**Whale Cart**
Aquarium of the Pacific

*This activity outline was developed for use in a variety of informal venues. By design, it provides the content, pedagogy and strategy necessary for implementation by both the novice and experienced informal educator. It is expected that this outline will be adapted and improved upon by the user. We welcome your feedback!*

**Synopsis of the Activity**
Guests learn more about the diversity, biology, and conservation of whales through hands on interaction with whale artifacts including skull replicas, bones, teeth, and baleen,.

**Audience**
The whale cart will target visitors of all ages. Themes can be modified easily with age appropriate concepts. Suited for small groups of participants.

**Setting**
Open areas on the floor easily visible to visitors.

**Activity Goals**
The goal of the whale cart is to help visitors develop a deeper understanding of the diversity and biology of whales, to communicate a message of marine mammal conservation, and to give visitors a chance to handle whale specimens.

**Concepts**
- There are two groups of whales based on the feeding structures in their mouths: toothed and baleen.
- Baleen whales use their baleen to filter large quantities of plankton and small fish from the water.
- Toothed whales typically feed on large prey including fish, squid, and other marine mammals.
- Baleen whales are generally larger than toothed whales.
- Toothed whales have the ability to use echolocation to locate food and navigate.
- Over the past two centuries, whales have been hunted extensively, many to near extinction. Whale populations have also been severely impacted by pollution, changes in the ocean temperature and availability of food, entanglement in fishing apparatuses, and boat strikes from boats.

**Ocean Literacy Principles**
5. The ocean supports a great diversity of life and ecosystems.
    a. Ocean life ranges in size from the smallest virus to the largest animal that has lived on Earth, the blue whale.
    c. Some major groups are found exclusively in the ocean. The diversity of major groups of organisms is much greater in the ocean than on land.

d. Ocean biology provides many unique examples of life cycles, adaptations and important relationships among organisms (symbiosis, predator-prey dynamics and energy transfer) that do not occur on land.

6. The ocean and humans are inextricably interconnected.

g. Everyone is responsible for caring for the ocean. The ocean sustains life on Earth and humans must live in ways that sustain the ocean. Individual and collective actions are needed to effectively manage ocean resources for all.

**Materials**

All materials are housed on or within a large rolling cart:

- Large orca skull replica (mounted to the top of the cart, optional)
- Large baleen whale upper and lower jaw model (mounted to the top of the cart, optional)
- Bottlenose dolphin skull replica
- Individual orca tooth replicas
- Plates of baleen
- Bottle of preserved krill
- Pictures of many different baleen and toothed whales
- Diagrams of "lunge feeding" and "echolocation"
- Diagram of whale mouth full of baleen, open and closed if possible
- Other diagrams or pictures of expanded baleen whale pleats, bubble netting in humpbacks, etc. may be helpful to demonstrate feeding behaviors

**Preparation and Set-up**

Place orca skull replica, baleen whale jaw models, bottlenose dolphin skull, orca teeth, and baleen plates on top of the cart. Arrange items randomly. Keep bottle of preserved krill and diagrams ready for demonstrating diet.

**Guiding Questions**

What differences do you notice between this mouth (skull of an Orca) and this mouth (plastic model of the upper and lower jaw of a baleen whale)?
How do you think a baleen whale gets so big eating such small food? How does it capture such tiny prey?
How do you think a toothed whale finds its food in the deep dark ocean?
How and what do whales breathe?
How do they stay warm in the cold ocean?
What do whales feed on as babies?
How might humans be connected to whales? Are you connected to whales even if you do not live near the ocean?
What might be some threats to whales? Can we do anything in our everyday lives to help protect them?

**Activity Description**

**Introduction:** Invite visitors to come over and participate. Try different strategies to draw them in. For instance, ask them if they have ever touched the tooth of an Orca or the skull of a Bottlenose dolphin. Or, share a couple of really cool facts about whales to

pique visitors' interests, and then invite them over to figure out the what, how, and why of that fact using the objects on your cart. For example, say, "the Blue Whale can eat up to 8,000 pounds of food a day. Come over and we can find out how they do that and why they need to eat so much."

**Free exploration:** Once visitors are hooked, allow them to touch and handle gently the objects. As they explore, initiate a conversation with the visitors and encourage discussion amongst the visitors. In this exploration, visitors have the opportunity to examine closely (touch, smell, think about) a variety of whale skeletal parts to become familiar with whale biology.

Two related tasks that can help focus their exploration include identifying and comparing the objects. As the visitors observe items and ask questions about them, the educator can help the visitors understand pertinent information about the items, such as composition of objects, use, biology, etc. The following are some guiding questions you may want to ask. As visitors respond to your questions, encourage them to explain how they know that or think that. The "evidence" for their explanations could come from observations of the objects or prior experiences and knowledge they already have. Make sure you model this as you share information with visitors. Be sure to encourage visitors to ask their own questions:

- How do the objects feel?
- As you touch the objects, think of some ideas on whales that you might want to find out more about. We can try to figure them out together.
- What do you notice about the objects?
- How are they similar to each other?
- How are they different from each other?
- How big do you think the whale is with a part that size?
- What do you think is the function of this animal part?
- How might this item help the animal survive?

<u>Key ideas to address in this conversation</u>

1. All whales are members of the order Cetacea. The Latin word *cetus* means "large sea animal," and the word "ketos" in Greek means "sea monster." Even within the order, there is a fair amount of diversity, as seen in the morphologies of the parts included on the whale cart.

**What's the difference?:** Engage in a conversation with visitors about the differences between baleen whales and toothed whales using humpback whales, blue whales, orcas, and bottlenose dolphins as examples. In this exploration, visitors examine and make comparisons between the objects at the cart to find out how the major groups of whales are categorized. Inform visitors that whales can be organized into two general categories based on the features they have for feeding. "Let's see if we can figure out what are those features." The following are some guiding questions you may want to ask to help visitors sort and to further understand the diversity of toothed and baleen whales. As visitors respond to your questions, encourage them to explain how they know that or think that.

The "evidence" for their explanations could come from observations of the objects or prior experiences and knowledge they already have. Make sure you model this as you share information with visitors. Be sure to encourage visitors to ask their own questions.

- If it is the way whales feed that is used to distinguish them into two major groups, then what are some feeding structures and behaviors that we can observe to figure this out?
- What can we find out about what whales might eat based on their teeth/feeding structures? (Do you think these whales eat the same thing? Why?)
- What do you think toothed whales eat?
- What do you think baleen whales eat?
- How do you think toothed whales find and catch their prey? How do you think baleen whales find and catch their prey?
- How do you think baleen whales eat their prey?

Key ideas to address in this conversation

1. Whales are organized into two major groups based on their feeding – baleen and toothed whales.
2. Baleen whales are filter feeders; they have many large plates of baleen (hair-like plates) that hang from their top jaw. The whale's ventral (belly) side is covered in throat pleats, which expand to allow for a great volume of water (several thousands of gallons) when the whale feeds. This water is filled with krill and other plankton. The whale then takes its massive tongue and forces all the water out in between the baleen plates, trapping all of the krill in the hair-like structure of the baleen. It then uses its tongue to scrape the krill off the baleen and swallows. Baleen whales consume several thousand tons of food each day during the feeding season.
3. Toothed whales have conical shaped teeth that run along the top and bottom jaw. Orcas and other larger whales hunt and eat large prey, such as seals, sharks, and other whales. Bottlenose dolphins and other smaller whales hunt and eat smaller prey, such as fish and squid. Toothed whales use echolocation to find and even stun their prey.

**Save the whales!** Talk with visitors about how human activities have affected whales in the past, and continue to do so in different ways. Ask visitors if they think that humans are connected to whales in any way and if whales are affected by humans in any way. For guests seeking more connections or stories, conservation stories about the right whale or the gray whale can be discussed. Visitors are challenged to think about the impact human choices have on whale populations. Discuss with visitors different ways that we can help conserve whales.

- (For a Southern California ISEIs): We can see whales off the coast of Southern California almost all year round. How are coastal communities like ours affected by whales?
- What are some ways we affect whale populations globally? Locally? Do you think that people who live inland can also affect whales? How so?
- Historically, whales have been hunted for many reasons. Talk with each other to share what you remember seeing from books and other places. What are some products we used to make from whales or whale parts?

Key ideas to address in this conversation

1. Historically, whales have been hunted in both commercial and subsistence capacities for meat and for oil which was then used to make many other products.
2. Whales are now federally protected from whaling in American waters.
3. In international waters, the protection of whales is monitored by an agency called the International Whaling Commission, or IWC. The IWC sets policies and makes recommendations for all participating countries, although participation is voluntary and enforcement of the laws can be difficult.
4. Water pollution may also affect whales.
5. Sound pollution from boats, watercraft, and sonar may affect echolocation in toothed whales.
6. Bycatch of dolphins and small cetaceans in fishing nets and entanglement in marine debris may also be discussed.

**Additional Resources**

Whales (Eyewitness Books). By Vassili Papastavrou. DK Publisher.

Whales Dolphins and Porpoises (Smithsonian Handbooks). By Mark Carwardine. DK Adult Publisher.

Echolocation:
http://www.enchantedlearning.com/subjects/whales/glossary/Echolocation.shtml

Toothed whales: http://en.wikipedia.org/wiki/Toothed_whale
Baleen whales: http://en.wikipedia.org/wiki/Baleen_whale

**Background**

**Vocabulary**

Cetacean – An order of marine mammals, including the whales.
Marine Mammal – A mammal that lives in, or depends upon, the marine environment for survival.
Baleen – A keratin structure with a rough edge used to filter small prey from the water. Generally speaking a baleen whale may have hundreds of plates of baleen hanging from its upper jaw. When stacked together, they form a giant filter. Keratin is the same protein that makes up human hair and fingernails.
Baleen Whale – A whale belonging to the suborder Mysticeti. These whales have baleen plates that are used to feed on large quantities of small prey. This group includes such species as humpback whales and blue whales.
Toothed Whale – A whale belonging to the suborder Odontoceti. These whales have teeth and include dolphins and porpoises as well as sperm whales.
Blowhole – The respiratory structure located at the top of a whale's head.
Melon – Structure found at the top of the skull of toothed whales. This oil filled area aides in the production of echolocation signals.

Echolocation – A biological version of sonar. Toothed whales can create a series of sounds that when directed into the marine environment can help them to navigate and to find food. The sound waves travel out from the melon, contact a surface and bounce back to the whale where the signals are interpreted.
Odontocetes – Toothed whales.
Mysticetes – Baleen whales.
Krill – A group of planktonic, small shrimp-like animals that form the staple diet of certain baleen whales.
Whaling – The process of hunting whales for food and for use in other industries.
Pollution – The release of contaminants into the environment often with negative repercussions.
Conservation – Effort to protect animals, plants, and the habitats they live in.
Adaptation – A structure or behavior that helps an organism to survive.
Blubber – A thick layer of fat that insulates marine mammals from cold ocean water.

Toothed Whales vs. Baleen Whales
Toothed: single blowhole, teeth for grasping fish and larger prey, melon for echolocation, typically smaller than baleen whales
Baleen: two blowholes, keratin plates for sieving prey from water, typically larger than toothed whales

Echolocation in Toothed Whales
Toothed whales use echolocation to locate and size up their prey. Essentially, echolocation is using sound in order to see where things are located. The whale forces air through an intricate system of nasal sacs in the blowhole. The melon, fatty tissue situated in the forehead, focuses the sound and the whale emits the beam of sound out. These projected sound waves will hit the prey item, bounce off, and will be received in the hollow lower jaw (pan bone) in the form of vibrations. The lower jaw is juxtaposed to the ear canal to better receive these vibrations. This process gives detailed information such as size, shape, and distance of the prey item.

Bubble net feeding in Humpback whales
Bubble net feeding is a behavior seen in baleen whales such as humpbacks. These whales produce rings of bubbles in order to corral small fish. Once fish have been concentrated inside the net of bubbles, the whales swim up through the bottom of the net, scooping up the thousands of fish inside in one mouthful. Bubble netting is often done cooperatively by a group of whales who all form the net together.

Humpback Whale

Classification

Kingdom: Animalia
Phylum: Chordata
Class: Mammalia
Order: Cetacea
Suborder: Mysticeti
Family: Balaenopteridae
Genus: Megaptera
Species: novaeangliae

## Physical Characteristics

### Size and Weight

Humpback whales are average-sized baleen whales, usually measuring between 12-16 m (40-50 ft) in length and may weigh between 25-40 tons. The females are usually larger than the males, which is normal for baleen whales. Humpback whale calves measure between 3-4.5 m (10-15 ft) and weigh between 1-2.5 tons.

### Distinguishing Characteristics

Humpbacks range in color from white to black to gray and have mottled white flippers, which are the largest of any whale. Often times the whale flippers are covered with barnacles. Humpbacks have a small dorsal fin toward the flukes and 14-35 throat grooves, which run from the chin to the navel. Humpbacks are distinguished from other large whales by their very long pectoral fins, which are about one-third of their body length. They also have a flat head with bumps called tubercles.

### Habitat

Humpback whales are found in all ocean of the world and live both in the open ocean and in shallow waters. During winter they mate and calve in warm tropical waters and then migrate to colder waters during the summer to feed.

### Diet and Feeding

Humpback whales are baleen whales that filter feed tiny crustaceans like krill and copepods, as well as small fish from the water. They are gulp feeders, and eat about 4,400-5,500 pounds of food each day. They have a series of 270-400 fringed overlapping baleen plates hanging from the upper jaw, and measure up to 30 inches in length and 13.5 inches wide. Humpbacks participate in cooperative hunting by rounding up large masses of prey by bubble-net feeding. The whales form a large circle and blow a wall of bubbles in a spiral path to trap their prey.

### Reproduction

Humpback whales breed during the winter and early spring in warm tropical waters and the gestation period is 12 months. They reach sexual maturity at 6-10 years of age and females will bear a calf every 2-3 years. After it is born, a calf will stay with its mother

for about a year, feeding off the rich milk, which is about 45% fat. A calf will drink about 100 pounds of milk each day and will start eating solid foods after a year.

Behavior

Humpback whales are most known for their loud songs. Only the males have been recorded singing and they have the largest frequency range of any whale ranging from 20-9,000 Hertz. The songs have only been recorded in warm waters, and may be used for mating. In cold waters, Humpbacks make groaning sounds that may be used to communicate and find food. Humpback whales can dive to a depth of 500-700 feet and can dive up to 30 minutes; however the average dive is usually only 15 minutes. They breathe air through their 2 blowholes and spout about 1-2 times per minute with a double-stream spray. This spray can rise 3-4 m (10-13 ft). These whales are also very acrobatic and have been known to breach high out of the water. They are also seen spyhopping, lobtailing, and slapping their fins against the water surface.

Adaptations

Humpbacks are able to move through the water at up to 16 miles per hour. These whales also have a thick layer of blubber, which helps to insulate them and serve as an energy reserve. Humpback whales have no teeth, but rather baleen plates that are made of keratin. Male humpback whales are able to produce songs for communication and possibly for attracting mates.

Longevity

Humpback whales have a life expectancy of 45-50 years.

Conservation

Humpback whales are an endangered species. They are protected by the Marine Mammal Protection Act, as well as the Endangered Species Act. It is estimated that there are 10,000-15,000 humpback whales worldwide.

Fun Facts

- The scientific name for the Humpback Whale is *Megaptera noveangliae*. This means "big-winged New Englander," named after the Humpback's large flippers, which can be as long as one third of the whale's body, and their presence in New England waters.
- Humpbacks are known for the amazing songs they produce underwater.
- Humpbacks are one of the most active and acrobatic of all the whales.

# Blue Whale

## Classification

Kingdom**:** Animalia
Phylum**:** Chordata
Class**:** Mammalia
Order**:** Cetacea
Family**:** Balaenopteridae
Genus**:** Balaenoptera
Species**:** Balaenoptera musculus

## Physical Characteristics

The blue whale's skin is usually blue-gray with white-gray spots. The underbelly has brown, yellow, or gray specks. Blue whales grow to be about 80 feet long on average, weighing about 120 tons or 300,000 pounds (as much as 2000 people). The largest specimen found was a female 94 feet long weighing more 174 tons. The newborn calf is about 25 feet long and weighs about 6-8 tons.

## Habitat

Blue whales migrate long distances between equatorial wintering grounds and high latitude feeding areas. In the eastern North Pacific, they winter off southern and Baja California. During the summer they may be found across the Gulf of Alaska, but they seldom enter the eastern Bering Sea.

## Diet and Feeding

Blue whales are seasonal feeders and carnivores. Their mouths are filled with baleen plates (hair-like plates) that filter krill (small shrimp like creatures) and plankton from the water. The whale's ventral (belly) side is covered in throat pleats, which aid in the feeding process. The entire underside of the whale's mouth has the ability to expand like a water balloon to capture food. When the whale takes in water, its throat pleats expand to allow for a greater volume of water, up to 17,000 gallons laden with food. The blue whale then takes its massive tongue and forces all the water out in between the baleen plates, trapping all of the krill. With this method of feeding the blue whale can consume up to 4 tons (8000 pounds) of krill per day. Feeding takes place while swimming slowly.

## Reproduction

Blue whale breeding occurs mostly in the winter to early spring while near the surface and in warm waters. The baby is nurtured with its mother's fat-laden milk and is weaned in about 7-8 months. Whale milk is approximately 40-50% milk fat (cow milk is 3% milk fat). This high percentage of milk fat allows the young whale to gain up to 9 pounds an hour (200 pounds a day) in the early stages of its life. The mother and calf may stay together for a year or longer, until the calf is about 45 feet long.

## Behavior

Blue whales live individually or in very small groups. They frequently swim in pairs. Blue whales are very fast swimmers; they normally swim 3-20 mph, but can go up to 24-30 mph in bursts when in danger.

Adaptation

Long and streamlined, they are capable of sustaining speeds of 12 mph while traveling or foraging for food. When frightened, the blue whale can reach speeds up to 30 mph. Enormous muscles in a blue whale's caudal flanks and peduncle power its wide flukes up and down.

Longevity

Blue whales have a life expectancy of 35-40 years, but records indicate that they can live to up to 80 years.

Conservation

Blue whales are an Alaskan and federal endangered species. Before these whales were over-hunted for their meat, oil, and other body parts, their population included about 200,000 individuals around the world. Since whale hunting has decreased due to the Marine Mammal Protection Act 1972 and the Endangered Species Act 1973, their populations are starting to recover to approximately 11,000.

Fun Facts

- Heart is as big as a small car
- Arteries are large enough for a small child to crawl through
- Tongue weighs as much as an African Elephant (6000-8000 pounds)

Orca Whale

Classification

Kingdom: Animalia
Phylum: Chordata
Class: Mammalia
Order: Cetacea
Suborder: Odontoceti
Family: Delphinidae
Genus: Orcinus
Species: orca

## Physical Characteristics

### Size and Weight

Orca whales are the largest type of dolphin. Males can grow as large as 9.6 m (32 feet) long and weigh 8 to 9 tons, while females can reach 8.2 m (23 feet) in length and weigh up to 4 tons.

### Distinguishing Characteristics

The Orca whale has a color pattern made up of areas of black and white. The top part of its body is black with a pale white or grey area behind the dorsal fin. These whales have a white eyepatch behind and above each eye. The undersides of their bodies are white, and each whale can be identified by the shape of the patch behind their dorsal fin. The dorsal fin of a male can reach 6 feet in length and is shaped like an isosceles triangle. The immature males and females have a smaller dorsal fin, which can measure up to 3 feet.

### Habitat

Orca whales are found in all of the world's oceans and they seem to prefer coastal waters. They make short seasonal migrations, and may travel hundreds of miles in search of prey.

### Diet and Feeding

Orca whales have sharp, conical teeth that are used for eating large animals. They are one of the top predators in the ocean and feed off of fish, squid, seals, sea lions, sharks, turtles, penguins, gulls and even other whales. These whales have 10-13 pairs of teeth on both the upper and lower jaws that curve inwards for catching prey. Killer whales often hunt in groups and can eat 551 pounds of food a day. They use echolocation to locate their prey.

### Reproduction

Orca whale breeding occurs mostly in the winter to the early spring in warm waters. Females reach maturity at 6-10 years old and gestation lasts 16-17 months. Males reach sexual maturity later at 12-16 years old. Calves range in size from 6-8 feet long at birth and weigh about 400 pounds. The mother and calf will stay together for one year or longer.

Behavior
Orcas are very social animals that live in small pods of 6-40 whales. These whales can dive to a depth of 100 feet for hunting prey and are often seen breaching and spyhopping in the water.

Adaptations
Orca whales have a single blowhole at the top of their heads that is used for breathing. They use a wide variety of vocalizations for communication, mating, and locating prey. Orcas use echolocation to detect objects in the water and find food. They are very fast swimmers, and can move up to 30 mph to catch their prey.

Longevity
Orca whales have a life span of 40-60 years; however some may live up to 90 years.

Conservation
Orca whales seem to be abundant in their habitat range and are not considered endangered. They are highly susceptible to pollution and chemical contaminants in their ocean waters.

Fun Facts
- The dorsal fins of male killer whales are the tallest of any cetacean in the world.
- Orca whales are the largest type of dolphin.
- Orca whales are the only whales to feed on other warm-blooded animals.

Bottlenose Dolphins

Classification

Kingdom: Animalia
Phylum: Chordata
Class: Mammalia
Order: Cetacea
Suborder: Odontoceti
Family: Delphinidae
Subfamily: Delphininae
Genus: Tursiops
Species: truncatus

## Physical Characteristics

### Size and Weight

Bottlenose dolphins range in size from 150-650 kg (330-1,433 lbs) and 3-4 m (9.8-13.1ft) in length. It's possible that there are several different species but the two main varieties are inshore and offshore. Inshore varieties tend to be smaller while the offshore varieties tend to be larger and more robust. Males also tend to be larger than females of the same age. Bottlenose dolphins are about 1-1.3 m (3.3-4.3 ft) long at birth.

### Distinguishing Characteristics

Bottlenose dolphins are relatively large dolphins whose bodies are robust and can be light to dark gray in color. They have a highly curved dorsal fin and a sharp crease between their melon (forehead) and rostrum (snout). Their ventral side can range in color from white to pink, getting darker again past the dorsal fin and closer to the flukes. They are also known for their mouth that curves in a perpetual smile.

### Habitat

Bottlenose dolphins are found in temperate and tropical latitudes of the world's oceans. They can be found in either coastal or pelagic (open ocean) populations as well as in bays, estuaries and river inlets.

### Diet and Feeding

Bottlenose dolphins feed on a variety of foods depending on their habitat. Coastal varieties tend to eat a lot of fish and invertebrates that live on or near the ocean floor. Pelagic varieties tend to eat more pelagic fish and have also been found with some deep-sea varieties in their stomachs suggesting that they will forage to very great depths. Bottlenose dolphins hunt for their food both individually and in cooperative groups. Sometimes they will catch their prey by striking the fish with their flukes, called "fish whacking." Sometimes they can be found driving large schools of fish onto muddy flats near the shore and then will practically beach themselves to capture the fish.

Reproduction

Female bottlenose dolphins become sexually mature between the ages of five and twelve, however male bottlenose dolphins don't reach sexual maturity until about ten to twelve years of age. Gestation lasts about a year and it is usually three years before they have another calf. There is no apparent season for birthing although dolphins in temperate waters don't tend to have calves in the winter months. Calves are usually weaned at about 18 to 20 months of age.

Behavior

Bottlenose dolphins are commonly seen leaping into the air, bowriding off of boats, and surfing in the waves. Related females may stay together in a group for many years and males may form pair bonds with each other that last for as long as twenty years. Occasionally, the males will join up with a group of females. The size of the groups depends largely on where they live. Dolphins found in pelagic waters tend to be in larger groups (even in the hundreds) and groups in bays tend to be smaller (from just 2 to 15).

Adaptation

Bottlenose dolphins are able to echolocate to help them navigate and find food without having to rely on eyesight. They send a series of clicks through their melon (the fatty bulb at the front of their head), which bounce off objects in the water and return to the dolphin, giving them information on size and location of objects in the water.

Longevity

The life expectancy for the bottlenose dolphin is believed to be around 20 years. However, some bottlenose dolphins have been known to live for more than 40 years.

Conservation

Bottlenose dolphins are abundant throughout the world. Some individual populations may be in danger due to pollutants, commercial fishing, and habitat degradation. Some dolphin deaths off the western Atlantic and Gulf of Mexico coasts are believed to have been caused by a weakened immune system from overexposure to toxins found in their bodies.

Fun Facts

- The age of a bottlenose dolphin can be determined by counting the growth rings in their teeth – much like counting the rings of a tree.
- Bottlenose dolphins can have up to 26 conical teeth in each side of their upper jaw and up to 24 teeth on each side of their bottom jaw for a possible total of 100 teeth in their mouths!
- Dolphins sleep about 8 hours a day by letting half of their brain sleep at a time.
- Bottlenose dolphins have been seen jumping as high as 11.9m (16ft).