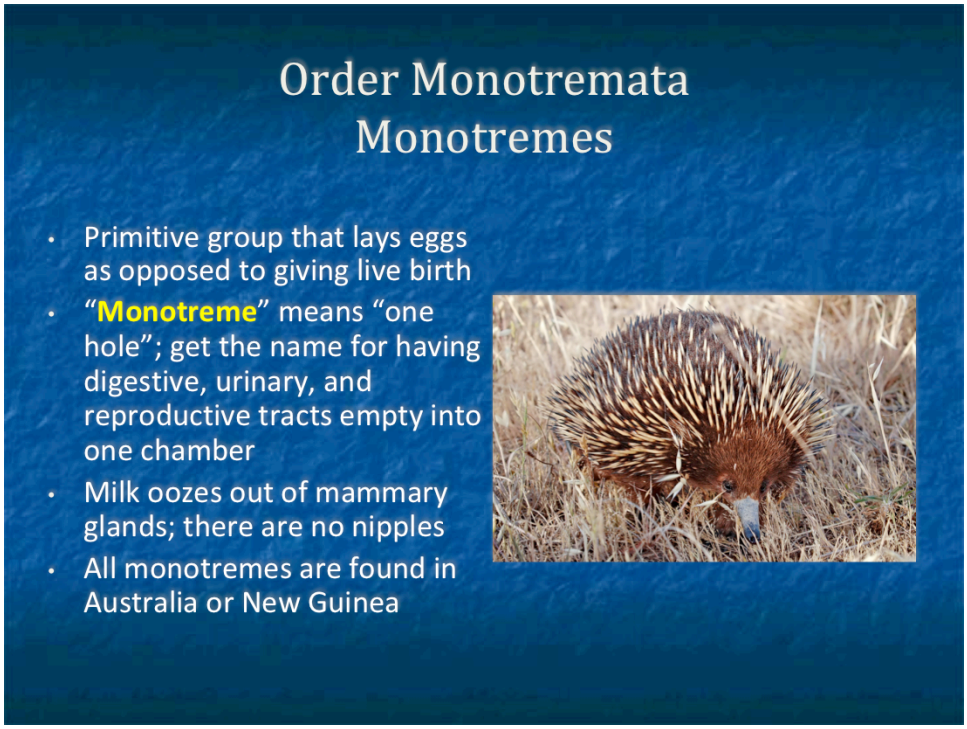


The majority of mammals are the placental mammals. The nonplacental mammals include the monotremes and the marsupials. The monotremes are the egg laying mammals and are the only exception to modern mammals giving birth to live young. The marsupial's distinctive characteristic is that the young are carried in a pouch (common to most species) after a brief gestation period.

Isolated from the placental mammals, Australia became home to the majority of nonplacental mammals. Marsupials of Australia came to occupy many of the ecological niches placental animals occupy elsewhere in the world.



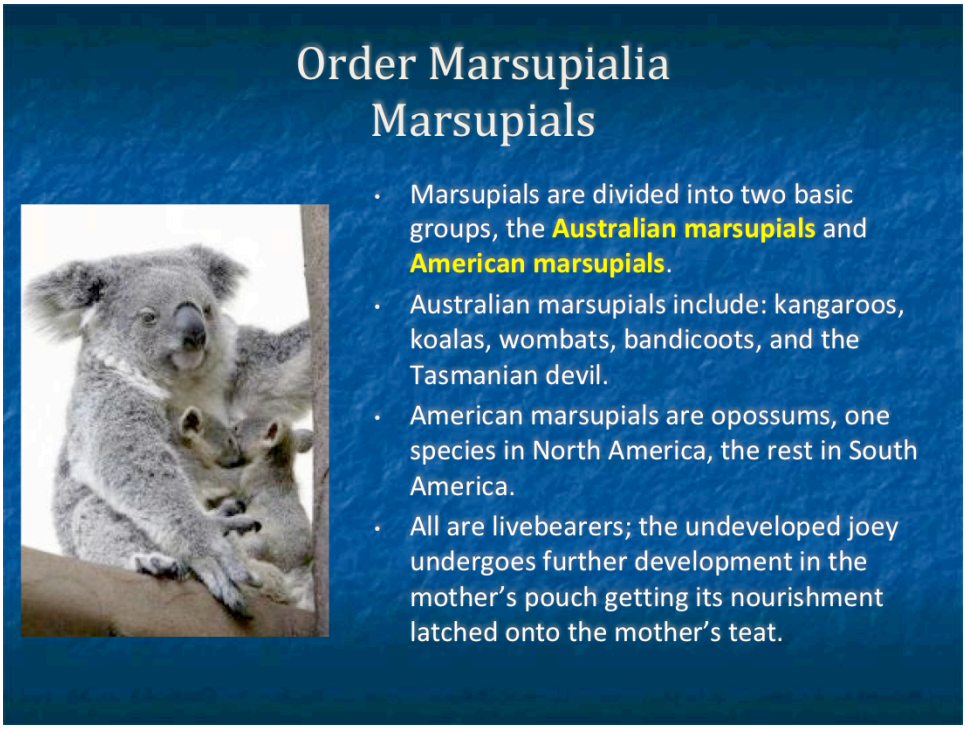
Of the three types of mammalian reproduction, the monotremes are the most primitive group and lay eggs as opposed to having live birth. "Monotreme" means "one hole"; they get the name for having "one hole," for reproduction and excretion. All monotremes are found in Australia or New Guinea. They include the platypus and echidnas or spiny anteaters.

In echidnas, the egg is carried in a pouch on the female's belly until the young hatches, at which point the barely-developed young must find a mammary gland and latch onto it for nourishment. In the platypus, the female retires to a burrow in the bank of a river or pond. The babies are not fully formed when they hatch; they lack hair, claws, and a sense of sight.

Monotremes have important mammalian characters including fur, a four chambered heart, three middle ear bones, and the ability to lactate. Mammary glands are open; milk oozes out and baby laps it off the mother's hair on her belly. They do not have nipples as the other mammals.

Monotremes retained a reptile-like gait, with legs on the sides of, rather than underneath, their bodies as in other mammals. The monotreme leg bears a spur in the ankle region; the spur is not functional in echidnas, but contains a powerful venom in the male platypus.

The Sculpture Learning Plaza has a platypus.



Marsupials are an Order whose members are born incompletely developed and are typically carried and suckled in a pouch on the mother's belly. The Order Marsupialia is divided into two basic groups, the Australian marsupials and American marsupials. Australian marsupials include; kangaroos, koalas, wombats, bandicoots, the Tasmanian devil and other species. American marsupials are opossums, one species in North America, the rest in South America. Since marsupials occupy many niches, each family has developed unique adaptations for its different lifestyles.

Australia has been isolated for a long time. During this time, marsupials and monotremes had practically no competition from placental mammals. Marsupial success in Australia has been attributed to their comparatively low metabolic rate, which means they have smaller energy demands. This gave marsupials an evolutionary advantage in the Australian environment, which is largely characterized by arid, inhospitable land with limited food resources. This environment favored mammals that had energy conserving traits. The introduction of placental mammals by humans caused many problems for the endemic species.

Marsupials give birth to live young, they have nipples that provide milk for the newborn (or joey) and they have a distinct method of birth. Most marsupials have pouches which provide protection for the developing joey. Marsupials have a very short gestation period, and the newborn (or **joey**) completes its development in the mother's pouch.

What type of placental mammals, found elsewhere from Australia, occupy the same ecological niche as the kangaroo? Deer and antelope are larger grazing animals and fill similar niches as the kangaroos. What zoo animal fills a similar niche to the Tasmanian devil? The wolverine. What zoo animal fills a similar niche to the koala? The sloths.

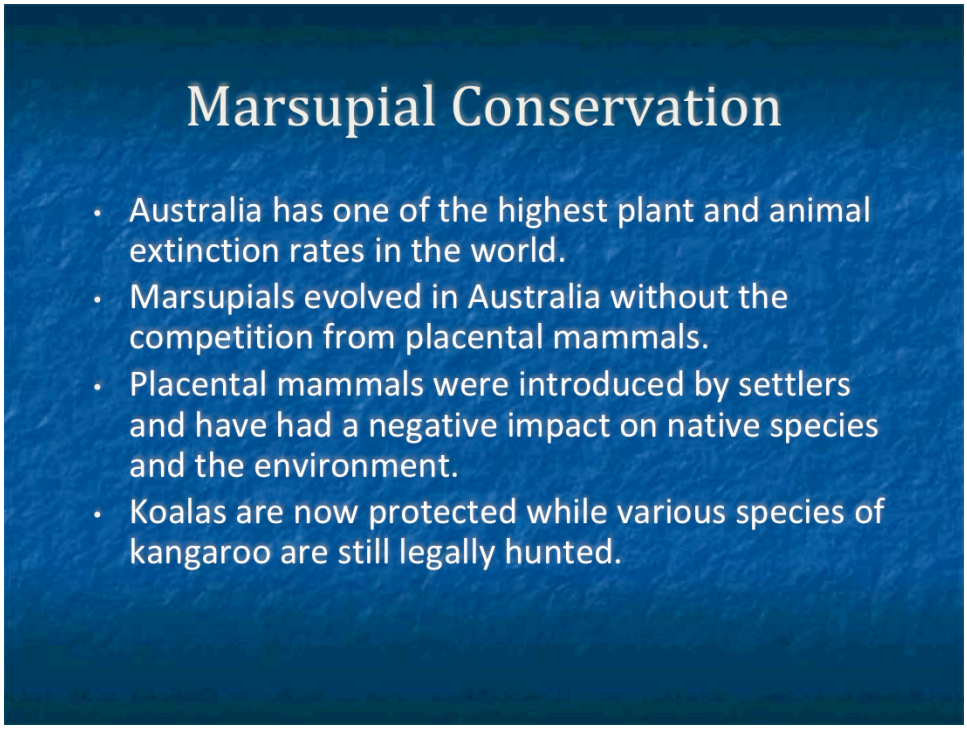
Marsupials in the Zoo include the koala, red kangaroo, common wallaroo and the red-necked wallaby. The Sculpture Learning Plaza has a Tasmanian devil, the largest carnivorous carnivore.

The primary characteristic defining the Order Marsupialia is the unique reproductive system in that they lack a true placenta. In marsupial reproduction, the female develops a kind of yolk sac in her womb, which delivers nutrients to the embryo. Birth occurs through a single external opening and the newborn makes its journey to the mother's pouch, where it attaches to a teat and will remain until it is ready to emerge from the pouch. The newborn is approximately the size of a jellybean. The embryo is blind, hairless with underdeveloped hind legs yet must pull itself through the mother's fur up from the vagina to the pouch, find a nipple, and attach itself to grow for several more weeks or months depending on the species. **Note:** there is a sign in the koala exhibit that can be used to show the difficult trek the joey has to make.

Joeys, will continue to use the pouch to sleep or for safety even after exploring outside. A marsupial joey is unable to regulate its own body temperature and relies upon the warmth inside the mother's pouch. Being able to regulate their body temperature and weaning occur about the same time and the joey will begin to come out of the pouch.

The kangaroo, wallaby, and wallaroo species exhibit **embryonic diapause** where the female mates shortly after giving birth and the fertilized embryo develops into a blastocyst of 85 - 100 cells, and then becomes dormant. While the female is nursing a joey in the pouch, the blastocyst remains dormant. When the joey stops nursing due to weaning or death the blastocyst resumes development. A blastocyst develops into an embryo which will emerge in approximately 33 days. **Note:** Embryonic diapause occurs in kangaroos but does not occur in koalas.

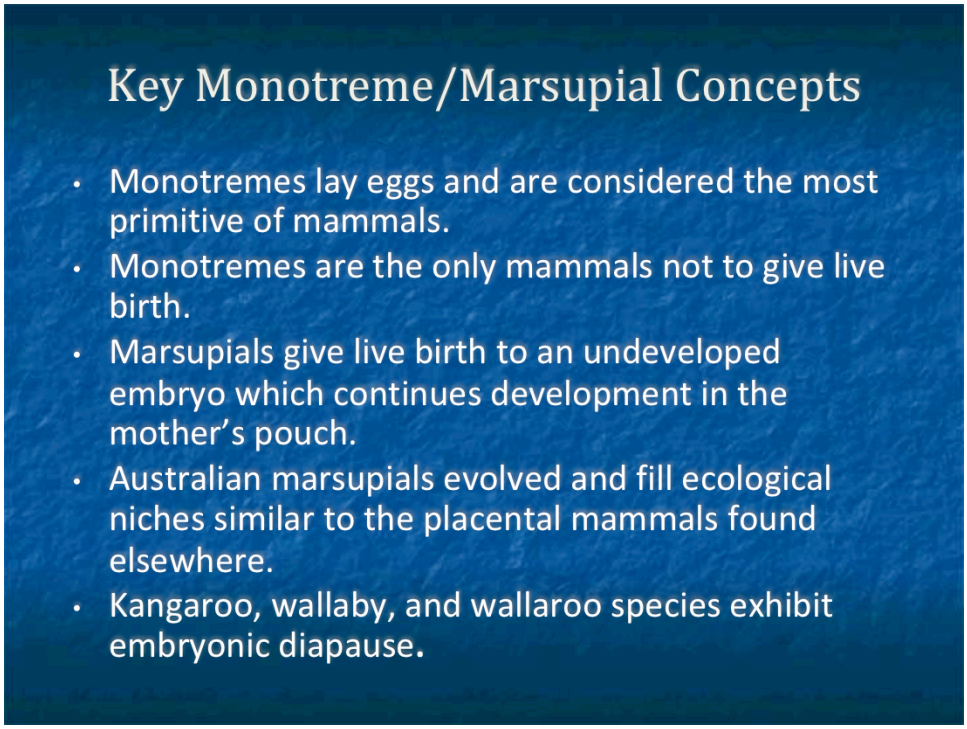
A female may have three offspring simultaneously in different stages of development; the blastocyst, the joey in the pouch and a partially weaned offspring (referred to as young-at-foot). The female produces different milk for the joey and the young at foot (the latter is richer)



According to the Red List in March, 2016, Australia is in the top five for extinction of animal and plant species, and the top 10 for endangered and threatened species. Most of Australia's wildlife is found nowhere else in the world, making its conservation even more important. (87% of Australia's mammal species, 93% of reptiles, 94% of frogs and 45% of the bird species are endemic and found only in Australia) Since marsupials evolved in Australia, without placental mammals, the introduction of dingos, feral cats, and rabbits by human settlers has had a negative impact on many species. Some small species are endangered or extinct because introduced predators have found them to be easy prey. Competition with dingos is thought to have eliminated the Tasmanian wolf from the Australian mainland. Rabbits effect on the ecology of Australia has been devastating. Rabbits overgraze and can reduce a plant to ground level leading to erosion and loss of plant diversity. They also compete with native animals for food and shelter.

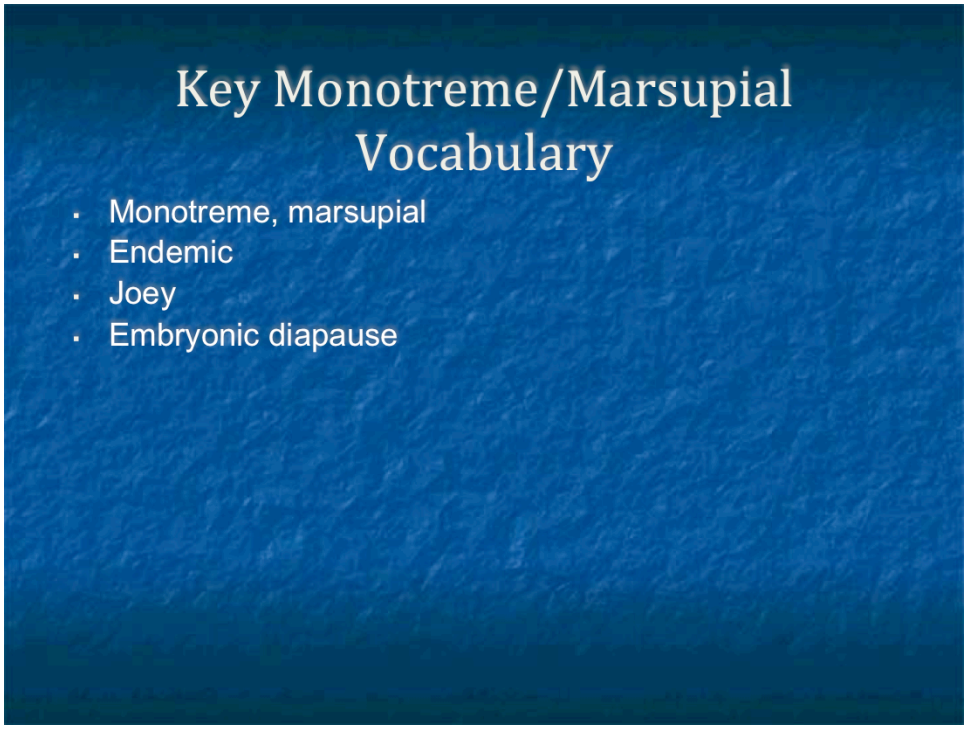
Koalas are now protected while various species of kangaroo are still legally hunted for pet food and to reduce the competition with sheep for grass and water. Yet kangaroo populations remain strong due in part to their ability to survive in harsh environments not suitable for agriculture.

Expanding human settlement and agriculture have altered the habitat of some marsupials and some species are endangered by lose of habitat. Grazing sheep have altered or eradicated certain habitats resulting in the decline of numerous small marsupials, while allowing the large kangaroos to expand their range.



Corresponds to the Mammalia (pages 9-11) and Marsupialia Study Guides

For specifics on the zoo's marsupial collection read the Marsupialia Fact Sheets in the Docent Notebook and go to the SF Zoo's website (sfzoo.org)



Definitions:

Embryonic diapause: a period of arrested development of an embryo at the stage of blastocyst (70- to 100-cell stage); found in some Kangaroos, wallaroos and wallabies; may result in having three young in different stages of development dependent on the mother at one time.

Endemic: indigenous or native only to specific locality or region.

Joey: an infant marsupial

Marsupial: an Order of animals whose members are born incompletely developed and are typically carried and suckled in a pouch on the mother's belly.

Monotreme: A term to describe a class of egg laying mammals with "one hole" used for reproduction and excretion.