



**Education Dept.**  
Georgia Aquarium  
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Atlanta, GA 30313  
404.581.4198

# Aqua Adventure Teacher Guide

## Grades 9-12

Dear Educators,

We are happy you are visiting us here at the Georgia Aquarium and extending your classroom to include our saltwater and freshwater habitats.

The following guide has been designed to make your day at the Aquarium engaging and fun for you and your students. We have divided it into five sections – *lesson overview, student guide, teacher guide, and classroom activities.*

**Extension of your classroom:** As educators ourselves, we are excited to offer you this as an extension of your own classroom. The following activities have been correlated to the Biology and Environmental Science Georgia Performance Standards. In just a morning or an afternoon you and your students can address the following objectives and GPS's:

### Enduring Understandings:

- Freshwater and marine ecosystems are home to diverse populations of organisms.
- All organisms, whether they live in freshwater or marine ecosystems, have characteristics that allow them to survive in their natural habitats.
- Humans play an important role in maintaining healthy ecosystems and the balance of nature.

### Objectives:

- Students will expand their knowledge about living organisms and understand the relevance, purpose and process of scientific investigations.
- Students will identify behavioral adaptations aquatic organisms have to survive.
- Students will investigate how living things are interconnected and the impact of humans on aquatic ecosystems.

### Georgia Performance Standards Addressed:

SCSh1: Student will evaluate the importance of curiosity, honesty, openness, and skepticism in science.

- a) Exhibit the above traits in their own scientific activities.
- b) Recognize that further explanation often can be given for the same evidence.



SEV2: Students will demonstrate an understanding that the Earth is one interconnected system.

- d) Characterize the components that define fresh-water and marine systems.  
Abiotic factors- to include light, dissolved oxygen, phosphorus, nitrogen, pH and substrate. Biotic factors- plant and animal adaptations characteristic to that system.

SEV3: Students will describe stability and change in ecosystems.

- c) Explain how succession may be altered by traumatic events.
- e) Describe interactions between individuals (i.e. mutualism, commensalisms, parasitism, predation, and competition).

SEV4: Students will understand and describe availability, allocation, and conservation of energy and other resources.

- f) Describe the need for informed decision making of resource utilization. (i.e. energy and water usage allocation, conservation, food and land, and long-term depletion)

SEV5: Students will recognize that human beings are part of the global ecosystems and will evaluate the effects of human activities and technology on ecosystems.

- c) Explain how human activities affect global and local sustainability.
- e) Describe the effects and potential implications of pollution and resource depletion on the environment at the local and global levels
- f) Describe how political, legal, social, and economic decisions may affect global and local ecosystems.

SB4: Students will assess the dependence of all organisms on one another and the flow of energy and matter within their ecosystems.

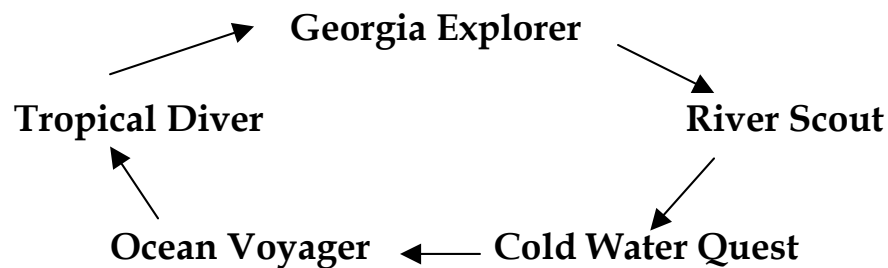
- a) Investigate the relationships among organisms, populations, communities, ecosystems, and biomes.
- c) Relate environmental conditions to successional changes in ecosystems.
- d) Assess and explain human activities that influence and modify the environment such as global warming, population growth, pesticide use, and water and power consumption.
- f) Relate animal adaptations, including behaviors, to the ability to survive stressful environmental conditions.

**Overall Format:** Each gallery has a few stops where we recommend you spend a little more time with your students. Each stop is highlighted by an exhibit overview along with some guiding questions for the students (and answers for the adults). These questions are meant to highlight key concepts for your group, whether it be observing an animal's behavior or simply finding some of our favorite animals in the exhibit. Students will need to bring **clipboards** and **writing utensils** with them to complete the activities.

Whenever your group is in front of the larger gallery windows at the aquarium, we ask that students sit cross-legged in a few rows close to the window. Please allow space for other groups at the windows.

At our touch pools, students will have the opportunity to explore using their senses. For the safety of the animals, please make sure they are touching softly with two fingers and not grabbing. Please make sure that you watch your students carefully for their safety as well as that of the animals.

**Your groups:** While at the aquarium, the smaller the individual group the better. We recommend one chaperone with five to seven students. This allows everyone to see the exhibits and helps with traffic in the galleries. We also recommend that your entire group does not start at the same gallery. There are 5 galleries, have them split up and start in different galleries and rotate. Here is our recommendation on how to rotate:



Since each gallery exits to the main atrium, it is easy to set up a meeting point for all groups before exiting through the gift shop or eating. **We recommend that all the adults in the group pick up a map when you enter the Aquarium to help guide you through the space.**

**Rules:** Finally, to ensure a great visit, we ask that you share the following rules with your students and chaperones for the safety of our animals and your students.

- No running
- Be respectful of the other guests
- No horseplay, pushing or shoving
- Use indoor voices
- No tapping on the windows - it can be very bothersome to our animals
- **Stay with your chaperones/students at all times**
- No gum
- Only touch with two fingers

We hope you have an amazing day here at the Georgia Aquarium, the world's most engaging aquarium, and that the tips and tricks listed in this guide are useful in extending your classroom to the watery world. Please be sure to complete the *Teacher Survey* located at the end of this guide.

Best Fishes!

The Georgia Aquarium Education Department



**Aqua Adventure**  
*Student Guide*  
*Grade 9-12*

Welcome to the Georgia Explorer gallery! Here we will discover the animals that share our state with us. You will be starting at the shark and ray touch tank, please use only two fingers.

ENTER the Georgia Explorer Gallery and turn towards your right, find the poster about the TED and be sure to check out the actual TED hanging from the ceiling of the gallery. What does the acronym TED stand for? \_\_\_\_\_

Did you know that Georgia shrimpers helped to develop the TED?  
Why was it important that shrimpers be included in the development of the TED? \_\_\_\_\_

WATCH the sea turtle video to your right. Where do the turtles go after they hatch?  
\_\_\_\_\_

How can sea turtles' food choices be detrimental to them?  
\_\_\_\_\_

CHECK OUT the horseshoe crabs in the Gray's Reef touch pool. Horseshoe crabs have been around for millions of years. THINK - How have they survived for so long with so little change to their physical appearance?  
\_\_\_\_\_  
\_\_\_\_\_

Red Lionfish are an invasive species in Georgia waters. How do they affect native species? \_\_\_\_\_

DID YOU KNOW that horseshoe crab blood is blue? It has copper in it instead of iron, which is what makes our blood red. Horseshoe crab blood is also used by NASA scientists to test their equipment for bacteria before it is sent into space!

VISIT our loggerhead sea turtle in the Gray's Reef exhibit. Loggerhead sea turtles are an endangered species that nest on Georgia's beaches each summer. In April of 2008, Dylan, a loggerhead sea turtle who lived at the Georgia Aquarium, was rehabilitated and released back into the ocean. Before being released, scientists attached a satellite transmitter to Dylan's shell so that her movements can be tracked.

OBSERVE the Gray's Reef Exhibit. Using the kiosk, locate the spiny lobster, squirrelfish and the longspine porcupine fish.

VISIT the Right Whale Theater and watch a short video about Gray's Reef, a National Marine Sanctuary protected by federal law. Name 2 endangered species that benefit from this protection.

\_\_\_\_\_ and \_\_\_\_\_

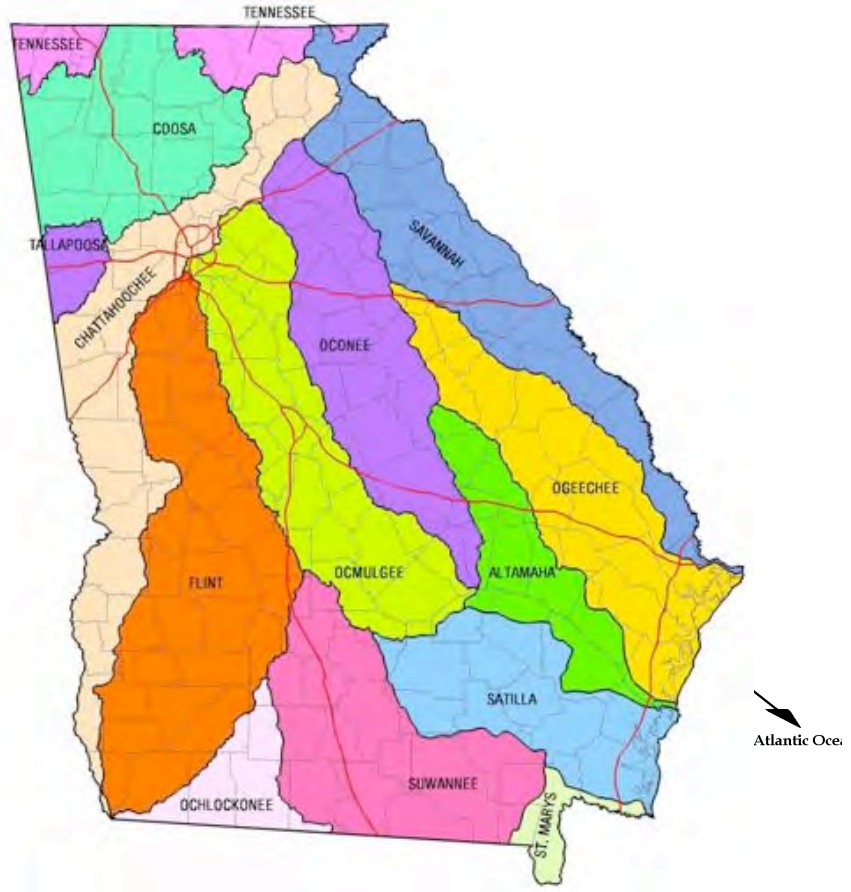


Before entering our River Scout Gallery which showcases freshwater habitats from around world, complete this first section about watersheds prior to entering the exhibit.

Freshwater is very important not only to animals but us too us. Here in the Southeast, we rely on freshwater for drinking, recreation, and food. So where does our freshwater originate from?

\_\_\_\_\_ Through a system of rivers and streams, all the water drains into a watershed and ultimately ends up in the ocean.

The Mississippi River watershed is the largest in the United States, and it extends across the middle of the country from the Rockies to the Appalachians. In Georgia, we have 14 major watersheds. The Aquarium is located in the Chattahoochee Watershed. What watershed do you live in? Check this map to find it.



Where do the rivers in your community end?

\_\_\_\_\_

CHECK OUT the African cichlids inside River Scout and to the left. What is a mouth brooder? \_\_\_\_\_

LOOK UP after entering the River Scout Gallery and you'll be looking at the North American river exhibit.

OBSERVE the American alligators. Did you know that alligators swallow rocks to help in their digestion process?

Electric eels use two different voltages (strengths) of electricity: low voltage (weaker) and high voltage (stronger). What do they use these different voltages for?

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**CONSERVATION ALERT:** What are some human activities that impact rivers and streams across the US and the animals that live there?\_\_\_\_\_

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LOOK at the Asian small-clawed otters. What makes them different from other otter species?

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What are two human activities that impact the Asian small-clawed otter?

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VISIT the anemone touch pool. Using two fingers, gently touch the anemones on their tentacles. If the tentacles attach to your fingers, slowly and gently pull your fingers away to allow them to safely release.

As a member of phylum Cnidaria, anemones have *nematocysts* or stinging cells on their tentacles. Why don't we feel their sting when we touch them?

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What other animals other than anemones are in the phylum Cnidaria?

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VISIT the kelp forest. Why do you think we use artificial kelp instead of live kelp?

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After checking out the kelp forest, touch pool, and Japanese spider crabs, STOP at the beluga whale exhibit for the BELUGA BEHAVIOR STUDY and turn to the following pages of your packet to find the instructions, data collection sheet and results sheet for this activity.

## Beluga Behavior Data Collection

One of the jobs of our biologists is to monitor the behavior of the animals for which they are responsible. It is their job to know what is “normal” for each animal. Behaviors can vary throughout the day and from animal to animal. By knowing individual animal and group behaviors, a biologist can alert the veterinarian to potential problems. By working with the animals on a daily basis, a biologist should be able to observe changes either through interacting with an animal one on one, as a group, or observing from underwater.

Below is a list of some common behaviors observed by our biologists, along with an ethogram describing those behaviors. Over the span of 5 minutes, observe a beluga. During your observations use tally marks (III) to keep track of each time the behavior occurs. Total the tallies to see which behaviors occur most frequently.

Time (5 minutes)

Behavior	Tallies of Observed Behavior	TOTALS
Body Shaking		
Interaction		
Bubbles		
Rock Rubbing		
Breathing		
Mouthing		
Swimming		
Other		

If you observed an “other” behavior, describe it here:

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General observations (summary of behaviors):

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## Beluga Study Ethogram

An ethogram is a pictorial inventory or list of behaviors of members of a species. The ethogram below shows common behaviors of the Beluga whales, and it can help you determine which behaviors you are seeing.



### SWIMMING

Moving tail up and down and propelling through water.



### BREATHING

Going to surface.



### BUBBLES

Releasing air from blowhole under water.



### BODY SHAKING

Moving tail or body vigorously.



### INTERACTION

Touching or swimming very close to one another.



### MOUTHING

Opening and closing of the mouth.



### ROCK RUBBING

Rubbing any part of the body on a rock.

## Behavior Study Results

Using the total amount of all the behaviors observed, copy your totals from the behavior study and calculate the percent of each behavior observed. Then graphically represent your data using a bar graph.

Behavior	Individual Behavior Total	% of total
Body Shaking		
Interaction		
Bubbles		
Rock Rub		
Breathing		
Mouthing		
Swimming		
Other		
Total		

Other than swimming, which behavior was most frequent?

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What is the significance of this behavior and its frequency? \_\_\_\_\_

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There is a population of beluga whales that live in the Saint Lawrence Seaway. When they die, their bodies must be disposed of as toxic waste. Toxins (often stored in fat cells) build up in belugas exponentially through the process of *bioaccumulation*. Which exponential food chain illustrates how 1 unit of mercury consumed by a snail can accumulate up the food chain so that a beluga whale has 1000 units of mercury?

- A. 1 small fish eats 100 snails - 100 small fish are eaten by 1 large fish - 10 large fish are eaten by 1 Beluga
- B. 1 small fish eats 10 snails - 10 small fish are eaten by 1 large fish - 10 large fish are eaten by 1 Beluga
- C. 1 small fish eats 1 snails - 10 small fish are eaten by 1 large fish - 10 large fish are eaten by 1 Beluga

What effect does bioaccumulation have on human food choices? \_\_\_\_\_

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Belugas are no longer hunted, but some populations are still classified as vulnerable. Why? \_\_\_\_\_



Welcome to the world ocean! We call it the world ocean because all oceans are part of one large ocean that covers the entire world allowing animals to roam from one area to another. **Pick up a species identification card from the box at the beginning of the gallery to help in identifying the animals as you walk through the tunnel.**

As you walk through the tunnel, use the Species ID Card to identify our fish, sharks, and rays.

VISIT the whale shark transport exhibit. What an amazing process it was to bring the whale sharks to the Georgia Aquarium! To safely arrive in Atlanta, many people from different professions had to work together.

What different backgrounds and jobs did the team members have that helped with the transport?

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Where is the world's largest aggregation of whale sharks? \_\_\_\_\_

EXPLORE the view at the main window in the Ocean Voyager exhibit. After observing for a few moments you may notice that some animals stay in certain areas of the water. Animals that live in the open ocean are *pelagic* animals, while those that live on the bottom of the ocean are *benthic* animals.

Locate one pelagic and one benthic animal. Describe different adaptations for each, and then compare and contrast the two animals.

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**DID YOU KNOW** – Sharks have 8-15 rows of teeth that are continually replaced through their lives. It works like a conveyor belt: when a tooth is lost others move into its spot.

ECOTOURISM (e.g. swimming with the whale sharks in the Gulf) is a growing industry in Mexico. The Mexican government is working with Georgia Aquarium researchers to set up guidelines for ecotourism. Describe two ways in which ecotourism could impact whale sharks:

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WHAT can be done to protect the whale sharks?

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WATCH the video on either side of the window. How do they quickly determine the entire length of a whale shark? \_\_\_\_\_

Why do the whale sharks congregate in the Gulf of Mexico? \_\_\_\_\_

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ASK one of the Georgia Aquarium employees in the gallery for a Seafood Savvy card. According to the card, which grouping of sea food is the most sustainable choice?

- a. tilapia, orange roughy, salmon
- b. squid, spiny US lobster, wahoo
- c. tilapia, stone crab, farmed rainbow trout
- d. Chilean sea bass, Atlantic halibut, imported swordfish

**DROP OFF THE SPECIES ID CARD AS YOU EXIT THE GALLERY**



VISIT the garden eel exhibit. While our main reef exhibit contains both live and artificial corals, all of the corals in the garden eel exhibit are artificial. One reason for this is that some of the species of fish in this exhibit feed on coral polyps.

Name one of these coral-eating species: \_\_\_\_\_

Why do the garden eels all face the same direction? \_\_\_\_\_

OBSERVE the jellies. In recent years, populations of jellies around the world have been growing rapidly due to a decrease in predator numbers as well as an increase in water temperatures. How might an overabundance of jellies affect an ecosystem?

\_\_\_\_\_  
\_\_\_\_\_

DID YOU KNOW? Jelly tentacles have *nematocysts*, toxic stinging cells used to catch prey. These toxins are species-specific (they only affect certain animals) and do not harm members of their own species. So if you see two sea nettles weaving together, they're not hurting each other. A sea nettle, however, is quite capable of catching and eating a moon jelly!

READ the descriptions below of some different types of relationships that exist between animals:

**Competition:** animals contesting (vying) for resources

**Commensalism:** one species benefits, the other is unaffected

**Cooperation:** animals working together

**Mutualism:** both species benefit

**Parasitism:** one species benefits, the other is harmed

**Predation:** when a predator consumes its prey

CONTINUE to the **coral reef** window. Find these three fish in the exhibit:

Fire anemonefish



Squarespot anthias



Longfin batfish



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Record the scientific names of the three fish (using the kiosks) and observe them each for at least one minute. Describe their interactions with other animals, using the relationships descriptions above.

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**Coral polyps** are the individual animals that make up the coral reef. Most reef-building corals have a symbiotic relationship with algae called *zooxanthellae* that live inside the coral tissues. *Zooxanthellae* make food for their coral hosts by the process of photosynthesis.

Human activities can negatively affect the general health of the coral reef environments. Research has found that corals have responded to stress by expelling their zooanthellae resulting in a white appearance called “coral bleaching”.

Can you think of two human activities that might cause coral bleaching?

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## TEACHER GUIDE

### Georgia Explorer Gallery

Welcome to the Georgia Explorer gallery! Here we will discover more about the animals that share our state with us. You will be starting with shark and ray touch, please use only two fingers.

Enter the Georgia Explorer Gallery and turn towards your right, find the poster about the TED and be sure to check out the actual TED hanging from the ceiling of the gallery. What does the acronym TED stand for? *Turtle Excluder Device*

Did you know that Georgia shrimpers helped to develop the TED? Why was it important that shrimpers be included in the development of the TED? *So they would use them*

WATCH the sea turtle video to your right. Where do the turtles go after they hatch? *Into the ocean and eventually the Sargasso Sea*

How can sea turtles' food choices be detrimental to them? *Sea turtles often confuse plastic bags for jellies and eat them, causing them to choke.*

CHECK OUT the horseshoe crabs in the Gray's Reef touch pool. Horseshoe crabs have been around for millions of years. THINK - How have they survived for so long with so little change to their physical appearance? *Horseshoe crabs have the ability to survive extreme temperatures, go for long periods without food, and their hard armor enables them to have no predators other than sharks.*

Red lionfish are an invasive species in Georgia waters. How do they affect native species. *Red lionfish out compete native species for food and they have no natural predators in Georgia.*

DID YOU KNOW that horseshoe crab blood is blue? It has copper in it instead of iron, which is what makes our blood red. Horseshoe crab blood is also used by NASA scientists to test their equipment for bacteria before it is sent into space!

VISIT our Loggerhead sea turtle in the Gray's Reef exhibit. Loggerhead sea turtles are an endangered species that nest on Georgia's beaches each summer. In April of 2008, Dylan, a loggerhead sea turtle who lived at the Georgia Aquarium, was rehabilitated and released back into the ocean. Before being released, scientists attached a satellite transmitter to Dylan's shell so that her movements can be tracked.

OBSERVE the Gray's Reef Exhibit. Using the kiosk, locate the spiny lobster, squirrelfish and the longspine porcupine fish.

VISIT the Right Whale Theater and watch a short video about Gray's Reef, a National Marine Sanctuary protected by federal law. Name 2 endangered species that benefit from this protection.

Northern right whales and Loggerhead sea turtle

## River Scout Gallery

Before entering our River Scout Gallery which showcases freshwater habitats from around world, complete this first section about watersheds.

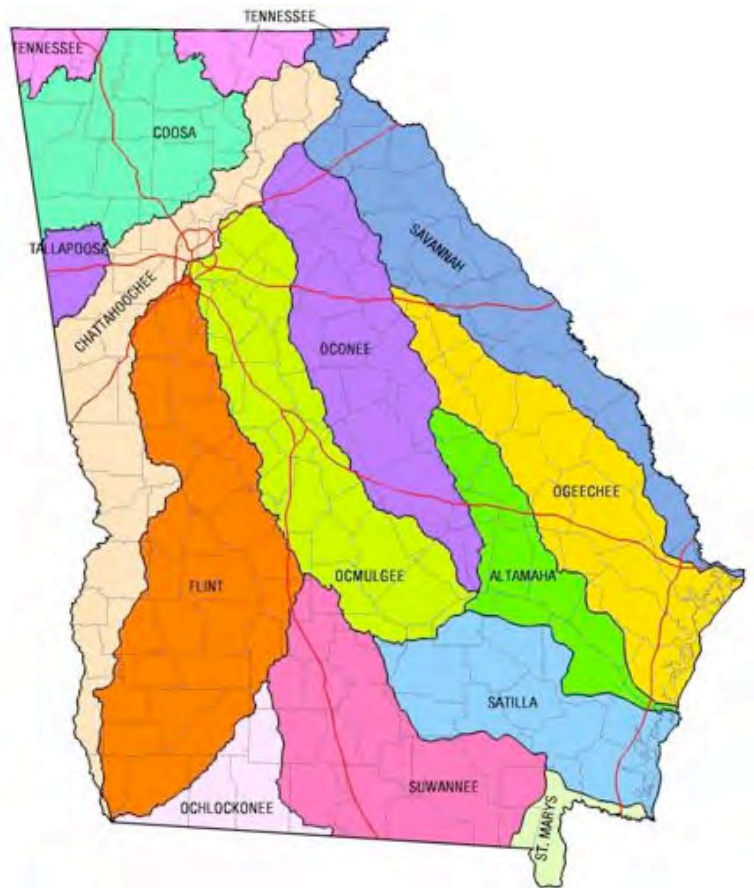
Freshwater is very important not only to animals but us too us. Here in the Southeast, we rely on freshwater for drinking, recreation, and food. So where does our freshwater originate from?

Precipitation Through a system of rivers and streams, all the water drains into a watershed and ultimately ends up in the ocean.

The Mississippi River watershed is the largest in the United States, and it extends across the middle of the country from the Rockies to the Appalachians. In Georgia, we have 14 major watersheds. The Aquarium is located in the Chattahoochee Watershed. What watershed do you live in? Check this map to find it.

Answers will vary

Where do the rivers in your community end? Either the Atlantic ocean or the Gulf of Mexico



CHECK OUT the African cichlids inside River Scout and to the left. What is a mouth brooder? An animal that holds their eggs in their mouths to incubate them instead of building a nest.

LOOK UP after entering the River Scout Gallery and you'll be looking at the North American river exhibit.

OBSERVE the American alligators. Did you know that alligators swallow rocks to help in their digestion process?

Electric eels use two different voltages (strengths) of electricity: low voltage (weaker) and high voltage (stronger). What do they use these different voltages for?

*To navigate through muddy rivers.*

**CONSERVATION ALERT:** What are some human activities that impact rivers and streams across the US and the animals that live here? *Nonpoint source pollution such as fertilizers, animal waste, septic/sewer, illegal dumping - oil/gas, litter, development - soil erosion and impervious surfaces, and channelization.*

LOOK at the Asian small-clawed otters. What makes them different from other otter species?

*Asian small-clawed otters catch prey with their paws instead of its mouth.*

What are two human activities that impact the Asian small-clawed otter?

*Habitat destruction and hunting.*

## Coldwater Quest Gallery

VISIT the anemone touch pool. Using two fingers gently touch the anemones on their tentacles. If the tentacles attach to your fingers, slowly and gently pull your fingers away to allow them to safely release.

As a member of the phylum Cnidaria, anemones have *nematocysts* or stinging cells on their tentacles. Why don't we feel their sting when we touch them?

*The sting is not strong enough to penetrate our skin*

What other animals are in phylum Cnidaria, which anemones related to? *Jellies and corals*

VISIT the kelp forest. Why do you think we use artificial kelp instead of live kelp? *Live kelp grows extremely fast - 1 to 2 feet a day, and would soon become unmanageable.*

After checking out the kelp forest, touch pool, and Japanese spider crabs, STOP at the beluga whale exhibit for the BELUGA BEHAVIOR STUDY and turn to the next page of

your packet to find the instructions, data collection sheet and results sheet for this activity.

## Beluga Behavior Data Collection

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Below is a list of some common behaviors observed by our biologists, along with an ethogram describing those behaviors. Over the span of 5 minutes, observe a beluga. During your observations use tally marks (III) to keep track of each time the behavior occurs. Total the tallies to see which behaviors occur most frequently.

Time (5 minutes)

<b>Behavior</b>	<b>Tallies of Observed Behavior</b>	<b>TOTALS</b>
Body Shaking	IIII	4
Interaction	I	1
Bubbles	IIII	4
Rock Rubbing	II	2
Breathing	IIIIIIII	9
Mouthing		0
Swimming	IIIIIIIIIIIIIIIIII	19
Other		0

If you observed an “other” behavior, describe it here:

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General observations (summary of behaviors):

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## Behavior Study Results

Using the total amount of all the behaviors observed, copy your totals from the behavior study and calculate the percent of each behavior observed. Then graphically represent your data using bar graph.

Behavior	Individual Behavior Total	% of total
Body Shaking	4	$4/39 \times 100$
Interaction	1	$1/39 \times 100$
Bubbles	4	$4/39 \times 100$
Rock Rub	2	$2/39 \times 100$
Breathing	9	$9/39 \times 100$
Mouthing	0	0%
Swimming	19	$19/39 \times 100$
Other	0	0%
Total	39	

Other than swimming, which behavior was most frequent? Answers will vary

What is the significance of this behavior and its frequency? Answers will vary based on the behavior exhibited.

There is a population of beluga whales that live in the Saint Lawrence Seaway. When they die, their bodies must be disposed of as toxic waste. Toxins (often stored in fat cells) build up in belugas exponentially through the process of *bioaccumulation*. Put together an exponential food chain to illustrate how 1 unit of mercury consumed by a snail can accumulate up the food chain so that a beluga whale has 1000 units of mercury.

**B: 1 small fish eats 1 snails - 10 small fish are eaten by 1 large fish - 10 large fish are eaten by 1 Beluga**

What effect does bioaccumulation have on human food choices? **Top predatory fish including tuna, shark, swordfish can have high levels of mercury which, if consumed by humans, can have impacts on ones health.**

Belugas are no longer hunted, but some populations are still classified as vulnerable. Why? **Pollution and habitat destruction.**

## **Ocean Voyager Gallery**

Welcome to the world ocean! We call it the world ocean because all oceans are part of one large ocean that covers the entire world allowing animals to roam from one area to another. **Pick up a species identification card from the box at the beginning of the gallery to help in identifying the animals as you walk through the tunnel.**

As you walk through the tunnel, use the Species ID Card to identify our fish, sharks, and rays.

VISIT the whale shark transport exhibit. What an amazing process it was to bring the whale sharks to the Georgia Aquarium! To safely arrive in Atlanta, many people from different professions had to work together.

What different backgrounds and jobs did the team members have that helped with the transport? **Pilot, co-pilot, engineer, lead master, biologist, veterinarian.**

Where is the world's largest aggregation of whale sharks? **Holbox, an area north of the Yucatan peninsula in the Gulf of Mexico.**

EXPLORE the view at the main window in the Ocean Voyager exhibit. After observing for a few moments you may notice that some animals stay in certain areas of the water. Animals that live in the open ocean are *pelagic* animals, while those that live on the bottom of the ocean are *benthic* animals.

Locate one pelagic and one benthic animal. Describe different adaptations for each, and then compare and contrast the two animals.

*Pelagic: whale sharks, hammerhead shark, manta ray, blacktip reef shark, grouper, mullet, porkfish, cownose ray, sandtiger shark, humphead wrasse.*

*Benthic: largetooth sawfish, zebra shark, guitarfish, black blotched fantail ray, southern stingray, leopard whiptail ray.*

DID YOU KNOW – Sharks have 8-15 rows of teeth that are continually replaced through their lives. It works like a conveyor belt: when a tooth is lost others move into its spot.

ECOTOURISM (e.g. swimming with the whale sharks in the Gulf) is a growing industry in Mexico. The Mexican government is working with Georgia Aquarium researchers to set up guidelines for ecotourism. Describe two ways in which ecotourism could impact whale sharks: *Positive impacts: increased visibility, knowledge, understanding and the desire to protect them.*

*Negative impacts: Habitat destruction, modification of behavior, feeding interference.*

WHAT can be done to protect the whale sharks? *Learn more about them, limit accessibility and monitor ecotourism impacts.*

WATCH the video on either side of the window. How do they quickly determine the entire length of a whale shark? *Measure the dorsal fin.*

Why do the whale sharks congregate in the Gulf of Mexico? *We think – for food, possibly mating, natural migration path.*

ASK one of the Georgia Aquarium employees in the gallery for a Seafood Savvy card. According to the card, which grouping of sea food is the most sustainable choice?

- a. tilapia, orange roughy, salmon
- b. squid, spiny US lobster, wahoo
- c. tilapia, stone crab, farmed rainbow trout*
- d. Chilean sea bass, Atlantic halibut, imported swordfish

## Tropical Diver Gallery

VISIT the garden eel exhibit. While our main reef exhibit contains both live and artificial corals, all of the corals in the garden eel exhibit are artificial. One reason for this is that some of the species of fish in this exhibit feed on coral polyps.

Name one of these coral-eating species: *threadfin butterfly fish*

Why do the garden eels all face the same direction? *They face the current to get food.*

OBSERVE the jellies. In recent years, populations of jellies around the world have been growing rapidly due to a decrease in predator numbers as well as an increase in water temperatures. How might an overabundance of jellies affect an ecosystem? *An overabundance of jellies in an area can cause a sharp decline in other plankton including larva or spawn, therefore decreasing future population numbers. The mass of jellies can also hinder movement of species through a certain area.*

DID YOU KNOW? Jelly tentacles have *nematocysts*, toxic stinging cells used to catch prey. These toxins are species-specific (they only affect certain animals) and do not harm members of their own species. So if you see two sea nettles weaving together, they're not hurting each other. A sea nettle, however, is quite capable of catching and eating a moon jelly!

READ the descriptions below of some different types of relationships that exist between animals:

**Competition:** animals contesting (vying) for resources

**Commensalism:** one species benefits, the other is unaffected

**Cooperation:** animals working together

**Mutualism:** both species benefit

**Parasitism:** one species benefits, the other is harmed

**Predation:** when a predator consumes its prey

CONTINUE to the **coral reef** window. Find these three fish in the exhibit:



**Fire anemonefish**  
*Amphiprion melanplus*



**Squarespot anthias**  
*Pseudanthias pleurotaenia*



**Longfin batfish**  
*Platax tiera*

Record the scientific names of the three fish (using the kiosks) and observe them each for at least one minute. Describe their interactions with other animals, using the relationships descriptions above.

*Answers will vary.*

Find and describe at least three of these interactions in the main coral reef window. Use the touch screens to identify the species involved.

*Answers will vary.*

**Coral polyps** are the individual animals that make up the coral reef. Most reef-building corals have a symbiotic relationship with algae called *zooxanthellae* that live inside the coral tissues. *Zooxanthellae* make food for their coral hosts by the process of photosynthesis.

Human activities can negatively affect the general health of the coral reef environments. Research has found that corals have responded to stress by expelling their algae resulting in a white appearance called “coral bleaching”.

Can you think of two human activities that might cause coral bleaching?

*Pollution, global warming, boat anchors, running into a reef, introduced species, sediment in the water column.*

# Conservation News Flash!

**Grade:** 9<sup>th</sup> – 12<sup>th</sup>

**Objective:** Students will investigate current conservation issues facing the ecosystems and/or animals they learned about during their visit and present their finding in one of three communication formats – brochure, graphic or news article.

**Duration:** 15 minute presentation

**Vocabulary:** endangered species, IUCN, wildlife trade, coral bleaching, invasive species, global warming, non point source pollution, watershed, habitat destruction, sustainability, threatened species, extinction, ecotourism, management plans, natural resources, Association of Zoos Aquariums (AZA), conservation, indicator species, and bioaccumulation (\* these are recommended terms and topics they should use/know as appropriate in their presentation)

**Materials:** resources books, internet, scientific journals, power point, publisher

## Procedure:

- 1) Have students reflect back on their visit to the Georgia Aquarium of possible conservation issues they encountered. Record all topics.
- 2) Have each student select one topic from the board to further research to create a brochure, graphic panel or news article about that topic.
- 3) Students can use Microsoft PowerPoint, Publisher or other software to create their product.
- 4) Once completed, have students present their brochure, graphic panel or news article to the entire class with a short 15 minute presentation.

## Assessment:

Use the attached rubric to score each student in the following areas:

- ✓ Creativity
- ✓ Accuracy
- ✓ Flow of information
- ✓ Did they address the conservation issue selected and provide a suggested plan action
- ✓ Verbal presentation – did they articulate the topic clearly

# Conservation News Flash!

Student name: \_\_\_\_\_

Conservation topic: \_\_\_\_\_

Product format: \_\_\_\_\_

Did the student.....

	score	Possible points
Creatively design their product and tell the "story" in unique way?		15
Provide accurate and unbiased information?		15
Presented the information in a logical format?		15
Address the conservation issue?		10
Provide a suggestion action plan?		10
Articulate the topic clearly in their presentation?		15
Submit a product that used correct grammar and was spell checked?		10
Overall		10

# Beluga Cuisine

**Grade:** 9<sup>th</sup> – 12<sup>th</sup>

**Objective:** Students will examine the challenges involved in providing an appropriate, cost-effective diet for marine animals in an aquarium.

**Duration:** 1 hour

**Vocabulary:** Moisture, fat, protein, carbohydrate, vitamins, minerals, kilocalorie, amino acid

**Materials:** Copies of student worksheet for each student, calculators, computers with Microsoft Excel (optional)

## **Background:**

Having the appropriate diet for animals is important in maintaining good health and preventing disease. Animals not fed a proper diet may have poor or stunted growth, health problems due to deficiencies, or may be more susceptible to disease. Feeding animals in captivity can be especially challenging because the diets of many aquatic animals are unknown. In addition, obtaining the correct foods for aquatic diets can be difficult and expensive due to the inconsistent availability of different food sources.

Not only do the daily caloric needs of the animal need to be met, but the nutrient content within the diet must meet the nutrient requirements of the animal in question. One of the biggest concerns the husbandry department must address is the correct amount of moisture, protein, carbohydrates and fat in a diet. Vitamins and minerals may also be supplied as needed (too much will lead to toxicity and too little will lead to deficiency) based on nutrient analysis of the entire diet.

Proteins are important in the development of animals because they provide amino acids, the building blocks of many bodily tissues. Certain amino acids may be synthesized by the body, but others can only be acquired through the animals' diet. These are called essential amino acids and they must be supplied in proper quantity so that the body can make its proteins. Proteins can also provide energy in the absence of fats and carbohydrates. One gram of protein contains 4 Kcal of energy.

Carbohydrates provide energy and fiber for intestinal function. Most marine mammals feed on fish and other aquatic animals that contain little to no carbohydrates. Therefore the diet of marine mammals in aquariums usually contains few carbohydrates. One gram of carbohydrate contains 4 Kcal of energy.

Moisture is an important component of any diet, as it helps the animal to maintain a correct balance of water within the body. Both freshwater and marine fishes are able to control water balance through the use of various cells in the body. However, most marine mammals obtain their freshwater through the foods they eat. Without enough moisture in the diet, marine mammals can become dehydrated, a serious health problem. In addition, water contains many of the vitamins and minerals needed in the body. Freshwater can actually act as a feeding stimulus in marine animals.

Fats provide the main energy source for animals, and also make food palatable. They are necessary building blocks for certain body parts such as cell membranes, and also control water loss from the animal's skin. Certain vitamins, called fat-soluble vitamins, can only be absorbed by fat in the body. One gram of fat contains 9 Kcal of energy.

In conclusion, aquarists must look at quality of food, caloric intake, nutrient balance and expense when determining an appropriate diet for aquatic animals. Often there are conflicts between the cost of a diet and the quality of a diet. The cheapest diet may not meet all of an animal's nutritional needs. A high-quality diet is important to keep animals in good condition and to prevent disease.

### **Procedure:**

1. Make copies of the student worksheets (1 per student).
2. Students may work in groups or individually in this activity. However, each student should show his or her own work on the worksheet.
3. Review concepts that were introduced at the aquarium. Have the students recall how the food was prepared for animals at the aquarium, and the difficulties involved in preparing proper diets. Review the roles of moisture, fat, proteins, carbohydrates, vitamins and minerals in the function of the body.
4. Students will need calculators or computers with Microsoft Excel to complete Parts II and III. There are three ways to complete this activity.
  - Students may be given the student worksheet and work through the problems in groups or individually.
  - For students who are in lower grades or who need more guidance, use the alternate guided student page for Part II, question #5. This three-page worksheet can be inserted into the rest of the activity.
  - Students who have experience with computers and are comfortable with Microsoft Excel may want to create an Excel spreadsheet to quickly calculate the beluga diets. The nutrition information may be entered into a table and students can enter Excel functions that will calculate the nutrient content and cost of a diet containing x pounds of each type of

food. Students can then use trial and error to enter in different combinations of foods, to find the most cost-effective diet for the beluga.

**Assessment:**

- Check that the students have correctly completed math operations to find nutrient and caloric values of different diets.
- Check that the students found a proper diet that meets the needs of all of the constraints: moisture, fat, carbohydrates, and protein.
- Were the students able to compare the cheaper diet with the most nutrient balanced diet?
- Were the students able to find a cost-effective diet that was not too rich in any of the nutrients?

**Resources:**

Reeves, Randall R. et al. 2002. National Audubon Society Guide to Marine Mammals of the World. New York: Alfred A. Knopf, Inc.

## Beluga Cuisine - Student Worksheet

One of the biggest challenges in the animal husbandry department at the Georgia Aquarium is finding an appropriate diet for each of the different animals. Certain animals can only eat certain types of food, and aquarists must be sure they are meeting the caloric and nutritional needs of each animal. Poor nutrition can cause a variety of health problems. To maintain animals at the correct weight, they must take in enough calories per day. However, the caloric value alone does not ensure an adequate diet. Moisture, fat, protein, carbohydrates, vitamins and minerals must also be in the correct proportions to ensure good development and growth and to prevent disease.

Because marine mammals live in saltwater, they obtain most of their freshwater supply through the food they eat. Without enough watery foods, they can become dehydrated and quickly die. Fats are the main energy source for animals. One gram of fat contains 9 Kilocalories. Keep in mind that the “calories” we often speak about when talking about diets or food consumption are actually Kilocalories, or Kcal. When we say a can of Coke has 200 “calories,” this actually means it contains 200 Kcal of energy.

Proteins and carbohydrates are also important in bodily functions. Proteins contain amino acids, which are the building blocks for many tissues in the body. Carbohydrates are another energy source for animals. The diets of marine mammals typically contain very few carbohydrates, because these animals’ stomachs are not well-adapted to digest carbohydrates. Most marine animals eat mainly fish and other aquatic organisms that contain very little carbohydrates. One gram of protein and one gram of carbohydrate each contain 4 Kcal.

In this activity, you will be working as a biologist to determine the proper diet for a beluga whale. The daily needs of a beluga whale are listed below, as well as the nutrient content of the three foods that are available for you to use. You will be determining several different diets, and will compare the most cost-effective diet with the diet that contains the best nutritional balance.

The daily caloric and nutritional needs of the average adult beluga whale are listed in the table below:

<b>Daily dietary needs of an adult beluga:</b>
30,000 Kcal per day
16.5 kg of water (moisture)
3.5 kg of protein
1.7 kg of fat
.03 kg of carbohydrates

The aquarium's commissary has herring, capelin, and squid available to use in the beluga's diet. However, you need to figure out what type of food to feed and calculate the weight of the food that should be fed to meet the animal's caloric and nutritional needs.

The table below shows the nutritional content and the cost of each type of food. The nutritional content is calculated by percentage weight. For example, if herring contains 70.9% moisture, this means that each 100 g of herring contains 70.9 g of water.

<b>Herring</b>	<b>Capelin</b>	<b>Squid</b>
<b>Cost: \$3.50 per kg</b>	<b>Cost: \$2 per kg</b>	<b>Cost: \$8 per kg</b>
Moisture 70.9 %	Moisture 83.0 %	Moisture 77.3 %
Protein 17.1 %	Protein 13.6 %	Protein 17.7 %
Fat 11.3 %	Fat 2.5 %	Fat 1.3 %
Carbs 0.0 %	Carbs 0.0 %	Carbs 2.6 %

You may notice that the percentages do not add up to exactly 100%. The remaining weight that is not accounted for in this table is ash, or minerals.

Because the daily dietary needs of the adult beluga were given in kilograms in the previous table, it is simpler to convert the percentage values into grams or kilograms.

Convert the percent nutritional content into grams or kilograms of nutrient per kilogram of food, and enter the values into the following table for your own reference. Remember that 10% of a nutrient by weight is equal to 10 g of nutrient per 100 g of food, or 100 g of nutrient per 1000 g of food (which equals .1 kg of nutrient per 1 kg of food). Example: 1 kg = 1000g, therefore 70.9% of 1000g = 709 g or 0.709 kg.

<b>Herring</b>	<b>Amount of nutrient per 1 kg of fish</b>	<b>Capelin</b>	<b>Amount of nutrient per 1 kg of fish</b>	<b>Squid</b>	<b>Amount of nutrient per 1 kg of fish</b>
Moisture 70.9 %	709 g 0.709 kg	Moisture 83.0 %	g kg	Moisture 77.3 %	g kg
Protein 17.1 %	g kg	Protein 13.6 %	g kg	Protein 17.7 %	g kg
Fat 11.3 %	g kg	Fat 2.5 %	g kg	Fat 1.3 %	g kg
Carbs 0.0 %	g kg	Carbs 0.0 %	g kg	Carbs 2.6 %	g kg

Now use the information in the above table and the beluga's daily dietary needs to answer the following questions.



## Part II

5. Now calculate a diet that will meet the nutritional needs and caloric needs of the beluga whale (as described in the table below). The amount of moisture, fat, protein and carbohydrates fed to the beluga each day should be as close as possible to the actual required amounts. (Hint: Since squid is the only food type containing carbohydrates, calculate the amount of squid to be fed first.)

<b>Daily dietary needs of an adult beluga:</b>
30,000 Kcal per day
16.5 kg of water (moisture)
3.5 kg of protein
1.7 kg of fat
.03 kg of carbohydrates

6. Now calculate the daily cost of the diet you created.

Kg of food		Cost of food		Daily Cost
Kg	x	\$	=	\$
Kg	x	\$	=	\$
Kg	x	\$	=	\$
<b>Total Daily Cost</b>				<b>\$</b>

7. Compare your diet with the diets your classmates created.

Whose diet was the most inexpensive?

Which diet most closely met the actual nutritional needs of the beluga?

**Part II –Guided Student Worksheet**

5. Now calculate a diet that will meet all of the nutritional needs and caloric needs of the beluga whale. The amount of moisture, fat, protein and carbohydrates fed to the beluga each day should be as close as possible to the actual required amounts. (Hint: Since squid is the only food type containing carbohydrates, calculate the amount of squid to be fed first.)

<b>Daily dietary needs of an adult beluga:</b>
30,000 Kcal per day
16.5 kg of water (moisture)
3.5 kg of protein
1.7 kg of fat
.03 kg of carbohydrates

Because squid is the only food source with carbohydrates, so we need to calculate this first.

How many kg of carbohydrates does the beluga need each day? \_\_\_\_\_

How many kg of carbohydrates does one kg of squid supply? \_\_\_\_\_

\_\_\_\_\_ / \_\_\_\_\_  
 Kg of carbs needed / kg of carbs per 1 kg squid = \_\_\_\_\_ kg of squid needed

We’ve now met the beluga’s daily needs for carbohydrates. However, the squid also contains moisture, protein and fat. Calculate how much moisture, protein and fat the squid is supplying to the beluga’s daily diet.

Kg of squid needed		Kg nutrient per 1 kg of squid		Kg nutrient supplied by squid
kg	*	Kg water	=	Kg water
kg	*	Kg protein	=	Kg protein
kg	*	Kg fat	=	Kg fat

Then, subtract these amounts from the total daily needs of the beluga whale to find the kg of each nutrient that is still needed in the diet.

<b>Total Beluga needs:</b>		<b>Squid provides:</b>		<b>Nutrients still needed:</b>
16.5 kg of water	-	_____ Kg water	=	_____ Kg water
3.5 kg of protein	-	_____ Kg protein	=	_____ Kg protein
1.7 kg of fat	-	_____ Kg fat	=	_____ Kg fat

Next, we need to find a balance between herring and capelin to be put in the diet. If we use too much herring, there won’t be enough moisture. If we use too much capelin,

there won't be enough fat. Extra water can easily be excreted from the beluga during urination. However, a diet that is too high in fat content will not be healthy for the beluga. In addition, the oily food can leave a film on the surface of the water, clog the filtration system, or cause poor water quality. It is best to keep oily foods to a minimum.

Use trial and error to find a good balance of herring and capelin in the diet. Use the table below for your calculations. Take an estimated guess as to how many kg of herring and capelin will be needed in the diet. Once you have totaled the amount of nutrients available in your calculated diet, you can adjust by adding or subtracting a few kg of one or both fish in order to attain the correct nutrient values. Three tables are given below so that you may complete several different trials.

<b>Capelin provides:</b>			<b>Kg of capelin to be fed</b>		<b>Total kg of each nutrient</b>
fish	Kg water/kg	x	Kg	=	Kg water
fish	Kg protein/kg	x	Kg	=	Kg protein
	Kg fat/kg fish	x	Kg	=	Kg fat
<b>Herring provides:</b>			<b>Kg of herring to be fed</b>		<b>+</b>
fish	Kg water/kg	x	Kg	=	Kg water
fish	Kg protein/kg	x	Kg	=	Kg protein
	Kg fat/kg fish	x	Kg	=	Kg fat
				=	
Total water					Kg water
Total protein					Kg protein
Total fish					Kg fat

Nutrients provided by squid:		Nutrients provided by capelin/herring:		Total nutrients provided by this diet:	
_____Kg water		_____Kg water		_____Kg water	
_____Kg protein		_____Kg protein		_____Kg protein	
_____Kg fat		_____Kg fat		_____Kg fat	
<b>Capelin provides:</b>		<b>Kg of capelin to be fed</b>		<b>Total kg of each nutrient</b>	
_____Kg water/kg fish	x	_____Kg	=	_____Kg water	
_____Kg protein/kg fish	x	_____Kg	=	_____Kg protein	
_____Kg fat/kg fish	x	_____Kg	=	_____Kg fat	
<b>Herring provides:</b>		<b>Kg of herring to be fed</b>		<b>+</b>	
_____Kg water/kg fish	x	_____Kg	=	_____Kg water	
_____Kg protein/kg fish	x	_____Kg	=	_____Kg protein	
_____Kg fat/kg fish	x	_____Kg	=	_____Kg fat	
		=			
		Total water		_____Kg water	
		Total protein		_____Kg protein	
		Total fish		_____Kg fat	

Nutrients provided by squid:		Nutrients provided by capelin/herring:		Total nutrients provided by this diet:	
_____Kg water		_____Kg water		_____Kg water	
_____Kg protein		_____Kg protein		_____Kg protein	
_____Kg fat		_____Kg fat		_____Kg fat	

<b>Capelin provides:</b>		<b>Kg of capelin to be</b>		<b>Total kg of each nutrient</b>	
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		<b>fed</b>			
fish	Kg water/kg	x	Kg	=	Kg water
fish	Kg protein/kg	x	Kg	=	Kg protein
	Kg fat/kg fish	x	Kg	=	Kg fat
<b>Herring provides:</b>			<b>Kg of herring to be fed</b>		<b>+</b>
fish	Kg water/kg	x	Kg	=	Kg water
fish	Kg protein/kg	x	Kg	=	Kg protein
	Kg fat/kg fish	x	Kg	=	Kg fat
			=		
			Total water		Kg water
			Total protein		Kg protein
			Total fish		Kg fat

### Part III.

Now calculate a diet that will meet all of the nutritional needs and caloric needs of an adult sea lion. The amount of moisture, fat, protein and carbohydrates fed to the sea lion each day should be as close as possible to the actual required amounts. The table below shows the daily requirements.

<b>Daily dietary needs of an adult sea lion:</b>
14,200 Kcal per day
8.3 kg of water (moisture)
1.7 kg of protein
0.82 kg of fat
0.01 kg of carbohydrates

## Answer Key

### Part I

1. Find the cheapest method to **meet the daily caloric needs (30,000 Kcal)** of a beluga using one or a combination of the three food sources. Remember that 1 gram of protein has 4 Kcal, 1 gram of carbohydrates has 4 Kcal, and 1 g of fat has 9 Kcal. (Hint: look at the relative fat and protein content of each of the food sources.)

The herring is the fattiest food and therefore it has the highest caloric content per kg of food. Although the capelin is cheaper, you would need about twice as much capelin as herring to meet the 30,000 Kcal requirement. Only 17.6 kg of herring would be needed.

The herring has 171 g of protein per kg, 113 g of fat per kg, and no carbohydrates. Thus the caloric value per kg is:

$$(171 \text{ g protein} * 4 \text{ Kcal / g}) + (113 \text{ g of fat} * 9 \text{ Kcal / g}) = 1701 \text{ Kcal / kg herring}$$

The beluga needs 30,000 kcal per day:

$$30,000 \text{ Kcal} / 1,701 \text{ Kcal per kg} = 17.6 \text{ kg of herring needed}$$

2. What is the cost to feed the beluga daily with the diet you calculated?

$$17.6 \text{ kg herring} * \$3.50 \text{ per kg} = \$ 61.73 \text{ daily}$$

3. Does this diet meet the **nutritional needs** of the beluga (enough fat, protein, and carbohydrates)?

Nutrient content of herring	* 17.6 kg of herring	Needed by beluga	Comments
709 g water per kg	12.5 kg of water	16.5 kg of water	Not enough
171 g protein per kg	3 kg of protein	3.5 kg of protein	Not enough
113 g fat per kg	1.98 kg of fat	1.7 kg of fat	Too much
0 g carbs per kg	0 kg carbs	.03 kg of carbs	Not enough

The diet contains too much fat and not enough water, protein or carbohydrates.

4. What do you think would happen to the beluga if it were fed this diet for an extended period of time?

Over a short period of time, the beluga would become dehydrated. This would happen very quickly, as the beluga is missing 4 kg of water each day. If this was not corrected, the beluga could die of dehydration.

**Part II**

- Now calculate a diet that will meet all of the nutritional needs and caloric needs of the beluga whale. The amount of moisture, fat, protein and carbohydrates fed to the beluga each day should be as close as possible to the actual required amounts. (Hint: Since squid is the only food type containing carbohydrates, calculate the amount of squid to be fed first.)

Squid is the only food source with carbohydrates, so we need to calculate this first.

The beluga needs .03 kg of carbs, and 1 kg of squid has 26 g or .026 kg  
 $0.03 \text{ kg carbs needed} / .026 \text{ kg carbs in 1 kg squid} = \mathbf{1.15 \text{ kg of squid needed}}$

<b>Beluga needs:</b>	<b>Squid provides per kg:</b>		<b>Still needed:</b>
16.5 kg of water	0.773 kg moisture	*1.15 kg=0.89 kg	15.61 kg water
3.5 kg of protein	0.177 kg protein	*1.15 kg=0.20 kg	3.3 kg protein
1.7 kg of fat	0.013 kg fat	*1.15 kg=0.014 kg	1.7 kg fat
.03 kg of carbs	0.026 kg carbs	*1.15 kg=0.03 kg	0 kg carbs

We still need to add 15.61 kg of water, 3.3 kg of protein, and 1.7 kg of fat to the diet by using various amounts of herring and capelin.

Use trial and error to find a good balance between herring and capelin that will provide the correct amount of nutrients to the beluga.

Students' answers will vary. A good balanced diet can be formed by using approximately 1.15 kg of squid, 12.7 kg of herring, and 10.0 kg of capelin.

- Now calculate the daily cost of the diet you created.

Kg of food		Cost of food		Daily Cost
12.7 g herring	x	\$3.50	=	\$ 44.45
10.0 kg capelin	x	\$2.00	=	\$ 20.00
1.15 kg squid	x	\$8.00	=	\$ 9.20
<b>Total Daily Cost</b>				<b>\$ 73.65</b>

- Compare your diet with the diets of the rest of your classmates.

Whose diet was the most inexpensive?

(Answers will vary.)

Which diet most closely met the actual nutritional needs of the beluga?

(Answers will vary.) Students should realize that the most inexpensive diet is not necessarily the best in terms of nutritional value. Students should also realize that it is difficult to meet the exact needs of the beluga when given only a few food choices.

**Part III.**

This problem may be solved using the same methods used to determine the diet for the beluga whales.