Lesson C3–3

# Describing Nutritional Requirements of Fish

**Unit C.** Animal Wildlife Management

**Problem Area 3.** Fish Management

**Lesson 3.** Describing Nutritional Requirements of Fish

## New Mexico Content Standard:

***Pathway Strand:*** Natural Resources and Environmental Systems

***Standard:*** **IV:** Employ knowledge of natural resource industries to describe production practices and processing procedures.

***Benchmark:*** **IV-A:** Prepare presentations to describe how natural resource products are produced, harvested, processed and used.

***Performance Standard:*** **3.** Describe fish harvest techniques and procedures.

**Student Learning Objectives.** Instruction in this lesson should result in students achieving the following objectives:

1. Describe the role of proteins in fish nutrition
2. Describe the role of fats in fish nutrition
3. Describe the role of carbohydrates in fish nutrition
4. Describe the role of minerals in fish nutrition
5. Describe the role of vitamins in fish nutrition

**List of Resources.** The following resources may be useful in teaching this lesson:

***Recommended Resources.*** One of the following resources should be selected to accompany the lesson:

Lee, J.S. & Newman, M.E. *Aquaculture—An Introduction* 2nd Edition. Danville, Illinois: Interstate Publishers, Inc., 1997.

***Other Resources.*** The following resources will be useful to students and teachers:

Gillespie, J.R. (1987). Animal Nutrition and Feeding. Albany, New York: Delmar Publishing, Inc.

Selness, D. *Exploration Activities in Aquaculture*. Danville, Illinois: Interstate Publishers, Inc., 1997.

## List of Equipment, Tools, Supplies, and Facilities

Writing surface
Overhead projector
Transparencies from attached masters
2 nutritional labels

**Terms.** The following terms are presented in this lesson (shown in bold italics):

Amino acid
Blood meal
Carbohydrates
Carnivore
Fat-soluble vitamins
Fats
Fish meal
Herbivore
Minerals
Omnivore
Protein
Soybean meal
Trace elements
Vitamins
Water-soluble vitamins

**Interest Approach.** Use an interest approach that will prepare the students for the lesson. Teachers often develop approaches for their unique class and student situations. A possible approach is included here.

*Obtain two nutritional labels from different food products for human consumption. Write the amount of fat, carbohydrates, proteins, and vitamins on the board. Discuss how different foods provide us with different nutrients. Now lead the discussion to how fish obtain their needed nutrients. Allow this to lead into discussion of the content of this lesson.*

# Summary of Content and Teaching Strategies

## Objective 1: Describe the role of proteins in fish nutrition

***Anticipated Problem:*** What is the role of protein in fish nutrition?

I. The first major component required for proper nutrition of fish is protein.

A. ***Protein*** is formed from compounds known as amino acids. Ten amino acids are essential to proper fish nutrition. ***Amino acids*** are the building blocks of protein and are needed by animals for proper nutrition. These amino acids are broken down during digestion and used to produce new tissue or reproduce damaged tissue.

B. The most critical component of fish feed is protein. Typical prepared fish feed will contain between 25 and 40 percent protein. Some common sources of protein in fish feed include:

1. ***Fish meal***, which is a high protein feed derived from fish.
2. Animal waste products, such as blood meal or meat scraps. ***Blood meal*** is a high protein feed derived from blood collected during the slaughter process.
3. Another source of protein is soybean meal. ***Soybean meal*** is a high protein feed produced from soybeans.

C. Fish that are carnivores require a feed that has 50 percent of its proteins from animals sources. ***Carnivores*** are animals that eat meat. Fish that are herbivores or omnivores only need about 30 percent of the protein in their feed from animal sources. ***Herbivores*** are animals that eat plants. ***Omnivores*** are animals that eat both plants and animals.

*There are many techniques that can be used to assist students in mastering this material. Students need text material to aid in describing the role of proteins in fish nutrition. Chapter 3 in Aquaculture—An Introduction 2nd Edition text is recommended. Use TM: C3–3A to aid in discussion on this topic.*

## **Objective 2:** Describe the role of fats in fish nutrition

***Anticipated Problem:*** What is the role of fats in fish nutrition?

II. Fats are another required component of fish feeds. ***Fats*** are composed of fatty acids.

A. Fats are used for proper health and growth.

B. The type of fat needed in a fish feed depends on the temperature of the water. To be properly digested, the fat must be able to melt. To melt, it must have a melting point that is below the water temperature.

1. Feed for cold water fish, such as trout, usually have unsaturated fats derived from plants, such as vegetable oil.
2. Feeds for warm water fish, such as tilapia, usually have saturated fats derived from animal products.

C. The total amount of fat in a feed is usually between 4 and 15 percent.

*There are many techniques that can be used to assist students in mastering this material. Students need text material to aid in describing the role of fats in fish nutrition. Chapter 3 in Aquaculture—An Introduction 2nd Edition text is recommended. Use TM: C3–3B to aid in discussion on this topic.*

## **Objective 3:** Describe the role of carbohydrates in fish nutrition

***Anticipated Problem:*** What is the role of carbohydrates in fish nutrition?

III. Another needed component of fish feed is carbohydrates. ***Carbohydrates*** are the source of energy for fish. Carbohydrates are organic compounds composed of carbon, hydrogen, and oxygen.

A. Plants including sugars, starches, and cellulose are sources of carbohydrates for fish feed.

B. Fish herbivores, such as carp, are better capable of digesting carbohydrates. This is a result of the production of an enzyme called amylase in their digestive system.

C. Fish carnivores, such as catfish, can't digest carbohydrates as well, so they only need about 10 percent carbohydrates in their ration.

*There are many techniques that can be used to assist students in mastering this material. Students need text material to aid in describing the role of carbohydrates in fish nutrition. Chapter 3 in Aquaculture—An Introduction 2nd Edition text is recommended. Use TM: C3–3C to aid in discussion on this topic.*

## **Objective 4:** Describe the role of minerals in fish nutrition

***Anticipated Problem:*** What is the role of minerals in fish feed?

IV. In addition to protein, fats, and carbohydrates, fish need minerals. ***Minerals*** are inorganic materials needed for health and growth. Most minerals are only needed in very small amounts for proper nutrition. In fact, large amounts of minerals may be fatal to fish. Minerals are often called ***trace elements***, because they are needed in very small quantities.

A. Calcium, iron, silicon, manganese, magnesium, boron, cobalt, copper, iodine, molybdenum, selenium, and sodium are all required for proper fish nutrition.

B. Testing the water can show which minerals are deficient. Minerals can be given to fish two ways.

1. Minerals can be added directly to the water. However, if the water is flowing, or moving, this may be a waste.
2. Minerals can be added to a commercially prepared feed.

*There are many techniques that can be used to assist students in mastering this material. Students need text material to aid in describing the role of minerals in fish nutrition. Chapter 3 in Aquaculture—An Introduction 2nd Edition text is recommended. Use TM: C3–3D to aid in discussion on this topic.*

## **Objective 5:** Describe the role of vitamins in fish nutrition

***Anticipated Problem:*** What is the role of vitamins in fish nutrition?

V. ***Vitamins*** are organic compounds need in small amounts for proper growth and maintenance of body functions. Specific vitamins are needed for different body functions. Vitamin deficiencies can cause poor growth, anemia, skin lesions, clubbed gills, and other problems. Vitamins can be classified into two types.

A. ***Water-soluble vitamins*** are taken in, used, and then excreted. Some water-soluble vitamins include Thiamin, Riboflavin, and Folic Acid.

B. ***Fat-soluble vitamins*** are taken in to the body and stored. As a result, if excess amounts are consumed, they could be as unhealthy as not enough. Fat-soluble vitamins include vitamin E, vitamin A, and vitamin D.

*There are many techniques that can be used to assist students in mastering this material. Students need text material to aid in describing the role of vitamins in fish nutrition. Chapter 3 in Aquaculture—An Introduction 2nd Edition text is recommended. Use TM: C3–3E to aid in discussion on this topic.*

**Review/Summary.** Use the student learning objectives to summarize the lesson. Have students explain the content associated with each objective. Student responses can be used in determining which objectives need to be reviewed or taught from a different angle. Questions at end of chapters in the textbook may also be used in the review/summary.

**Application.** Several opportunities for application are listed in the "Exploring" section at the end of Chapter 3 in the *Aquaculture—An Introduction* 2nd Edition text. Laboratory Activity 16 in: *Exploration Activities in Aquaculture* is appropriate for this lesson.

## Evaluation.

## Answers to Sample Test:

### *Part One: Matching*

1 = f, 2 = k, 3 = b, 4 = c, 5 = j, 6 = d, 7 = a, 8 = e, 9 = g, 10 = h

### *Part Two: Completion*

1. fish meal
2. water-soluble
3. carbohydrates
4. minerals
5. warm

### *Part Three: Short Answer*

1. proteins, fats, carbohydrates, minerals, and vitamins
2. they produce an enzyme called amylase

**Sample Test** Name _____

# Test

## Lesson C3–3: Describing Nutritional Requirements of Fish

### *Part One: Matching*

*Instructions.* Match the term with the correct response. Write the letter of the term by the definition.

| | |
|---|---|
| a. amino acid | f. minerals |
| b. carbohydrates | g. omnivore |
| c. carnivore | h. protein |
| d. fats | j. soybean meal |
| e. herbivore | k. trace elements |

_____ 1. Inorganic materials needed for health and growth.

_____ 2. When something is needed in very small quantities.

_____ 3. The source of energy for fish.

_____ 4. An animals that eats meat.

_____ 5. A high protein feed produced from a plant source.

_____ 6. Composed of fatty acids.

_____ 7. The building blocks of protein.

_____ 8. An animal that eats plants.

_____ 9. An animal that eats plants and animals.

_____ 10. Used to produce new tissue or reproduce damaged tissue.

### *Part Two: Completion*

*Instructions.* Provide the word or words to complete the following statements.

1. _____ is a high protein feed derived from fish.
2. _____ vitamins are taken in, used, and then excreted.
3. Sugars, starches, and cellulose are sources of _____.
4. _____ may be added directly to the water or in feed.
5. Feeds for _____ water fish usually have saturated fats.

***Part Three: Short Answer***

*Instructions.* Provide information to answer the following questions.

1. What five components are needed in a fish feed?

2. Why can fish herbivores digest carbohydrates better that fish carnivores?

TM: C3–3A

## Amino Acids Essential to Fish and the Minimum Percentage Required for Rainbow Trout

| Amino Acid | Percentage Required |
|---|---|
| Arginine | 2.5 |
| Lysine | 2.1 |
| Isoleucine | 1.5 |
| Valine | 1.5 |
| Cystine | 1.0 |
| Leucine | 1.0 |
| Threonine | 0.8 |
| Histidine | 0.7 |
| Methionine | 0.5 |
| Tryptophan | 0.2 |

Source: W.O. McLarney, *The Freshwater Aquaculture Book*. Point Roberts, Washington: Hartley & Marks, Inc., 1987, p. 156.

# FATS IN FISH NUTRITION

- Composed of fatty acids
- Used for health and growth
- Type of fat needed depends on water temperature
  - Warm water – saturated fats
  - Cool water – unsaturated fats
- Total fat between 4 and 15 percent

# CARBOHYDRATES

- Provide energy to fish
- Sources include sugars, starches, and cellulose
- Herbivores can digest more carbohydrates
- Carnivores need only about 10 percent carbohydrates in ration

# MINERALS

- Inorganic Compounds
- Needed in small amounts (trace elements)
- When deficient, they may be added to water or in the feed
- Required Minerals
  - Calcium
  - Iron
  - Silicon
  - Manganese
  - Magnesium
  - Boron
  - Cobalt
  - Copper
  - Iodine
  - Molybdenum
  - Selenium
  - Sodium

## Vitamins Essential to Fish and Minimum Daily Requirement (MDR) for Rainbow Trout

| Vitamin | MDR | Vitamin | MDR |
|---|---|---|---|
| **Water-soluble Vitamins** | | | |
| Thiamine ($B_1$) | 0.15–0.2 mg/kg of fish | Folacin or folic acid | 0.10–1.15 |
| Roboflavin ($B_2$) | 0.5–1.0 | Cyanocobalamin ($B_{12}$) | 0.0002–0.0003 |
| Pyridoxine ($B_6$) | 0.25–0.5 | Ascorbic acid (C) | 450–500 |
| Pantothenic acid | 1.0–2.0 | Inositol | 18–20 |
| Niacin or nicotinic acid | 4.0–7.0 | Choline | 50–60 |
| Biotin (H) | 0.04–0.08 | | |
| **Fat-soluble Vitamins** | | | |
| $K_3$ | 15–20 mg/kg of fish | A | 8,000–10,000 |
| E | 125 IU/kg of feed | D | 1,000 |

Source: Source: W.O. McLarney, *The Freshwater Aquaculture Book*. Point Roberts, Washington: Hartley & Marks, Inc., 1987, p. 158.