



National Certificate of Educational Achievement  
TAUMATA MĀTAURANGA Ā-MOTU KUA TAEA

## **Exemplar for Internal Achievement Standard Science Level 1**

This exemplar supports assessment against:

**Achievement Standard 90943**

**Investigate implications of heat for everyday life**

An annotated exemplar is an extract of student evidence, with a commentary, to explain key aspects of the standard. These will assist teachers to make assessment judgements at the grade boundaries.

New Zealand Qualification Authority

To support internal assessment from 2014

	Grade Boundary: Low Excellence
1.	<p>For Excellence, the student needs to investigate, comprehensively, implications of heat for everyday life. This involves providing reasons and linking them in a way that clearly explains the science that is involved in an issue that students encounter in their everyday lives. Implications for heat should include conduction, convection and radiation.</p> <p>The student has investigated the science of heat transfer in clothing, and comprehensively explained the implications for everyday life. Reasons have been provided why wool and polypropylene reduce heat loss caused by conduction and convection (1) and clearly linked to the science of heat transfer in clothing. Radiation heat loss is also mentioned (2).</p> <p>For a more secure Excellence, the student could provide more evidence to fully link the science to the implication(s) on society. For example, the student could discuss more fully the role of radiation as a form of heat loss that cannot be fully prevented but can be slowed down.</p>

**Question: How does clothing worn in cold weather retain body heat?**

Since hot air is made up of particles moving quite quickly compared to particles moving slowly in cold air clothing will be of a type that restricts heat loss due to conduction, convection and radiation.

**Conduction:**

Conduction is the movement of heat by direct contact with clothing fibres. To reduce conduction we use fibres that have a low conductivity to heat. Merino, polyprop are two such fibres. They conduct slowly and so act as insulators. When clothes get wet then there is more particles to allow for an increase of heat loss by conduction. Wool can get wet but still keep heat in and the wool fibres overlap and so reduce heat loss by conduction. (1)

**Convection:**

Convection is the key way the body loses heat. In convection the air moves and rises and this takes heat away from the body. In clothing the key warming method involves stopping this air movement. This is done by having air pockets trapped in the clothing and the movement of the air is stopped by the fibres. This forms an insulating "blanket" over the body and keeps us warm.(2)

**Radiation:**

Radiation involves heat loss as heat on the electromagnetic spectrum. All hot bodies radiate heat. This form of heat loss cannot be stopped but can be reduced. Wool reduces heat loss by radiation. [3]

	Grade Boundary: High Merit
2.	<p>For Merit, the student needs to investigate, in depth, implications of heat for everyday life. This involves providing reasons for the way science is involved in an issue that students encounter in their everyday lives. Implications for heat should include conduction, convection and radiation</p> <p>The student has investigated the science of heat transfer in clothing, and shows an in-depth awareness of the implications for society. For example, some reasons are provided as to how polypropylene and wool reduce heat loss by convection (1) and conduction (2), and awareness is communicated for how this affects society's choice of clothing in order to keep warm (3). Radiation is mentioned.</p> <p>For Excellence, the student could comprehensively explain radiation, and how certain clothing can slow heat loss by radiation but never fully stop it.</p>

**Question: How does clothing worn in cold weather retain body heat?**

Heat is the kinetic energy of atoms have as they vibrate, The more kinetic energy particles have the more heat they have.

**Conduction:**

Conduction is the movement of heat by direct contact with clothing fibres. To reduce conduction we use fibres that have a low conductivity to heat. Merino, polyprop are two such fibres. They conduct slowly and so act as insulators. When clothes get wet then there is more particles to allow for an increase of heat loss by conduction. Wool can get wet but still keep heat in and the wool fibres overlap and so reduce heat loss by conduction. (1)

**Convection:**

Convection is the key way the body loses heat. In convection the air moves and rises and this takes heat away from the body. In clothing the key warming method involves stopping this air movement. This is done by having air pockets trapped in the clothing and the movement of the air is stopped by the fibres. This forms an insulating "blanket" over the body and keeps us warm. [2]

**Radiation:**

Heat is lost as radiation. Heat is part of the electromagnetic spectrum. In clothing heat is lost from a hot body to the cold. This means hot objects always cool down. Clothing slows this down. (3)

	Grade Boundary: Low Merit
3.	<p>For Merit, the student needs to investigate, in depth, implications of heat for everyday life. This involves providing reasons for the way science is involved in an issue that students encounter in their everyday lives. Implications for heat should include conduction, convection and radiation</p> <p>The student has explained in some depth the science of heat transfer in clothing, and shows an awareness of how conduction (1), convection (2) and radiation (3) are slowed in insulated clothing and therefore keep people warm. For example, the student describes the effects of air being trapped in pockets.</p> <p>For a more secure Merit, the student could explain, in greater depth, convection, conduction and radiation, and link the explanation to clothing, showing an in-depth awareness of the choice of clothing used for keeping people warm.</p>

**Question: How does clothing worn in cold weather retain body heat?**

Heat is where particles move fast. The faster they move the hotter it is.

**Conduction:**

Conduction is the movement of heat by direct contact with clothing fibres. They conduct slowly and so act as insulators. Wool can get wet but still keep heat in and the wool fibres overlap and so reduce heat loss by conduction. Metal conducts heat well so is not used for clothing except in fashion shows. Metal would be no use in the bush. (1)

**Convection:**

Convection is the key way the body loses heat. In convection the air moves and rises and this takes heat away from the body. In clothing the key warming method involves stopping this air movement. This is done by having air pockets trapped in the clothing and the movement of the air is stopped by the fibres. Wool has plenty of good sized air pockets. (2)

**Radiation:**

Heat can also be lost as radiation. This is where heat is lost in the infra-red part of the spectrum. (3)

	Grade Boundary: High Achieved
4.	<p>For Achieved, the student needs to investigate implications of heat for everyday life. This involves showing awareness of how science is involved in an issue that students encounter in their everyday lives. Implications should include convection and conduction.</p> <p>The student has described two methods of heat loss: conduction (1) and convection (2). They have communicated an awareness of how certain clothing slows down heat loss. For example, the student describes the effect of air moving away from a warm body.</p> <p>To reach Merit, the student could explain in greater depth both conduction and convection, and link the explanation to show an in-depth awareness of the choice of clothing used for keeping people warm. They also need to describe radiation.</p>

AS 90943

Student 4

**Question: How does clothing worn in cold weather retain body heat?**

Fleece like merino and other fibres keep us warm because they are insulators. We lose heat from our bodies by three ways convection, conduction and radiation. Fleeces like merino or wool stop us losing heat. This keeps us alive.

Wool stops conduction because it can't conduct easily. The fibres don't carry heat easily. By stopping conduction merino covered people can't lose heat through conduction easily. (1)

These people can still get cold because they can lose some heat through convection. Convection is where heat is lost because hot air moves away from the hot body. This means you then get cold. Merino has pockets to stop this heat loss. The air can't move so you keep warm. (2)

Humans don't lose heat through radiation.

	Grade Boundary: Low Achieved
5.	<p>For Achieved, the student needs to investigate implications of heat for everyday life. This involves showing awareness of how science is involved in an issue that students encounter in their everyday lives. Implications should include convection and conduction.</p> <p>The student has described two methods of heat transfer in clothing: conduction and convection (1). An awareness of how the science of heat transfer, affects the choice of clothing to keep people warm has been communicated to some extent. For example, the implications of air pockets in swanndris are recognised (2).</p> <p>For a more secure Achieved, the student could describe the science of heat transfer behind convection and conduction, and show an awareness of how these methods of heat transfer affect the choice of clothing worn by people to keep warm.</p>

AS 90943

Student 5

**Question: How does clothing worn in cold weather retain body heat?**

Fleece like merino and other fibres keep us warm because they are insulators. We lose heat from our bodies by three ways convection, conduction and radiation. Fleeces like merino or wool stop us losing heat. This keeps us alive.

Wool stops conduction because it can't conduct. So merino stops heat loss because it stops conduction so we don't need to worry about conduction.

These people can still get cold because they can lose some heat through convection. Convection is where heat is lost because hot air moves away from the hot body. This means you then get cold. Merino has pockets to stop this heat loss. The air can't move so you keep warm. (1) Good outdoor clothes like a swandri have pockets of air to keep us warm. (2)

Humans don't lose heat through radiation.

	Grade Boundary: High Not Achieved
6.	<p>For Achieved, the student needs to investigate implications of heat for everyday life. This involves showing awareness of how science is involved in an issue that students encounter in their everyday lives. Implications should include convection and conduction.</p> <p>The student has described heat transfer in clothing in the form of convection only (1).</p> <p>To reach Achieved, the student could clearly describe the science behind heat transfer and describe convection and conduction. Links between heat transfer and conduction could be established in greater detail. For example, the student could state that conduction involves heat transfer (loss) in the solid fibres, and point out that wool fibres are poor heat conductors.</p>

AS 90943

Student 6

**Question: How does clothing worn in cold weather retain body heat?**

Fleece like merino and other fibres keep us warm because they are insulators. We lose heat from our bodies by three ways convection, conduction and radiation. Fleeces like merino or wool stop us losing heat. This keeps us alive.

These people can get cold because they can lose some heat through convection.

Convection is where heat is lost because hot air moves away from the hot body. This means you then get cold. Merino has pockets to stop this heat loss. (1) The air can't move so you keep warm.

Humans don't lose heat through radiation or conduction.