1.1 Analyse and categorise physical agents in diverse occupational environments.

Learning Outcome

This learning outcome develops the learner's ability to identify, classify and analyse physical agents across different occupational environments, understand how workers may be exposed, and determine which hazards require priority based on their potential to cause harm.

Physical agents are workplace energy sources or physical conditions that can adversely affect health and safety. Unlike chemical hazards, they are generally not substances; they involve forms of energy, environmental conditions or physical forces.

1. Understanding Physical Agents

Physical agents can occur in almost every sector. The level of risk depends on factors such as:
Source → intensity → duration → frequency → exposure pathway → worker susceptibility → effectiveness of controls

For example, noise from a machine may be acceptable for a short maintenance activity but create significant hearing risk when workers are exposed to high levels for several hours every day.

The main physical agents relevant to this learning outcome are:

1. Noise
2. Vibration
3. Radiation
4. Thermal stress

Other physical agents can also occur, such as pressure, lighting and electromagnetic fields, depending on the industry and occupational context.

2. Noise

Health implications

Prolonged exposure to excessive occupational noise can contribute to:

- Noise-induced hearing loss.
- Tinnitus.
- Difficulty communicating.
- Increased stress and fatigue.
- Reduced concentration.
- Increased potential for accidents where warning signals cannot be heard.

Example

A worker operating a cutting machine for eight hours may have substantially greater cumulative exposure than a supervisor who enters the area for short periods.

Therefore, job title alone cannot be used to determine noise risk.

3. Vibration

Occupational vibration is generally divided into two important categories.
Hand-arm vibration

This occurs when vibration is transmitted through the hands and arms from equipment such as:

- Grinders.
- Drills.
- Impact tools.
- Pneumatic tools.
- Breakers.

Repeated exposure can contribute to hand-arm vibration syndrome (HAVS) and associated vascular, neurological and musculoskeletal effects.

3. Vibration

Whole-body vibration

Whole-body vibration occurs when vibration is transmitted through a worker's body, commonly when operating:

- Forklifts.
- Heavy construction machinery.
- Agricultural machinery.
- Mining vehicles.

Potential effects include discomfort, fatigue and musculoskeletal problems, particularly where exposure is prolonged or combined with poor posture and repetitive movement.

Key consideration

Vibration risk depends not only on the machine but also on:

Magnitude + frequency + exposure duration + method of use + maintenance + worker posture

A poorly maintained tool may produce greater vibration than the same equipment operating under properly

4. Radiation

Radiation can be broadly classified into ionising and non-ionising radiation.
Ionising radiation

This has sufficient energy to ionise atoms and can cause cellular and tissue damage.
Examples include:

- X-rays.
- Gamma radiation.
- Certain radioactive materials.

Occupational exposure can occur in healthcare, laboratories, industrial radiography and nuclear-related activities.

Potential health effects depend on factors such as dose, exposure duration and sensitivity of the affected tissue and may include tissue damage and increased long-term cancer risk.

4. Radiation

Non-ionising radiation
This includes forms such as:

- Ultraviolet (UV).
- Infrared (IR).
- Lasers.
- Radiofrequency and microwave radiation.

Examples include welding, industrial lasers, ultraviolet curing processes and certain telecommunications activities.
Potential effects depend on the type and intensity of radiation. For example, excessive UV exposure can damage the skin and eyes, while sufficiently intense laser radiation can cause serious eye injury. Therefore, simply identifying a workplace as having "radiation" is insufficient. The specific type, source, intensity and exposure conditions must be established.

5. Thermal Stress

Thermal stress occurs when environmental conditions place excessive physiological demands on the body's ability to maintain a safe internal temperature.

It includes:

Heat stress

Common sources include:

- Foundries.
- Steel plants.
- Outdoor construction.
- Kitchens.
- Confined spaces with high temperatures.
- Work involving radiant heat.

Potential effects range from discomfort and fatigue to heat exhaustion and potentially life-threatening heat stroke.

5. Thermal Stress

Risk can increase because of:

- High temperature.
- Humidity.
- Radiant heat.
- Heavy physical work.
- Protective clothing.
- Inadequate hydration.
- Long exposure periods.

Cold stress

Workers may be exposed in:

- Cold-storage facilities.
- Refrigeration plants.
- Outdoor winter work.
- Food-processing environments.

Potential effects include reduced manual performance, hypothermia and cold-related tissue injury.

6. Exposure Pathways and Health Implications

Physical agent	Typical exposure pathway	Main potential effects
Noise	Sound reaching the ear	Hearing loss, tinnitus, fatigue
Hand-arm vibration	Vibration transmitted through hands	Vascular, neurological and musculoskeletal effects
Whole-body vibration	Vibration transmitted through the body	Discomfort, fatigue, musculoskeletal effects
Ionising radiation	External or internal radiation exposure	Tissue damage, increased long-term health risks
UV/laser	Radiation reaching skin or eyes	Burns, eye injury, skin effects
Heat	Environmental/physiological heat load	Heat exhaustion, heat stroke
Cold	Excessive loss of body heat	Hypothermia, reduced performance

7. Risk-Based Prioritisation of Physical Agents

Not every physical agent presents the same level of risk. A professional assessment should prioritise hazards based on factors such as:

- Severity of potential harm
- Magnitude or intensity of exposure
- Duration and frequency
- Number of workers exposed
- Exposure variability
- Existing controls
- Vulnerable or susceptible workers
- Likelihood of serious or irreversible health effects

For example, a workplace may have both office noise and high-energy industrial noise. Both are technically "noise", but they should not automatically receive the same level of risk priority.

8. Applying the Analysis to Different Workplaces

Construction

Potential physical agents include:

- High noise from machinery.
- Hand-arm vibration from power tools.
- Whole-body vibration from mobile plant.
- Solar/thermal exposure.
- UV radiation from sunlight and welding.

Manufacturing

Potential hazards may include:

- Machinery noise.
- Vibration.
- Heat from furnaces.
- UV/infrared radiation from welding.
- Ionising radiation in specialised processes.

8. Applying the Analysis to Different Workplaces

Healthcare

Potential hazards may include:

- Ionising radiation from X-ray equipment.
- Laser radiation.
- Noise from equipment.
- Thermal conditions in specialised areas.

Outdoor work

Potential hazards can include:

- Solar UV radiation.
- Heat stress.
- Cold exposure.
- Noise and vibration from machinery.

This demonstrates why physical-agent assessment must be workplace-specific rather than based only on generic hazard lists.

Critical Evaluation

The key principle is that identifying a physical agent is only the starting point.
For example, stating "noise present" does not establish whether workers are at significant risk.
Similarly, identifying "heat" does not determine whether heat stress is likely.

Effective occupational hygiene requires the practitioner to move from:
Hazard identification → exposure characterisation → health-effect analysis → risk prioritisation.
The assessment must therefore consider the nature of the physical agent and the actual conditions under which workers are exposed.

Key Takeaways

- The major physical agents include noise, vibration, radiation and thermal stress.
- Each physical agent has different exposure pathways and health effects.
- Physical hazards must be analysed according to the task, worker, exposure intensity, duration and existing controls.
- Risk prioritisation should be based on severity, likelihood, exposure magnitude and potential consequences.
- A good occupational hygiene assessment goes beyond simply identifying hazards; it determines which exposures require measurement, control and further investigation.

Thank you