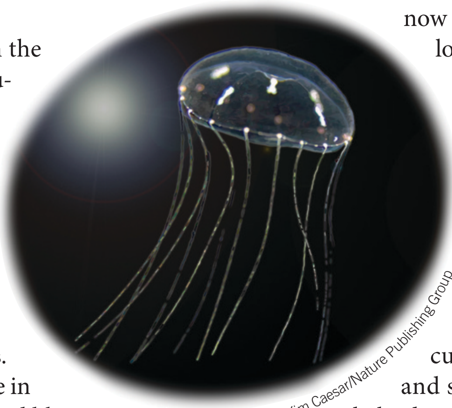
Unraveling the mysteries of the medusa

by Gregory D. Larsen

TAXONOMY
PHYLUM: Cnidaria
SUBPHYLUM: Medusazoa



General Description

Jellyfish include a diversity of species within the phylum Cnidaria that are distinguished, in maturity, by the distinctive 'medusa' body shape—a gelatinous bell with trailing tentacles. The subphylum Medusozoa encompasses all cnidarians that produce medusas, and these are currently grouped into four classes: scyphozoa, called "true jellyfish"; cubozoa, called "box jellyfish"; staurozoa, called "stalked jellyfish"; and hydrozoa, which includes marine jellyfish as well as sessile and freshwater species. Jellyfish of different species and ages can range in size from millimeters to meters in diameter, and like all cnidarians, they are radially symmetrical and bear venomous cells called cnidocytes. Different species can have very different lifecycles and reproductive modes that often involve both sessile, asexual polyp stages and free-swimming, sexual medusa stages. In some species, such as *Clytia hemisphaerica*, scientists can reproduce and manipulate the jellyfish lifecycle to maintain experimental colonies under laboratory conditions[1]. A single polyp colony can asexually produce genetically identical male or female medusae, depending on temperature conditions, and medusa can be bred sexually, with females spawning eggs daily in response to lighting conditions.

Research Résumé

Phylogenetically, cnidarians are considered basal metazoans, and all four classes of Medusazoa are represented in the Cambrian fossil record from about 500 million years ago. For this reason, jellyfish are often used in studies of developmental and evolutionary biology, particularly to explore the origins of bilaterian animals through shared and contrasting characteristics[2]. For example, Cnidaria is the most basal phylum that features complex eyes, so researchers have studied the presence and function of opsin proteins in jellyfish to better understand the evolutionary divergence of cilliary photoreceptor cells, which are predominant in vertebrates, from rhabdomeric photoreceptor cells, which are predominant among invertebrates[3,4]. Similarly, cnidarians possess smooth and striated muscle cells that resemble those of bilateria, and by examining the mechanical structure and genetic expression of these cells, researchers now believe that cnidarian and bilaterian animals evolved similar muscles convergently from a common ancestor with a basic contractile apparatus[5].

Perhaps the greatest single advancement that cnidarians have contributed to the life sciences is a gene that comes from the crystal jelly, *Aequorea victoria*. In 1962 researchers described the purification and characterization of highly visible fluorescent proteins from *A. victoria*, and following the advent of modern genetic techniques in the 1990s, scientists isolated, sequenced and cloned the gene for the now ubiquitous green fluorescent protein[6]. In following years this jellyfish protein, with its many variants and diverse applications, has become an invaluable tool in studies that build upon transgenic research and techniques.

Today researchers in many fields continue to draw upon jellyfish for inspiration and advancements. Scientists have analyzed and recreated the simple but effective jet propulsion by which jellyfish locomote, first in a biomimetic robot[7] and later in a muscular pump composed of dissociated rat tissue and silicone polymer[8]. Other experiments have hybridized synthetic hydrogels with those of the jellyfish body to develop robust candidate materials for tissue replacement[9]. Additionally, jellyfish collagen has been described as an abundant and safe choice for tissue engineering[10] and several other biomedical applications[11], particularly since mammalian collagens can confer known zoonotic diseases to humans. With populations blooming across the oceans and cropping up in laboratories, jellyfish will no doubt remain important subjects for research across the life sciences in the coming years.

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