Objectives
Students make decisions about how to solve a complex real-life problem by breaking it down into simpler parts.

Materials
- paper and pencils
- calculators
- Ocean Animals cards
- wholesale seafood costs (below)

Background
The animals at each SeaWorld park eat about 4,000 pounds of food daily. Animal care specialists weigh the food before distributing it to the marine animals, and they keep careful records of each animal’s daily food intake. In this exercise, students take on the role of animal care specialists. They use the seafood costs given at left and the Ocean Animals information cards to solve a complex problem. Before you begin, copy the table at right onto the board.

WHOLESALE SEAFOOD COSTS

<table>
<thead>
<tr>
<th>food item</th>
<th>price per pound</th>
</tr>
</thead>
<tbody>
<tr>
<td>capelin</td>
<td>0.45</td>
</tr>
<tr>
<td>clams</td>
<td>1.65</td>
</tr>
<tr>
<td>crabs</td>
<td>1.20</td>
</tr>
<tr>
<td>herring</td>
<td>0.40</td>
</tr>
<tr>
<td>mackerel</td>
<td>0.40</td>
</tr>
<tr>
<td>sea urchins</td>
<td>1.40</td>
</tr>
<tr>
<td>shrimp</td>
<td>3.50</td>
</tr>
<tr>
<td>squid</td>
<td>0.35</td>
</tr>
<tr>
<td>smelt</td>
<td>0.35</td>
</tr>
</tbody>
</table>

Action
1. Pose the following problem to your students:
   Estimate the animal food order and cost to feed 5 sea otters, 10 bottlenose dolphins, 19 California sea lions, 6 killer whales, and 8 emperor penguins for one day.
2. Students work through the problem individually or in learning groups. Ask them to state their assumptions before they begin their calculations.
3. When students have completed their work, discuss the problem together. How did they tackle the problem?
ANSWERS

Given that for most animals there is a range of sizes and a range of food intake, students will have to make and state their assumptions on the size of the animals and on how much the animals eat. The solution below is correct given the following assumptions.

- Sea otter weight is 25 kilograms, daily food intake is 25% body weight
- Bottlenose dolphin weight is 300 kilograms, daily food intake is 5% body weight
- California sea lion weight is 300 kilograms, daily food intake is 7% body weight
- Killer whale weight is 3,000 kilograms, daily food intake is 4% body weight
- Emperor penguin weight is 40 kilograms, daily food intake is 4% body weight

**Converting from metric to pounds:** Students must convert metric weights to pounds. They can either convert the animal’s weights or they can convert the amount of food each animal eats. For this solution we will start by converting each animal’s weight to pounds. (*Numbers are rounded to the nearest pound.*)

- Sea otter: $25 \text{ kg} \times \frac{2.2046}{1} \frac{\text{kg}}{\text{lb}} = 55 \text{ lb.}$
- Bottlenose dolphin: $300 \text{ kg} \times \frac{2.2046}{1} \frac{\text{kg}}{\text{lb}} = 661 \text{ lb.}$
- California sea lion: $300 \text{ kg} \times \frac{2.2046}{1} \frac{\text{kg}}{\text{lb}} = 661 \text{ lb.}$
- Killer whale: $3,000 \text{ kg} \times \frac{2.2046}{1} \frac{\text{kg}}{\text{lb}} = 6,614 \text{ lb.}$
- Emperor penguin: $40 \text{ kg} \times \frac{2.2046}{1} \frac{\text{kg}}{\text{lb}} = 88 \text{ lb.}$

**Calculating amount of food eaten per day:**

- Sea otter: $55 \text{ lb.} \times .25 = 14 \text{ lb.}$
- Bottlenose dolphin: $661 \text{ lb.} \times .05 = 33 \text{ lb.}$
- California sea lion: $661 \text{ lb.} \times .07 = 46 \text{ lb.}$
- Killer whale: $6,614 \text{ lb.} \times .04 = 265 \text{ lb.}$
- Emperor penguin: $88 \text{ lb.} \times .04 = 4 \text{ lb.}$

**Cost of feeding 5 sea otters:**

- 55% clams: $14 \times .55 \times 1.65 = 12.71$
- 30% shrimp: $14 \times .30 \times 3.50 = 14.70$
- 10% crabs: $14 \times .10 \times 1.20 = 1.68$
- 5% sea urchins: $14 \times .05 \times 1.40 = .98$

**TOTAL:** $30.07 \times 5 = 150.35$

**Cost of feeding 6 killer whales:**

- 50% herring: $265 \times .50 \times .40 = 53.00$
- 30% smelt: $265 \times .30 \times .35 = 27.83$
- 10% squid: $265 \times .10 \times .35 = 9.28$
- 10% mackerel: $265 \times .10 \times .40 = 10.60$

**TOTAL:** $100.71 \times 6 = 604.26$

**Cost of feeding 10 bottlenose dolphins:**

- 60% smelt: $33 \times .60 \times .35 = 6.93$
- 20% herring: $33 \times .20 \times .40 = 2.64$
- 15% squid: $33 \times .15 \times .35 = 1.73$
- 5% mackerel: $33 \times .05 \times .40 = .66$

**TOTAL:** $11.96 \times 10 = 119.60$

**Cost of feeding 19 California sea lions:**

- 40% herring: $46 \times .40 \times .40 = 7.36$
- 20% mackerel: $46 \times .20 \times .40 = 3.68$
- 20% smelt: $46 \times .20 \times .35 = 3.22$
- 20% squid: $46 \times .20 \times .35 = 3.22$

**TOTAL:** $17.48 \times 19 = 332.12$

**Total for all animals:**

- $150.35$
- $604.26$
- $119.60$
- $332.12$
- $13.12$

**Total:** $1,219.45
**Ocean Animals**

When we describe ocean animals we often use numbers; numbers describe how big an animal is, how fast it swims, or how much it eats. Numbers can also describe an animal’s population or life span. These cards use numbers to describe several ocean animals.

Some of the activities in this Teacher’s Guide require the use of the information in these cards. Here are some other ideas for ways to use these cards in your classroom:

- Use the facts on the cards to help you prepare lessons and lead discussions in class.
- Copy and cut apart the cards. Distribute a different card to each cooperative learning group or to each student. Visit the school library to learn more about the animals.
- Encourage students to use the information on these cards to develop their own story problems to share with their classmates.

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**bottlenose dolphin**

*Tursiops truncatus*

- **adult size:** 2.5 to 3.7 meters and 190 to 454 kilograms, females slightly smaller than males
- **food intake:** 4% to 6% of body weight per day
- **typical diet at SeaWorld:** 60% smelt, 20% herring, 15% squid, 5% mackerel
- **population:** unknown, not endangered
- **swimming speed:** usually 5 to 11 kilometers per hour, as fast as 35 kilometers per hour
- **diving depth:** usually within 46 meters of the surface

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**killer whale**

*Orcinus Orca*

- **adult size:** males 5.8 to 6.7 meters and 3,628 to 5,442 kilograms, females 4.9 to 5.8 meters and 1,361 to 3,628 kilograms
- **food intake:** about 3% to 4% of body weight per day
- **typical diet at SeaWorld:** 50% herring, 30% smelt, 10% squid, 10% mackerel
- **population:** unknown, not endangered
- **swimming speed:** usually 3 to 10 kilometers per hour, but as fast as 48 kilometers per hour
- **diving depth:** usually within 60 meters of the surface

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**blue whale**

*Balaenoptera musculus*

- **adult size:** about 21 meters and 64,000 kilograms
- **food intake:** about 4% of body weight per day during a feeding season that lasts about 120 days
- **population:** about 11,000
- **swimming speed:** to 18 to 22 kilometers per hour
- **diving depth:** unknown
Feeding Time

California sea lion
_Zalophus californianus_

- **adult size:** males 2.25 meters and 200 to 400 kilograms, females 1.5 to 2 meters and 50 to 110 kilograms
- **food intake:** about 5% to 8% of body weight per day
- **typical diet** at SeaWorld: 40% herring, 20% mackerel, 20% smelt, 20% squid
- **population:** about 200,000
- **swimming speed:** as fast as 19 kilometers per hour, usually slower
- **diving depth:** usually within 74 meters of the surface

Pacific walrus
_Odobenus rosmarus divergens_

- **adult size:** males 2.7 to 3.6 meters and 800 to 1,700 kilograms, females 2.3 to 3.1 meters and 400 to 1,250 kilograms
- **food intake:** 4% to 6% of body weight per day
- **typical diet** at SeaWorld: 45% herring, 15% clams, 15% capelin, 10% mackerel, 10% sardines, 5% squid
- **population:** about 200,000
- **swimming speed:** usually about 7 kilometers per hour, as fast as 35 kilometers per hour in short bursts
- **diving depth:** usually within 80 meters of the surface

Florida manatee
_Tricetes manatus latirostris_

- **adult size:** about 3 meters and 363 to 544 kilograms (Females are usually larger than males.)
- **food intake:** 4% to 9% of body weight per day
- **typical diet** at SeaWorld: 61% romaine lettuce, 21% other types of lettuce, 10% spinach, 7% cabbage, 1% carrots and apples
- **population:** probably less than 3,000
- **swimming speed:** usually 3 to 10 kilometers per hour, as fast as 24 kilometers per hour in short bursts
- **diving depth:** usually within 5 meters of the surface, as deep as 10 meters

California sea otter
_Enhydra lutris nereis_

- **adult size:** males about 1.5 meters and 29 kilograms, females about 1.2 meters and 20 kilograms
- **food intake:** 20% to 30% of body weight per day
- **typical diet** at SeaWorld: 55% clams, 30% shrimp, 10% crab, 5% sea urchins
- **population:** probably less than 2,000
- **swimming speed:** about 9 kilometers per hour under water and 12.5 kilometers per hour at the surface
- **diving depth:** usually within about 20 meters of the surface
Feeding Time

**emperor penguin**  
*Aptenodytes forsteri*
- adult size: about 1.1 meter and 27 to 41 kilograms  
- food intake: on average, about 4% of body weight per day  
- typical diet: 80% herring, 20% capelin  
- at SeaWorld: mostly within 21 meters of the surface, as deep as 534 meters  
- population: about 436,200 mature adults

**polar bear**  
*Ursus maritimus*
- adult size: males 2.5 to 3 meters and 350 to 650 kilograms, females 2.0 to 2.5 meters and 150 to 250 kilograms  
- food intake: about 2% of body weight per day  
- typical diet: 30% polar bear biscuits, 25% meat, 20% capelin, 15% herring, 10% fruits and vegetables  
- at SeaWorld: usually within 4.5 meters of the surface  
- swimming speed: as fast as 10 kilometers per hour, usually slower  
- population: 21,000 to 28,000

**sandtiger shark**  
*Carcharias taurus*
- adult size: 2.2 to 3.2 meters and about 140 kilograms  
- food intake: 1% to 10% of body weight per week  
- typical diet: 50% blue runner, 40% mackerel, 10% squid  
- at SeaWorld: unknown  
- swimming speed: unknown  
- population: unknown  
- average depth: to 191 meters

**leatherback sea turtle**  
*Dermochelys coriacea*
- adult size: 1.2 to 1.9 meters and 200 to 506 kilograms (the largest of the sea turtles)  
- food intake: unknown  
- swimming speed: 1.5 to 9.3 kilometers per hour  
- diving depth: 305 meters in routine dives, as deep as 1,190 meters  
- population: less than 115,000 females  
  (Only mature females are counted, when they come ashore to lay eggs.)