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DepED
DEPARTMENT OF EDUCATION

Lesson Exemplar for TLE

Quarter 2
Lesson
4

Lesson Exemplar for TLE Grade 8
Quarter 2: Lesson 4 (Week 4)
SY/TP 2025-2026

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TLE /QUARTER 2 / GRADE 8

I. CURRICULUM CONTENT, STANDARDS, AND LESSON COMPETENCIES	
A. **Content Standards**	The learners demonstrate an understanding of the concepts and skills in fisheries.
B. Performance Standards	The learners perform the skills in fisheries following safety precautions.
C. Learning Competencies and Objectives	***Learning Competency*** ● Discuss Occupational Safety and Health (OSH) hazards in fisheries. ● Discuss advantages and disadvantages of organic aquaculture. ● Identify different aquaculture methods and selected practices. ● Determine the area and depth requirement of aquaculture facilities.
D. Content	**Occupational Hazards in Fisheries** **Advantages and Disadvantages of Organic Aquaculture** **Aquaculture Methods and Practices**
E. Integration	**SDG 9:** Industry, Innovation and Infrastructure **SDG 14:** Life Below Water ● Environmental impact assessment strategies associated with aquaculture operations

II. LEARNING RESOURCES
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III. TEACHING AND LEARNING PROCEDURE		**NOTES TO TEACHERS**
***A.* Activating Prior Knowledge**	**DAY 1 – DAY 2** **1. Short Review** **Fact or Bluff** Directions: Determine whether the statement is Fact (True) or Bluff (False). 1. Aquatic pollution, as defined in the Republic Act No. 10654 Section 107, shall be unlawful. 2. Republic Act No. 10654 is an amendment to the Philippine Agriculture Code of 1998. 3. All aquatic and fishery resources, whether inland, coastal, or offshore, including fishponds, fish pens/cages. 4. One of the Technical Committee of Rule 107.2 shall be composed of representative from the Environmental Management Bureau of the Department of Environment and Natural Resources (DENR). **5.** Fish capture technology encompasses the process of catching any land animal. 2. **Feedback (Optional)**	Answers: 1. Fact 2. Bluff (Fisheries) 3. Fact 4. Fact 5. Bluff (Aquatic)

B. Establishing Lesson Purpose	**1. Lesson Purpose** The teacher will explain the purpose of Occupational safety and health hazards. That the primarily focus is to protect the people from any accidents, injuries, and exposure to harmful substances. **2. Unlocking Content Vocabulary** ● **Biological Health** - Biological hazards, also known as biohazards, are organic substances that pose a threat to the health of living organisms, primarily humans. ● **Brackish water Culture** - It is rich in oxygen and plankton. Brackish water organisms can be cultured in various ways such as in tidal ponds, pens, cages or by rack, raft, or rope culture. ● **Chemical hazards** - mean any organic or inorganic substance of a particular identity, any element or uncombined chemical and any combination of such substances, or any mixture or two or more chemical substances. ● **Ergonomic Health** - It is the science of fitting jobs to workers instead of trying to get the worker to fit the job. It focuses on designing workstations, tools & work tasks for safety, efficiency, and comfort. ● **Manmade Hazard** - Anthropological hazards are those hazards caused directly or indirectly by human action or inaction. They can be contrasted with natural hazards. ● **Mariculture** - For the culture of fish, prawns, and lobster floating cages are used. ● **Natural Hazard** - It is a natural phenomenon that might have a negative effect on people or the environment. Natural hazard events can be grouped into four broad categories. ● **Physical Health** - Refer to the potential risks that can cause physical harm or injury to workers due to physical agents, factors or conditions present in the workplace. ● **Psychosocial Hazard** - refer to the stressors and factors in the workplace or environment that can cause emotional distress or mental health issues in individuals. **SUB-TOPIC 1: Occupational Safety and Health (OSH) hazards in Fisheries** **1. Explicitation** Whether working on-board a fishing vessel or in port, fishers are often exposed to occupational hazards. Fishing requires working for long hours at sea, often at night and in rough weather. The work involves transporting and operating heavy equipment and gears and handling of sometimes dangerous catches. The work in commercial fisheries can therefore have severe health consequences, cause accidents, injuries, and fatalities. Health and safety in fisheries are a complex issue with multiple aspects. Fishing is performed under unpredictable and rapidly changing weather and sea conditions, yet many fishing vessel crew are lacking any form of protection. Many fishing crews, particularly in small-scale fisheries, have only informal and self-employed work arrangements, lack proper employment contracts and have limited or no access to social security, including pensions, disability, and health insurance. A large majority of fishing crews worldwide have not received basic safety training nor have access to safety gear and protective clothing while working on	

	board, which contributes to their exposure to occupational hazards. In addition, cultural norms and views around masculinity tend to influence the perception of risks and behavior of fishers. Occupational health issues commonly encountered in commercial fisheries include: ● Cancers and allergies, such as skin cancers, from lengthy and unprotected exposure to ultraviolet (UV) rays from the sun. ● Eye disorders, such as sunburned eyes and blurred vision, from overexposure to UV rays from the sun. ● Injuries, from sharp objects on deck, gears or fish handling. ● Hearing disorders, from working in noisy engine rooms. ● Musculoskeletal disorders, from falls on slippery wet surfaces, getting caught in winches or other machinery or from lifting heavy loads. ● Suicides, from lengthy periods of stress and fatigue. ● Drug and alcohol addictions.	

C.Developing and Deepening Understanding	**Precationary measures in the fisheries workplace:** • Do not get caught in winches or machinery. • Be careful with deck openings and hatches. • Wear gloves when handling catch. • Wear protective clothing. • Limit alcohol consumption on board. • Check ladders before use. 3. **Worked Example** A **hazard** is a situation that poses a level of threat to life, health property, and environment. Hazards can be dormant or potential, with only a theoretical risk of harm; however, once a hazard becomes "active", it can create an emergency. A hazard that has come to pass is called incident. Hazard and possibility interact together to create risk. **Types of Hazards:** ***Natural Hazard*** **-** It is a natural phenomenon that might have a negative effect on people or the environment. Natural hazard events can be grouped into four broad categories. • *Geophysical hazards* – these hazards are driven by geological (i.e., Earth) processes, in particular, plate tectonics. This includes earthquakes and volcanic eruptions. • *Meteorological hazards* – these hazards driven by meteorological (i.e., weather) processes, in particular those related to temperature and wind. This includes heat wave, cold waves, cyclones, hurricanes, and freezing rain. • *Hydrological hazards* – hazards driven by hydrological (i.e., water) processes. This includes floods, droughts, mudslides, and tsunamis. • *Biological hazards* – can refer to a diverse array of disease and infestation. ***Manmade Hazard*** **-** Anthropological hazards are those hazards caused directly or indirectly by human action or inaction. They can be contrasted with natural hazards. • These are the result of carelessness or human errors during technological and industrial use. • Disasters are in the form of accidents, which occur all of a sudden and take a huge toll on life and property. Mostly such disasters cause injuries, disease, and casualties where they occur. • Anthropogenic hazards may adversely affect human, other organisms and biomes and eco-systems. **Types of Natural and Manmade Hazard in Fisheries** **CYCLONE** • Cyclone is a large scale of air mass that rotates around a strong center of low atmospheric pressure. 	As there are many contents in this lesson. The teacher may opt to choose necessary points. Not all lessons can be covered. This is lesson menu for the teachers.

- In the northern hemisphere, cyclones are called **hurricanes** or **typhoons**, and their winds blow in an anti-clockwise circle. In the southern hemisphere, these tropical storms are known as **cyclones**, whose winds blow in a clockwise circle.
- In common terms, cyclone can be described as a giant circular storm system whose wind speed must be more than 119km/hr.

FLOODS

- Floods refer to the inundation of large parts of land which otherwise remain dry by water for some duration of time.
- Floods are two types: Natural floods and catastrophic floods.
- The floods in the mountainous regions due to cloudbursts or damming of streams are referred to as flashfloods. In flashfloods, the water drains away quickly but only after causing extensive damage.
- Floods are also caused by heavy snow melting.

DROUGHT

- It is a condition of abnormally dry weather within a geographic region. It is the lack or insufficiency of rain for an extended period of time in a specific region.
- During droughts, rainfall is less than normal causing a water imbalance and resultant water shortage. It occurs when the rate of evaporation and transpiration exceeds precipitation for a considerable period.
- Droughts usually occur in hot dry areas of land. It most cases the area is dry because there is very minimal rainfall. The rain that does fall will be quickly absorbed into the ground or blown away by the dry air flow that moves along the ground. Therefore, the land is very dry and not many things can live there.

TSUNAMI

- Tsunami is a Japanese word with the English translation, “harbor wave.” Also known as **seismic sea wave**.
- it is a series of waves in a water body cause by the displacement of a large volume of water, generally in an ocean or a large lake.
- Tsunami may reach a maximum vertical height onshore above sea level, often called a run-up height, of 10, 20 and even 30 meters.

EL-NINO

- It is defined by prolonged differences in Pacific Ocean surface temperature when compared with the average value. The accepted definition is a warming or cooling of at least 0.5-degree Celsius average over the east-central tropical Pacific Ocean.

- It affects the global climate and disrupts normal weather patterns, which as a result can led to intense storms in some places and droughts in others. It also affects the Indian climate by altering rainfall, floods, marine habitat, and storm patterns.

Occupational Safety and Health (OSH) Hazards

OSH is a risk associated with working in specific occupations. The Occupational Safety and Health Administration (OSHA) describes five categories of occupational hazards: ergonomic health, physical health, biological, psychological health, environmental and chemical risk factors.

Ergonomic Health **-** It is the science of fitting jobs to workers instead of trying to get the worker to fit the job. It focuses on designing workstations, tools & work tasks for safety, efficiency, and comfort. Ergonomics seeks to decrease fatigue and injuries, along with increasing comfort, productivity, job satisfaction and safety, because work injuries are not inevitable, and a well-designed job should not hurt you. Ergonomics is important because when you're doing a job, and your body is stressed by an awkward posture, extreme temperature, or repeated movement your musculoskeletal system is affected. Your body may begin to have symptoms such as fatigue, discomfort, and pain, which can be the first signs of a musculoskeletal disorder.

What are Musculoskeletal Disorders or MSDs?

Musculoskeletal disorders or MSDs are cumulative and chronic injuries of the soft tissue-muscles, tendons, ligaments, nerves, joints, and blood vessels. The body has limits and can fail or wear out when abused or misused. MSDs are defined as injuries to muscles, tendons, ligaments, joints, nerves, and discs that are caused or aggravated by our actions and/or environment that does not follow safe and healthy work practices.

A well-known MSD is carpal tunnel syndrome which occurs when the nerve, which runs from the forearm into the palm of the hand, becomes pressed or squeezed at the wrist. The carpal tunnel - a narrow, rigid passageway of ligament and bones at the base of the hand - houses the 5 median nerves and tendons. Sometimes, thickening from irritated tendons or other swelling narrows the tunnel and causes the median nerve to be compressed resulting in pain, weakness, loss of grip or numbness in the hand and wrist, radiating up the arm.

Symptoms of MSDs

- Pain
- Weakness
- Stiffness
- Sensitivity
- Swelling
- Burning sensation
- Tingling
- Drowsiness
- Difficulty moving
- Clumsiness

Ergonomic Risk Factors

- Force
- Heaving lifting
- Push or pull
- Carrying
- Gripping
- Awkward or prolonged
- postures
- Repetitive activitie
- Overhead work
- Contact stress
- Vibration

Some Ways to Reduce Ergonomic Risks

Engineering Improvements. Engineering improvements include rearranging modifying, redesigning, or replacing tools, equipment, workstations, packaging parts, or products. These improvements can be very effective because they may reduce or eliminate contributing factors. (For example, if your job requires sitting for long periods of time, having an adjustable seat or foot stool so that your knees are higher than your hips help protect your lower back.)

Administrative Improvements. Administrative improvements include changing work practices, or the way work is organized.

- Providing variety in jobs
- Adjusting work schedules and work pace
- Providing recovery time (i.e., muscle relaxation time)
- Modifying work practices
- Ensuring regular housekeeping and maintenance of workspaces, tools, and equipment
- Encouraging exercise

Personal Protective Equipment. Safety gear, or personal protective equipment (PPE), includes gloves, knee and elbow pads, footwear, and other items that employees wear.

***Physical Health* -** Refer to the potential risks that can cause physical harm or injury to workers due to physical agents, factors or conditions present in the workplace.

Types of Physical Hazards

The main factors and conditions associated with physical hazards include:
Body Stressing - Body stress is a collective term covering a broad range of health problems associated with repetitive and strenuous work.

Factors Influencing Body Stress
Body stressing injuries, or musculoskeletal disorders (MSD), often develop from ergonomic hazards or carrying out hazardous manual tasks. Body stressing injuries at work can result from a variety of factors:

- *Psychosocial aspects of work* – factors such as job demands, control, support and satisfaction, imbalance between effort and reward and monotony of tasks. Financial concerns or relationship issues may also contribute.
- *Biomechanical* - soft tissue damage which may occur through:
  - direct exposure (blunt trauma or sudden overload), leading to a muscle tear or sprain, or
  - indirect exposure (repeated light loading), leading to symptoms that may accumulate to cause further degeneration and injury.
- *Individual worker characteristics* – factors including health problems or out of hours demands.

Electricity - Electric shock through poor electrical installation and faulty appliances can cause serious injury and even death. It can result in:

- death from electrocution
- burn injuries to skin and internal tissue as well as damage to the heart
- other injuries, such as falling from ladders and heights, muscle spasms, palpitations, and unconsciousness.

Heat - Heat strain can result from working in hot temperatures and being exposed to high levels of humidity or thermal radiation, such as in foundries, commercial kitchens and laundries.

- When working in extreme heat conditions, you must be able to carry out work without a risk to your health and safety, so far as is reasonably practicable.

Heights - Working at heights is a high-risk activity and a leading cause of death and serious injury.
Noise - Noise in the workplace is considered excessive when you need to raise your voice to be heard by someone a meter away.

- Excessive noise can lead to temporary or permanent hearing loss or tinnitus (ringing in the ears). It can also affect psychological health including anxiety, depression, fatigue, sleeplessness, memory, and decision making.

Vibration - There are risks connected to working with vibrating equipment and plant which need to be assessed and managed.

- Evidence also shows that people who experience vibration and noise at the same time are more likely to suffer hearing loss and musculoskeletal problems, than people exposed to noise or vibration alone.

Biological Health **-** Biological hazards, also known as biohazards, are organic substances that pose a threat to the health of living organisms, primarily humans. This category includes pathogens such as viruses, bacteria, fungi, parasites, and other microorganisms that can cause infections. They also include biological toxins, allergens, and biological vectors that can carry diseases across different species.

Biological hazards can affect the human body in several ways, depending on the nature of the hazard and the route of exposure. The primary routes of entry into the body are:

Examples of Biological Hazards

- *Inhalation:* Breathing in airborne pathogens or toxins can lead to respiratory infections or conditions. Examples include tuberculosis bacteria or the spores of fungi.
- *Skin Contact:* Some biohazards can enter through cuts or abrasions in the skin or can cause infections or allergic reactions upon contact. For instance. bloodborne pathogens like HIV and hepatitis B virus can enter through open wounds.
- *Ingestion:* Consuming contaminated food or water can result in gastrointestinal illnesses. E. coli or Salmonella bacteria are common causes of foodborne diseases.

- *Inoculation:* This occurs when a pathogen is introduced into the body through a puncture, needlestick injury, or a bite from an infected vector, like a mosquito carrying the dengue virus.
- *Mucous Membrane Exposure:* Pathogens can enter the body through the eyes, nose, or mouth. For example, conjunctivitis can be caused by certain viruses or bacteria entering the eye.

The measures which need to be taken to eliminate or reduce the risks to workers will depend on the biohazard, but there are a number of common actions that can be implemented:

- Many biological agents are communicated via air, such as exhaled bacteria or toxins of moldy grains. The production of aerosols and dust should be avoided in the manufacturing process, during cleaning and/or maintenance.
- Good housekeeping, hygienic working procedures and the use of relevant warning signs are key elements of safe and healthy working conditions.
- Many microorganisms have developed mechanisms to survive or resist heat, dehydration, or radiation, for example by producing spores. The workplace must develop decontamination measures for waste, equipment and clothing, and appropriate hygienic measures for workers, as well as proper instructions for safe disposal of waste, emergency procedures, and first aid.

Psychosocial Health **-** Psychosocial hazards refer to the stressors and factors in the workplace or environment that can cause emotional distress or mental health issues in individuals. They are increasingly recognized as major challenges to occupational health and safety. Psychosocial hazards are aspects of work design, organization, and management, as well as social and environmental factors, that have the potential to cause psychological or physical harm.

Examples of Psychosocial Hazards

- *Work Stress*: This can be caused by a variety of factors such as high workloads, tight deadlines, lack of control over work, and poor organizational support. Chronic work stress can lead to burnout, which is characterized by exhaustion, cynicism, and reduced professional efficacy.
- *Workplace Violence:* This includes bullying, harassment, and physical violence from colleagues, managers, or members of the public. It can lead to physical injury as well as psychological trauma.
- *Work-life Balance:* Poor work-life balance due to long hours or shift work can lead to stress and conflict between work and family or personal life.
- *Job Insecurity:* Uncertainty about the future of one's job can be a significant source of stress and anxiety.
- *Poor Organizational Culture:* A workplace that lacks policies for promoting respect and fair treatment may lead to a toxic work environment.
- *Lack of Participation and Control:* Having little influence over one's job or working conditions can lead to dissatisfaction, stress, and a feeling of lack of control.

Environmental - Environmental health is a field that focuses on how the natural and human-built surroundings as well as behaviors affect human well-being. The field is concerned with preventing disease,

death, and disability by reducing exposure to environmental hazards and promoting behavioral change. Environmental hazards are threats to human health and well-being.

The importance of workplace health

- The world of work is evolving rapidly, and employee health has become a major concern. The Covid-19 pandemic has heightened this awareness, emphasizing the importance of a healthy work environment.
- Studies indicate that companies implementing a proactive approach to prevention and occupational health and safety standards (OHS) have employees who are healthy, safe, and perform well.
- Employee health stands as a fundamental pillar within a company's overall framework. Healthy employees are more engaged, productive, and less prone to extended absences or workplace accidents.

The role of Occupational Health Prevention Services in environmental monitoring

- The Occupational Health and Prevention Services (OHPS) play a crucial role in environmental monitoring within companies.
- Their primary mission is to ensure the protection and promotion of workers' health by assessing occupational risks, including those related to the work environment. As part of workplace environmental monitoring, these services analyze working conditions, potential exposure to environmental pollutants such as chemical, physical, or biological agents, as well as other environmental factors that could impact employee health.
- These identifications and risk assessments by the Occupational Health and Prevention Services contribute to the implementation of preventive measures and action plans, aiming to reduce occupational accidents and work-related illnesses, which result in economic losses equivalent to 4-6% of GDP in most countries (WHO).
- Promoting a healthy and safe work environment not only helps meet regulatory standards but also enhances the quality of work life, fosters employee well-being, and improves productivity.

Potential environmental risk hazards and effects on employee health

The environmental risks to which employees are exposed can vary depending on the industry, type of work performed, and geographical location. Here are some of the environmental risks commonly encountered by workers:

- *Air Pollution* - Possibility of exposure to various pollutants and chemicals. In the service sector, pollutants such as fine particles, carbon dioxide (CO_2), nitrogen dioxide (NO_2), or volatile organic compounds (VOCs) or light (VOLCs) are found.
- *Noise Pollution* - Exposure to high levels of noise from machinery, equipment, or industrial processes. According to the INRS (National Institute for Research and Safety), noise represents a significant nuisance in the workplace.
- *Thermal Comfort*

- o High temperature: Can lead to heat strokes, dehydration, and discomfort, with potentially serious health consequences.
- o Low temperature: Exposing workers to cold conditions can result in frostbite, hypothermia, and circulatory problems.

The benefits of environmental monitoring

Environmental monitoring emerges as an essential tool to ensure workplace health and prevent risks. By conducting an assessment of occupational hazards, proactive preventive measures can be taken to promote well-being, health, and enhance working conditions.

- *Detection of Health Risks* - Environmental monitoring allows for quickly identifying potential exposures to harmful substances or hazardous working conditions. This facilitates the implementation of preventive measures before health issues manifest among workers.
- *Prevention of Occupational Diseases* - By monitoring work-related environmental factors, health prevention services can help prevent the development of occupational diseases. This includes early detection of risks associated with inhaling chemicals, exposure to carcinogenic agents, etc.
- *Regulatory Compliance* - By monitoring environmental parameters, health prevention services can ensure that the company complies with health and safety regulations in the workplace (OHS). This reduces the risk of legal sanctions and enhances the company's reputation.
- *Improvement of Productivity* - Healthy and safe working conditions contribute to a more productive workforce. By monitoring environmental aspects, companies can minimize absences due to health reasons, reduce costs associated with sick leave, and increase overall productivity.
- *Employee Education and Awareness* - Environmental monitoring provides a solid foundation for employee education and awareness. Informed workers about potential risks are more likely to adopt safe behaviors and correctly use personal protective equipment.
- *Tracking Trends and Evaluating Interventions* - By collecting data over an extended period, health prevention services can assess the effectiveness of implemented preventive measures. This allows for adjusting prevention strategies based on observed trends.

Chemical - Chemical hazards mean any organic or inorganic substance of a particular identity, any element or uncombined chemical and any combination of such substances, or any mixture or two or more chemical substances. Inhalation, skin absorption, ingestion, or contact with harmful substances can pose risks. In various industries, these substances can be present in the form of liquids, solids, gases, mist, dusts, fumes, and vapors.

Examples of Chemical Hazards

- *Toxic Substances*: These can cause various health effects, ranging from mild irritation to severe health conditions, including organ damage and cancer. Toxicity can depend on the dose, duration of exposure, and the nature of the chemical.
- *Corrosives:* Chemicals like acids and bases can cause burns on contact with skin or eyes. They can also damage respiratory tissues if inhaled and can corrode metal equipment.

- *Irritants:* These substances may not cause immediate damage but can lead to inflammation or irritation of the skin, eyes, nose, or throat with exposure.
- *Sensitizers:* Sensitizers can lead to allergic reactions upon exposure. Repeated exposure can increase sensitivity and lead to sever reactions like dermatitis or respiratory issues.
- *Carcinogens:* These are substances that are known or suspected to cause cancer. Regular exposure, even at low levels, can be dangerous over time.
- *Mutagens:* Mutagenic chemicals can cause changes in the DNA of exposed individuals, leading to genetic mutations.
- *Reproductive Toxins:* These chemicals affect reproductive capabilities, including fertility issues, developmental disorders, and birth defects.
- *Asphyxiants:* These chemicals either consume or displace oxygen in the air or interfere with the body's ability to transport or utilize oxygen, leading to suffocation. Carbon monoxide is a well-known example.
- *Neurotoxins:* Substances that have harmful effects on the nervous system, leading to symptoms such as dizziness, tremors, and, in severe cases, brain damage.
- *Systemic Toxins:* These affect entire body systems or multiple organs, such as the liver, kidneys, or the central nervous system.

4. **Lesson Activity**

Spot the Hazard: How observant are you? Do you know what it takes to spot the hazards in these photos?

Photo 1: What do you think are the ergonomic hazards in this photo?

-Enter 3 hazards below:
-Enter safety hazards below:

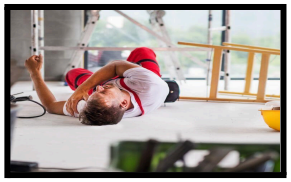

Photo 2: What do you are the physical haza this photo?

-Enter 3 hazards belo
-Enter safety hazards

DAY 2

SUB-TOPIC 2: ADVANTAGES AND DISADVANTAGES OF ORGANIC AQUACULTURE

Disadvantages of Organic Aquaculture

Organic Aquaculture gives more nutritious and safe food. It is popular for growing organic foods. that is thought to have become healthier and safer. Perhaps ensures food safety from farm to plate. This process is more eco-friendly than conventional farming. Our government should increase awareness of biological farming

Less output.
Higher price.
The lack of awareness.
Organic products generally demand a higher price due to higher demand.
They have a shorter life span due to the absence of artificial preservatives.

1. Explicitation

Aquaculture is the cultivation of aquatic organisms such as fish, shellfish and even plants. This term refers to the cultivation of marine and freshwater species and can range from land-based to deep-sea production.

Present for several millennia, aquaculture has been improving with time. Today, the ponds are located in ponds, enclosures. Fish swim freely in large net structures in the protected coastal areas. This means they have continuous access to clean water and exercise, so the fish are healthy, lean, and firm.

2. Worked Example

Organic fish farming is a newly developed concept and is still in the early stages of development and strives to re-establish a proper balance in aquaculture systems, for the benefit of the fish, the environment, and consumers.

The feed, mainly consisting of fish meal, oil, cereal-based products, vitamins, and minerals, etc. should be organically produced. And it is not an easy task to bring down and remove the level of organochlorine pollutants in the marine fish that are used for conversion into fishmeal. Fish fed with natural ingredients from certified organic agriculture and sustainable fisheries-feeds are particularly formulated to match exactly what the fish would eat in the wild.

Advantages of Organic Aquaculture

Organic foods are free of dangerous pesticides and antibiotics. Recycles animal waste back into the farm. Environment-friendly organic products are more nutritional, tasty, and good for health.

Environment-friendly.
Promotes sustainable development.
Healthy and tasty food.
Inexpensive process.
It uses organic inputs.
Generates income through exports.
Source of employment.
It is more labor-intensive.
Hence, it generates more employment.

3. Lesson Activity

To assess the learner's current understanding of the lesson that is integrated with Philippine contemporary context. The teacher asks this simple question to the students: "As a Grade 8 students, in what way can you contribute to protecting these advantages and disadvantages?"

DAY 3 - DAY 4

SUB-TOPIC 3: AQUACULTURE METHODS AND PRACTICES

1. Explicitation

Aquaculture has a tradition of about 4 000 years. It began in China, possibly due to the desires of an emperor to have a constant supply of fish. It is speculated that the techniques for keeping fish in ponds originated in China with fishermen who kept their surplus catch alive temporarily in baskets submerged in rivers or small bodies of water created by damming one side of a riverbed. Another possibility is that aquaculture developed from ancient practices for trapping fish, with the operations steadily improving from trapping-holding to trapping-holding-growing, and finally into complete husbandry practices (Ling, 1977).

2. Worked Example

Overview of Aquaculture Methods and Practice

A number of aquaculture practices are used world-wide in three types of environments (freshwater, brackish water, and marine) for a great variety of culture organisms. Freshwater aquaculture is carried out either in fishponds, fish pens, fish cages or, on a limited scale, in rice paddies. Brackish water aquaculture is done mainly in fishponds located in coastal areas. Marine culture employs either fish cages or substrates for mollusks and seaweed such as stakes, ropes, and rafts.

These practices include:

1. Mariculture
2. Metahaline culture
3. Brackish water culture
4. Freshwater Culture

Mariculture

For the culture of fish, prawns, and lobster floating cages are used. Racks, rafts, rope, pole, and long lines are used for the culture of mussels, particularly pearl oyster. Seaweed also is widely cultured with the help of nets or webbings.

Fish farming in cage by Michael S. Jurick, from Wikimedia Commo

Cage culture – it is an aquaculture production system made of a floating
frame, net materials, and mooring system (with rope, buoy, anchor etc.) with a
round or square shape floating net to hold and culture large number of fishes and can be installed in reservoir, river, lake, or sea. Cage culture involves the growing of fish in existing water resources. A Catwalk and handrail is built around a battery of floating cages. There are four (4) types of fish-rearing cages namely: *(a) fixed cages, (b) floating cages, (c) submerged cages, and (d) moveable cages.*

Raft culture – is one of the commercially important methods of intensive aquaculture. These are the rectangular wooden frames floating on the water. They are made of bamboo and made to flows by empty dumps. The basic raft unit consists of a long floating rope buoyed with numerous floats and anchored with fixed wooden.

- *Single Floating Rope Raft* – it is independently positioned raft units, i.e. they are not joined to other floating raft ropes but are anchored separately.
- *Block of Floating Rafts* – is composed of between 10-40 floating kelp rope rafts joined together. Floating raft ropes in parallel series are positioned 3-5m apart so that water circulation is not impeded and so that kelp plants at maturity do not tangle.

Fish farming in cage by Michael S. Jurick, from Wikimedia Commons

Crassostrea iredalei (slipper oyster) by Devakie Nair, from CABI Digital Library

Rack culture is an improvement of intertidal culture methods over the traditional beach culture method. Using steel racks placed into the sand or mud bottom, plastic mesh bags filled with small culture organisms are laid across the tops of the racks where they are surrounded with water when the tides come in.

Pole culture is mainly undertaken in France. This is also called the "Bouchot" or stake culture. The poles used are big branches or trunks of oak tree, 4-6m in length, which are staked in rows, 0.7m apart on soft and muddy bottoms of the intertidal zone during low tide.

Long-line culture is an alternative to raft culture in areas less protected from wave action. A long line supported by a series of small floats joined by a cable or chain and anchored at the bottom on both end is employed. Collected mussel spats on ropes or strings are suspended on the line.

Bouchot, from Rom Plastica

Pinoy longline: Resilient, cost-effective method of mussel production, from PCAARRD DOST

Bottom culture is used on oysters, traditionally been cultured on the bottom just like a wild oyster. Bottom culture is pacing the oyster on the bottom of the oyster lease or placing oyster shells on the bottom of the lease to catch wild oyster.

Bottom culture, from Global Seafood Alliance

Artificial reef culture – are intentionally placed benthic structures built of natural or man-made materials, which are designed to protect, enhance, or restore components of marine ecosystem.

Freshwater culture refers to raising and breeding aquatic animals (fish, shrimp, crab, shellfish, etc.) and plants for economic purposes by the use of ponds, reservoirs, lakes, rivers, and other inland waterways (including brackish water), which play an important role in the aquaculture industry.

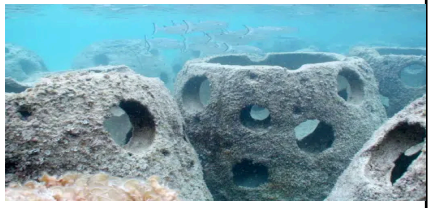

Image from Urban Marine Ecology

- *Composite fish culture* – it is a system in which five or six different species of fish are grown together in a single fishpond. Fish with different food habitats are chosen so that they do not compete for food among themselves. This ensures complete utilization of food resources in the pond.
- *Monosex culture* – refers to the culture of either all male or all female populations, a sought-after approach in aquaculture. The advantages of monosex population culture and details the mechanisms to achieve it based on different modes of sex determination and sexual differentiation.
- *Monospecies culture* – this is concerned with the culturing of individual species of fish.
- Air breathing fish culture – shallow water bodies with poor oxygen content is used for culturing air breathing fish species such as Channa, Clarias, Heteropneustes, etc.
- *Predator-Prey culture (murrel-tilapia)* – is also undertaken in shallow waters and in swampy areas. Here, predator fish like murrels are cultured along with their prey-fish, tilapia.

Open Water System

The farming of mollusks and seaweeds in open marine waters has become increasingly popular in a number of countries, especially in the Third World where it is seen as a viable alternative to municipal or artisanal fisheries or as a means of supplementary income for small-scale fishermen. Because sea farming is generally low-cost and labor-intensive and could thus involve entire coastal communities, it is particularly appropriate in areas where production from municipal fisheries has substantially declined and where, as a result, subsistence fishermen have little or no means of livelihood.

A. Mollusk Culture

Bivalves are widely cultured in a number of countries world-wide. In Asia and the Pacific, they represent a high-quality food resource with annual production higher than from crustacean culture on a per hectare basis (Sitoy, 1988). In 1984, mollusks accounted for approximately 35% of the total production of coastal aquaculture in terms of gross weight in the region (Shang, 1986).

The most important species for culture in Southeast Asia are the oysters (mainly Crassostrea spp.), mussels (mainly Perna spp.), clams, cockles, and scallops (Pagcatipunan, 1987; Sitoy, 1988; Cheong, 1988; Liong et al., 1988). In Japan, the most commonly cultured species include Crassostrea gigas, C. rivularis, C. nippona, C. echinata, and Ostrea denseramellosa, with C. gigas as the predominant species (Honma, 1980). In Africa, the culture of Venerupis is reported in Tunisia and Pinctada spp. in Sudan (Shehedah, 1975). In Mexico, the culture of the large oyster Crassostrea spp. is carried out by cooperative societies and of the mussel Mytilus edulis on floating rafts by private investors.

Oysters are widely distributed in estuaries and bays which receive some run-off from land and have somewhat lower salinity than the open sea. As they filter their food from the water, they grow best in areas with moderate to high concentrations of phytoplankton (SCSP, 1982c). Oysters grow best in intertidal areas where they are exposed for some minutes or a few hours during low tide (Pagcatipunan, 1987). Mussels, on the other hand, cannot tolerate tidal exposure even during low tide.

The best sites for culturing mollusks are therefore those that meet their biological requirements, including the following:

(i) Seawater salinity range of 15-35 ppt.
(ii) Water depth of 1-10 m, and
(iii) Muddy bottom for mussels and hard rocky or coralline substrates for oysters.

In addition, the area for mollusk culture should be protected from strong water currents reaching three knots and should be accessible to source of seed, transport, and markets. Furthermore, the presence of local available stock in an area is a good indicator of its suitability for mollusk culture.

Countries which have successfully cultured bivalve mollusks have developed their own systems of culture which depend entirely on natural seed stock, which are either gathered from natural seed beds or collected using suitable materials for collecting seed from natural grounds (Sitoy, 1988).

In the Philippines, both natural and synthetic ropes have been used for spat collection. However, since natural ropes, which have been found to attract more larvae than synthetic polyethylene or polypropylene ropes, do not last long, natural fibrous materials like coconut coir are sometimes interwoven with synthetic nylon ropes to make them more attractive to the larvae (Yap et al., 1979; Sitoy et al., 1983).

The string seed collectors are submerged in the sea water for seed collection at the right time. They are hung on a collector rack, normally 12 strings along a distance of 1.8 m to hold about 1 000 shells. Sometimes, strings are hung separately from each other at regular intervals; at others, three or four strings are put together for hanging to prevent branches from attaching to strings when they occur in large quantities (Fig. 21) (Honma, 1980).

B. Seaweed Farming

Seaweed, aside from being used as food, are important sources of colloids or gels, such as agar, as well as minerals of medicinal importance such as iodine. Eucheuma, ared algae, is a valuable source of carrageenan, an important industrial compound used in stabilizing and improving the quality of a great number of products. Caulerpa lentillifera, a green alga, is economically important because it is a favorite and nutritious salad dish containing essential trace minerals such as calcium, potassium, magnesium, sodium, copper, iron and zinc. It is also known for its medicinal properties, being used as an anti-fungal agent and as a natural means for lowering blood pressure. Gracilaria, another red alga, is economically important in Taiwan (PC) for its agar extracts.

The culture of the seaweed Porphyra is believed to have started as early as between 1596 and 1614 in Hiroshima Bay utilizing pole and net devices originally installed to catch fish. At present, commercial seaweed culture is limited to five countries in East Asia, viz., Japan and Korea (which both grow mainly Porphyra, Undaria and Laminaria), China (Porphyra and Laminaria), Taiwan (PC) (Gracilaria and Porphyra), and the Philippines (Eucheuma spinosium, E. cottonii and Caulerpa lentillifera). Thirty-one species belonging to 18 genera and three divisions are presently cultured in these five countries, of which only three out of the 31 species are green algae (Table 13) (Trono, 1986).

In 1988, the estimated world seaweed production for use in the manufacture of carrageenan was nearly 68 000 t of dried seaweeds, of which nearly 66% was supplied by the Philippines and the rest by Indonesia, Chile and Canada. The bulk of the Philippine seaweed production consists of Eucheuma produced mainly in the southern part of the country in reef-protected coastal areas. Caulerpa is also successfully farmed in seawater ponds in Mactan, Cebu (Trono, 1986).

Fishpond, Cage, and Pen System

Fishpond Culture

Pond culture, or the breeding and rearing of fish in natural or artificial basins, is the earliest form of aquaculture with its origins dating back to the era of the Yin Dynasty (1400-1137 B.C.). Over the years, the practice has spread to almost all parts of the world and is used for a wide variety of culture organisms in freshwater, brackish water, and marine environments. It is carried out mostly using stagnant waters but can also be used in running waters especially in highland sites with flowing water.

1. Culture species

Commonly raised species in freshwater ponds are the carps, tilapia, catfish, snakehead, eel, trout, goldfish, gourami, trout, pike, Tench, salmonids, palaemonids, and the giant freshwater prawn Macro brachium. In brackish water ponds, common species include milkfish (Chanos chanos), mullet (Mugil sp.) and the different penaeid shrimps (Penaeus monodon, P. orientalis, P. merguiensis, P. penicillatus, P. semisulcatus, P. japonicus, and M. ensis). The more popular species for culture in marine ponds are the sea bass, grouper, red sea bream, yellowtail, rabbitfish, and marine shrimps.

In Asia, where the bulk of world production from aquaculture emanates, fishponds are mostly freshwater or brackish water, and rarely marine. In China and most of the Indian sub-continent, pond culture is traditionally dominated by freshwater species, mainly the carps, usually in polyculture and/or integrated with animal husbandry. In Southeast Asia, fishponds are predominantly brackish water, with milkfish and penaeid shrimps grown either in polyculture or in monoculture.

2. Site Selection

Proper site selection is recognized as the first step guaranteeing the eventual success of any aquaculture project and forms the basis for the design, layout, and management of the project (SCSP, 1982a). For fishponds, especially those to be used for coastal/brackishwater aquaculture of high-value species like shrimps, site selection is critical and should be given utmost attention. Adisukresno (1982), Hechanova (1982), and Jamandre and Rabanal (1975) listed the following guidelines for the selection of a suitable site for coastal fishponds:

(i) *Soil Quality:* preferably, clay-loam, or sandy-clay for water retention and suitability for diking; alkaline pH (7 and above) to prevent problems that result from acid-sulphate soils (e.g., poor fertilizer response; low natural food production and slow growth of culture species; probable fish kills).

(ii) *Land elevation and tidal characteristics; preferably with average elevation that can be watered by ordinary high tides and drained by ordinary low tides;* tidal fluctuation preferably moderate at 2-3 m. (Sites where tidal fluctuation is large, say 4 m, are not suitable because they would require very large, expensive dikes to prevent flooding during high tide. On the other hand, areas with slight tidal fluctuation, say 1 m or less, could not be drained or filled properly.)

(iii) *Vegetation:* preferably without big tree stumps and thick vegetation which entails large expense for clearing; areas near riverbanks and those at coastal shores exposed to wave action require a buffer

zone with substantial growths of mangrove. (The presence of Avicennia indicates productive soil; nipa and trees with high tannin content indicate low pH.)

(iv) *Water supply and quality:* with a steady supply of both fresh and brackish water in adequate quantities throughout the year, the water supply should be pollution-free and with a pH of 7.8-8.5.

(v) *Accessibility:* preferably readily accessible by land/water transport; close to sources of inputs such as fry, feeds, fertilizers, and markets, fish ports, processing plants, and ice plants; and linked by communication facilities to major centers.

(vi) Availability of manpower for construction and operation.

3. Pond Layout

The layout of the pond system depends on the species for culture and on the size and shape of the area, which in turn determines the number and sizes of ponds and the position of the water canals and gates. A fish farm is considered properly planned if all the water control structures, canals, and the different pond compartments mutually complement each other (SCSP, 1982a). A complete fish farm has nursery and grow-out ponds and, in some instances, transition ponds for intermediate-sized fish/shrimp, all of which are properly proportioned and positioned within.

Milkfish culture in brackish water ponds in the Philippines follows the traditional practice of providing for nursery, transition, and rearing operations. In some cases, formation ponds are used for additional growth or stunting of fingerlings prior to stocking in rearing ponds (Fig. 2). The nursery ponds comprise about 1-4% of the total production area while the transition and formation ponds constitute about 6-9% of total area (Camacho and Lagua, 1988).

It has been suggested that a similar progressive culture scheme be adopted for shrimp pond culture when no supplementary feeding is practiced. For growing to a medium size, a two-stage progression composed of a nursery pond (NP) and a rearing pond (RP) is adequate (Fig. 3); for growing to larger sizes, a three-stage progression composed of nursery, transition, and rearing ponds is recommended (Fig. 4) (ASEAN/SCSP, 1978).

Cage Culture

The culture of fish in meshed boxes placed in water is called cage culture. It is an intensive method of aquaculture and practiced un areas where there is sufficient water movement. It is done in rivers, estuaries, and seas. It is originated in kampuchia about 200 years ago and originally cages were used to transport fishes alive from capture area to the market area.

Types of Culture: Cage

Cages in Lake **Fish Pen** **Cages in the Ocean**

nage from Philippine News Agency

Cage fish farming in lake by Ankur P, from Wikimedia Commons

Sunset in a fish pen in Obando, Bulacan by Marcopolo, from Wikimedia Commons

Sustainable fish farming by M.C. Deblois, from Wikimedia Commons

Construction:

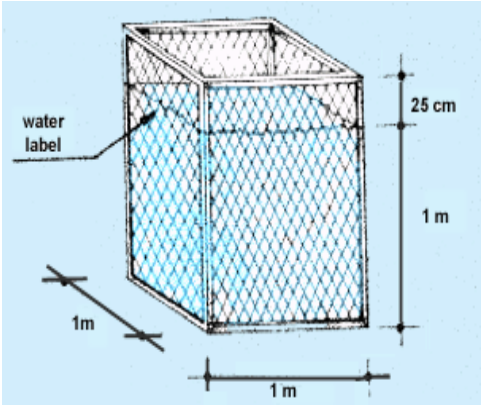

Image from FAO

Components of a fish cage

- Frame - It can be made of wood, plastic, or
- steel. Generally, plastic is used.
- Floats – They are made up of empty barrels or polythene balls.
- Sinkers – They are made of stone concrete or metal.
- Net – Three types of nets are present inner net, outer net, and cover net. It is made up of nylon, welded mesh or woven split bamboo.

Structure of a cage

- The cage may be square, rectangular, circular, six sided or eight sided.
- Generally, square and rectangular cages are preferred for culture.
- The normal size of the cage is a 20-to-60-meter cube.

Types of cages

Fixed cages – installed in running water

Image from FAO

Floating cages – lakes, rivers and offshore water.

Aquaculture by WorldFish Center, from Flickr

Submerged and movable cag – areas affected by cyclone.

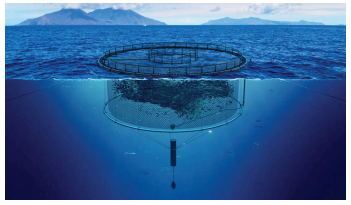

Image from Fish Farming Expert

Feeding

- The water movement brings in nutrients and natural feed.
- In addition, artificial feed is also given. Examples: rice bran, fish meal, and soyabean cake.

Advantages and limitations of cage culture

Pen Culture

Cage culture and pen culture both terms are often used interchangeably, particularly in N. America, where sea pens and sea cages describe the same method of culture. Generally, "enclosure culture" is used to describe what more precisely could be defined as cage or pen culture. Both cage and pen culture are types of enclosure, i.e. holding culturable aquatic organisms in captivity within an enclosed space whilst maintaining a free exchange of water. The two methods (cage and pen culture), however, are distinct from one another. A cage is totally enclosed on all sides by mesh or netting, whereas in pen culture the bottom of the enclosure is formed by the lake or sea bottom.

History of Pen Culture

The origin of pen culture is more obscure, but it also seems to have begun in Asia. According to Alfarez (1977) and others, pen culture originated in the inland sea area of Japan in the early 10920's. It was adopted by the People's Republic of China in the early 1950's for rearing carps in freshwater lakes. Later, introduced to Laguna de Bay and San Pablo Lakes in Philippines by the Bureau of Fisheries and Aquatic Resources (BFAR) and Laguna Lake Development Authority (LLDA) between 1968 and 1970 in order to rear milk fish (Chanos chanos). Pens are still constructed at old pattern except that nylon or polyethylene mesh nets have replaced the traditional split bamboo fences. The nets are attached to ports set every few meters, and the bottom of the net is pinned to the substrate with long wooden pegs. Buttressing may be used to strengthen the structures in exposed areas.

Where are Pens built?

- Pens are usually built in shallow (<10 m) waters, are 3-5 deep, and 2-7 ha in size. Although there are much larger enclosures in N. America measuring up to 50 ha and up to 120 ha or more in Japan.
- The areas with too much silt and decomposing organic matter should be avoided.
- The bottom soil should be muddy, clayey, clay loam, or sandy mud with detritus.
- The flow of water should be 0.2-0.5 m/sec. soft substrates are preferable.
- Pens are formed by damming a bay, an arm of river, lake or reservoir, estuary or sea.

Barriers in Pen Culture

- There may be one or one series of barriers when the blind end of the aquatic body is to be enclosed.
- In the enclosures, where continuous flow of water takes place, there may be two series of barriers – one being upstream and another being downstream.

Types of Barriers

The barriers may be of the following types:

1. **Site Material-Dependent Barriers** – the barriers or dams may be built with concrete or stones, sand or soil depending upon the availability of the materials at the sites.
   - Such type of barriers is generally equipped with screens which are made of vertical aluminum or galvanized metal bars with little spacing.
   - Screens function to check the escape of the fish stock.

Wire-Mesh Barriers – it is an uncommon type of barrier and includes galvanized wire mesh or chain links.

- At the bottom of the poles or pilings under water, such net barrier is fixed through a rope along the seabed for approximately 1m, until it terminates in a lead line
- Generally, the net is embedded in the silt or sand of the bottom, sealing it properly, so that the entry predators and escape of aquatic culturable organisms is checked.

2. **Nylon-Net Barriers** – it is an enclosure system used to partition of areas of an open aquatic body, e.g. intertidal of the sea or foreshore areas of large lakes and reservoirs.
   - Normally, the enclosure is framed on one side by the shore and the rest three sides by a wall of nylon netting hung from stone on concrete walls of approximately 3 m wide core constructed.
   - Net barriers may be hung from steel cables tied between walls. The latter are anchored to large anchor blocks by steel cables, to check any lateral oscillation of the piles.

Types of Enclosures used in Pen Culture

The enclosures used in pen culture may be of following types:

1. **Bamboo Scaffolding-Enclosure** – it is generally used in Bays of Philippines and Lakes of China. These enclosures are of various sizes (about 2.5 m high and 5-10 cm wide). A gap or interspace of approximately 1.0-1.5 cm is essential between two bamboo splits for free exchange of water in pens.
2. **Floating-Net Enclosure** – it is a type of improved net enclosure. The enclosure is held in place by concrete block sinkers with a series of small weights on the foot rope which is secured to a chain link between the sinkers. The net is kept floating by floats attached to the headrope. To prevent fishes from jumping, a horizontal net is stretched at the top of the enclosure. This type of enclosure has been proved useful for the culture of tilapia and milk fish in the lakes
3. **Single layered pens of nylon webbing** – in this type of enclosures, Palmyra (a tropical Asian Fan palm) poles are used for support which are pointed at one end. The size of the poles is 3m length, 15cm wide and 5cm thick. The poles are driven into the mud at about 50cm and are 1.5 m part. A 20-25mm thick polythene rope serves as a head rope and foot rope. Head rope is connected to a nail driven at the top of the poles so that webbing is firmly held to the poles. The laterite stones are

attached to the foot rope at an interval of about 1.5m. The stones along with foot rope and webbing are anchored roughly 40-45cm in the mud.

The mesh size of knotless nylon webbing is about 10-20mm, and the approximate area enclosed by such nets is up to 1.0 hectare. A scare-line composed of tender leaves of Palmyra is attached to a polyethylene twine at an interval of about 1.0m inside the enclosure about 40-50cm above the bed of the pen. It is because the fingerlings and juveniles may not dash against the webbing and get themselves injured. These are suitably applied as nurseries for fish or prawn seeds.

Aquatic Species Suitable for pens

- The market demand and the availability of seed greatly influence the selection of candidate species for pen culture.
- The main desirable characteristics for enclosure are faster growth rate, high survivability, capacity to withstand overcrowding, acceptance of artificial feeds, high FCR, and resistance to diseases.
- Air-breathing catfishes, Tilapia, Murrells and prawns can be cultured in the pens.
- The principal fish species cultured in south eat Asian countries like Philippines and China are milk fish and carps viz., grass carp, silver carp, big head carp.
- Some experimental culture of carps has been carried out in pens in oxbow lakes in Hungary and other countries such as Bangladesh and Egypt have expressed interest in their use.
- The production of tilapias in net pens is also being evaluated in Philippines. Generally, the fish species which are herbivores or detritovores, fast growing and tolerant to salinity changes in coastal areas are preferred the most.
- Apart from fish, certain species of prawns and edible clams may also be cultured in pens.

Merits of Pen Culture

- More than arranged, production is assured in a limited space with rich food and oxygen supply.
- It is a nonstop process because of the continuous water supply.
- Maximum growth is possible in pens as energy is saved towards locomotion and feeding.
- No danger for mass mortality of fish, since toxic wastes like ammonia are flushed regularly.
- It generates employment opportunities for the coastal fisher-folk.
- It reduces over-exploitation of the fry.
- It requires comparatively low capital outlay.
- It requires simple technology of operation.

Demerits of Pen Culture

- Nylon-webbing enclosures may be cut or damaged by some species of crabs.
- Predator fishes, if not eradicated periodically, may cause considerable damage to cultured individuals viz., fry, fishes and prawns.
- The abundance of weeds in the surroundings of pens may disturb the environment by lowering the oxygen level through release of H_2S upon death and decay.

Answers:

1.Cage Culture
2.Raft Culture
3.Pen Culture
4.Culture
5.Running
6.Barriers
7.Monosex
8.Freshwater
9.Tidal Ponds
10.Saltwater

- Few barnacles and algae like *Ectocarpus* when adhered to the bamboo poles, nets or other material of the pens may cause biofouling.
- Terrestrial insects also take shelter in exposed portions of pens and may cause damage.
- Unfavorable climatic conditions may damage the pen.
- Pen culture may be adversely affected with the occasional abundance of red tide causing organisms such as dinoflagellates, especially during summer or southwest monsoon.
- Pen culture may not be suitable for all fish species.
- Fishes culture in pens are bound to bear toxic industrial pollution, if happens.
- Pens are largely restricted to lentic water bodies.

Lesson Activity

Complete Me!
Directions: Write the missing word/words in the blank.

Raft Culture	Saltwater	Pen culture	Running
Tidal Ponds	Cage culture	Culture	
Monosex	Freshwater	Barriers	

1. _____ is an aquaculture production system made of a floating frame, net materials, and mooring system.
2. _____ is one of the commercially important methods of intensive aquaculture. These are the rectangular wooden frames floating on the water.
3. _____ refers to small enclosures used for confinement or safe keeping of domestic animals.
4. The _____ of fish in meshed boxes placed in water is called cage culture.
5. Fixed cages are installed in _____ water.
6. Nylon-Net _____ is an enclosure system used to partition of areas of an open aquatic body.
7. _____ culture refers to the culture of either all male or all female populations, a sought-after approach in aquaculture.
8. _____ culture refers to raising and breeding aquatic animals (fish, shrimp, crab, shellfish, etc.).
9. _____ are a shallow coastal inlet or bay that fills and empties with water as the tide rises and falls, often characterized by tidal flats and marshes.
10. _____ ponds can also be called marine ponds, as they are filled with saltwater like the sea, and contain some of the same species.

C. Making Generalizations	**1. Learners' Takeaways** Complete the following statements based on what you have learned in the lesson. I have learned that _____ I have realized that _____ I will apply _____ **2. Reflection on Learning** The learners will elaborate their answer and the teacher can give a follow up question.	

IV. EVALUATING LEARNING: FORMATIVE ASSESSMENT AND TEACHER'S REFLECTION				**NOTES TO TEACHERS**
A. Evaluating Learning	**1. Formative Assessment** a. Give the different types of Hazards. b. Enumerate the six Occupational Safety and Health Hazards and give a short description. **2. Homework (Optional)** **3. Slogan Making (Individual)** a. Make slogan on how important Occupational Health and Safety procedure. b. Use Oslo paper, appropriate color medium and drawing tools. c. Submit your output to your teacher for proper evaluation.			The formative assessment questions could be answered on paper or in the learners' notebooks. The best answers could be shared after the teacher checked the learners' answers.
B. Teacher's Remarks	*Note observations on any of the following areas:*	**Effective Practices**	**Problems Encountered**	The teacher may take note of some observations related to the effective practices and problems encountered after utilizing the different strategies, materials used, the earner engagement and other related stuff.
	strategies explored			
	materials used			
	learner engagement/ interaction			
	others			

				Teachers may also suggest ways to improve the different activities explored.
C. Teacher's Reflection	*Reflection guide or prompt can be on:* ▪ *principles behind the teaching* *What principles and beliefs informed my lesson?* *Why did I teach the lesson the way I did?* ▪ *students* *What roles did my students play in my lesson?* *What did my students learn? How did they learn?* ▪ *ways forward* *What could I have done differently?* *What can I explore in the next lesson?*			Teacher's reflection in every lesson conducted/facilitated is essential and necessary to improve practice. You may also consider this as an input for the LAC/Collab sessions.