TAU
7–10

NGĀ HEKAHEKA O AOTEAROA

HE ARATOHU MĀ TE POUAKO
A GUIDE FOR TEACHERS

PŪTAIAO
SCIENCE

Manaaki Whenua
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NGĀ HEKAHEKA O AOTEAROA

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HE MIHI

Kei te mihi ngā kaituhi ki ngā tūpuna me tō rātou matatau ki ngā momo koiora o Aotearoa, tae atu ki ngā momo hekaheka. I takea tēnei tuhituhinga i te hiahia kia whakahokia mai ēnei mātauranga ki mua i te aroaro o ngāi Māori; arā ki ngā tamariki e ako ana i roto i ngā kura reo Māori o te motu. Ka mihi hoki ki a Huia Publishers, nā rātou ēnei mahi i whakaputa.

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- Auckland Art Gallery (p. 20, whakaahua a Lindauer)
- Olly Ball (p. 21, pūrerehua āwheto)
- Taylor Lockwood (p. 26–27, harore hinātore)
- Ross Beever (p. 30–31, kōpurawhetū; p. 32, pukurau)
- Mikey Watson (p. 34–35, angiangi),
- Andy Mardell (p. 36–37, kaikākā)

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Ko ngā huruhuru mō tēnei kaupapa i ahu mai i te pūtea o He Hihiri i Te Mahara/Curious Minds a te Ministry of Business, Innovation and Employment.

NGĀ IHIRANGI

ALL ABOUT FUNGI

Our great forests of Tāne-mahuta hold a treasure-trove of life that is mostly found only in Aotearoa. Fungi are among Tāne's descendants, along with plants and animals. Certain kinds of fungi were known and valued by tūpuna for their practical usefulness. We will learn about different uses of fungi, but first let's answer some questions like: What are Fungi? and How are Fungi important?

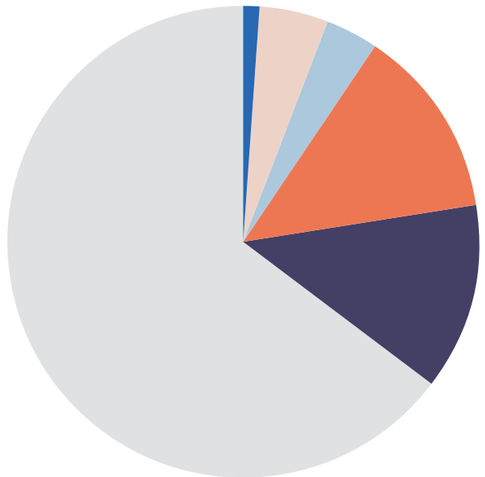
WHAT (AND WHERE) ARE FUNGI?

Fungi are almost everywhere – in the air you are breathing, in lots of the food that you eat, in the soil that you walk on, in the plants around you, in a stream's foam bubbles, and even on and inside you! Fungi are really common, but often hard to see because they can be very small, or are living hidden inside their home – their home may be a log, the soil, a plant, or an animal on which they are feeding. They live on and in their food!

Fungi are not plants. While plants make their own food in their leaves, using sunlight and a gas in the air called CO_2, fungi can't do this. Instead fungi have to get their food from other sources, living or dead. Animals, like fungi, cannot make their own food but they can at least move to find the food they need. Fungi don't move, so how do fungi find their food?

Fungi are very different from plants and animals, and there are so many kinds of fungi. Did you know that there are more different kinds of fungi in the forests of Aotearoa than different kinds of plants? And there are even more different kinds of insects and other animals. All of these fungi, plants, and animals live together in the forest, and are linked together in many ways including in food webs. Like us, fungi can only live and grow if they have food, water, and the gas oxygen (O_2) from the air – but fungi don't chew food, drink water, or breathe air! Instead, fungi grow as masses of narrow branched threads called "hyphae".

DIAGRAM 1



Pie chart to show the different kingdoms of life in Aotearoa and their size as number of named species (adapted from Gordon 2009)

TĒNEI MEA TE HEKAHEKA

He puna koiora puiaki te wao nui a Tāne. Waihoki, ko Aotearoa anake te kāinga e tupu māori ai te nuinga o ōna hanga ora. Ko ngā hekaheka tētahi o ngā aitanga a Tāne. Ko ngā tipu (arā, ngā rākau, ngā otaota) me ngā kīrehe (pērā i te kiore, i te manu, i te ngārara) ētahi atu. Arā ētahi momo hekaheka i āta mōhiotia e ngā tūpuna, i whaihua, i noho taonga hoki ki a rātou. Taihoa ka whakamāramatia ētahi o ngā painga o te hekaheka. Engari me tīmata ake i te whakautu i ētahi pātai matua mō te hekaheka, pēnei i ēnei: He aha tēnei mea, te hekaheka? He aha ngā painga o te hekaheka?

HE AHA TĒNEI MEA TE HEKAHEKA? KITEA AI I HEA?

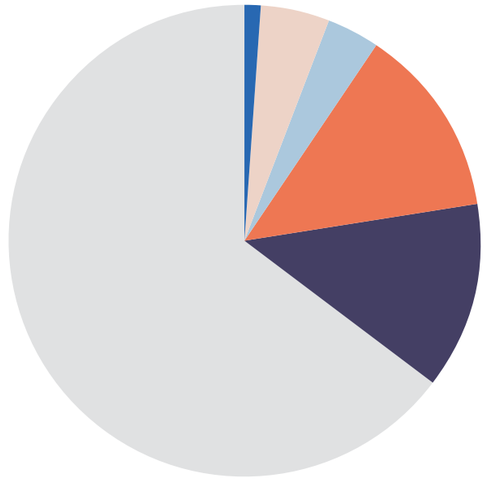
Me kī kei ngā wāhi katoa te hekaheka – kei te hau takiwā e kapohia atu nei ki ō pūkahukahu, kei te maha noa atu o ngā kai ka pau i a koe, kei te oneone ka takahia e te waewae, kei ngā rākau, kei ngā otaota e karapoti ana i a koe, kei ngā mirumiru i te hukahuka kitea ai i ngā wai o te kōawa, kei runga, kei roto anō i a koe! He hanga māori noa te hekaheka, engari me uaua ka kitea, i te mea he tino moroiti ētahi, kei te noho huna rānei ki ō rātou kāinga noho. He nui hoki ngā momo kāinga o te hekaheka – he poro rākau pea, he oneone, he tipu, he kararehe, he ngārara, he aha atu rānei, ko taua mea rā tāna kai. He noho hoki te hekaheka ki runga tonu, ki roto tonu rānei i tana kai!

E ai ki te pūtaiao Pākehā, ehara te hekaheka i te tipu, pēnei i te rākau, i te otaota. Ko tā te tipu, he hanga i āna ake kai i roto i ōna rau, mā te whakamahi i te aho o Tamanuiterā me tētahi haurehu kei te hau takiwā, arā, ko te hauhā (CO_2). Kāore e taea e te hekaheka tēnei mahi. Me tiki kē te hekaheka i te kai māna i wāhi kē – i ngā puna kai ora, i ngā puna kai mate anō hoki. He pērā anō te kīrehe – kāore e waihanga i āna ake kai. Engari ko te rerekē o te kīrehe, ka oreore, ka neke haere ki te kimi kai māna. Tēnā ia ko te hekaheka, kāore e neke. Nō reira, me pēhea te hekaheka e kimi kai ai māna?

Kua oti kē te kī ake he tino rerekē te hekaheka i te rākau me ngā hanga oreore. He tino huhua hoki ngā momo. He maha ake ngā momo hekaheka i ngā ngahere o Aotearoa i ngā momo tipu. Ā, he huhua ake i tērā ngā momo ngārara me ērā atu hanga oreore. Noho tahi ai te manomano o ngāi hekaheka, o ngāi tipu, o ngāi kīrehe i te wao o Tāne. He tini hoki ngā hononga i waenganui i a rātou. Ko tētahi o ngā momo hononga, ko ngā māwhaiwhai kai.

Pērā anō i a tātou te tangata, e ora ai, e tupu ai te hekaheka, me whiwhi kai, me whiwhi wai, me whiwhi hāora (O_2) anō hoki mai i te hau takiwā. Engari kāore te hekaheka e ngaungau i āna kai, kāore e inu rawa i te wai, kāore hoki e whakahā! Ko tāna kē, he whakaputa i

HOAHOA 1



Ngā mātāmuatanga koiora i Aotearoa, me te rahi o tēnā o tēnā i runga i te maha o ōna momo kua whakaingoatia (I whakahāngaitia mai i Gordon 2009)

These hyphae have thin outer walls, and their food, water, and oxygen need to move across the wall into the living fungal cell - a process called absorption. Any waste products, like CO_2, leave the cell by crossing the thin wall in the other direction.

Hyphae can change their form from when they are feeding to when they become part of a mushroom, for example. A mushroom is made up of masses of specially arranged hyphae. Fungal hyphae can often be seen as white threads, about as narrow as spider silk, among dead leaves on the forest floor, or under bark of rotting trees, or they can be grown in a laboratory on a kind of jelly-like food in a plastic petri dish.

HOW DO FUNGI MOVE?

Imagine you were as tiny as fungal hyphae, with no legs or wings, or other ways of moving. If you have food, water and O_2, you can grow from the ends of the hyphae, and maybe branch and grow off in different directions. But being so tiny, you will only move a small amount, and likely not enough to find a new source of food.

Fungi must leave their food to find more, and they do this not as hyphae but as 'spores'. Spores are tiny cells that form on special hyphae, and are so small that more than 1000 would easily fit on a pin-head. Being so small and light-weight, spores can easily move unseen in the air currents, and most fungal spores are spread by the wind. You are breathing them in (and out) without noticing it, and the spores don't cause you any problems. Some spores are also spread by water droplets from rain or in streams, and others need help from animals such as flies. Flies like stinky things, so the "stinkhorn" fungi have developed their spores in a really bad smelling slime. The flies eat this, and then carry the spores until they later 'deposit' them in their poo.

ngā io tarapī tini māioio, he io tokomanga. Ka kīia ēnei io he torohihi (he "hyphae" ki te reo Pākehā).

He angiangi te kiri whakawaho o te torohihi. Ka whakawhiti te kai, te wai me te hāora mā te kiri tonu, ka uru ki roto, ki te pūtau ora o te hekaheka. Ka kīia tēnei mahi ko te mitimitinga. Ā, ko ngā para, pērā i te hauhā, ka whakawhiti ki waho, mā te puta atu i te kiri i tērā atu taha o te pūhihi.

Kāore e pūmau te āhua o ngā pūhihi. Hei tauira, he rerekē te āhua o ngā torohihi o te harore i te wā e kai ana tēnei momo hekaheka, tēnā i te wā e noho ai aua torohihi hei wāhanga tonu o ngā kiko o te harore. I te harore, he mano tini ngā torohihi ka āta noho tahi ki tōna anō tauira e tika ana mō te harore. Ko te āhua o ngā torohihi ka kitea nuitia, he pēnei i te miro mā, āhua rite nei ki te miro o te pūngāwerewere te angiangi, e tipu ana i ngā rau mate kei te papa o te ngahere, i raro rānei i te hiako o te rākau kua pirau haere. Ka taea hoki te whakatipu torohihi ki te pae porowhita, ki tētahi pia whakatipu.

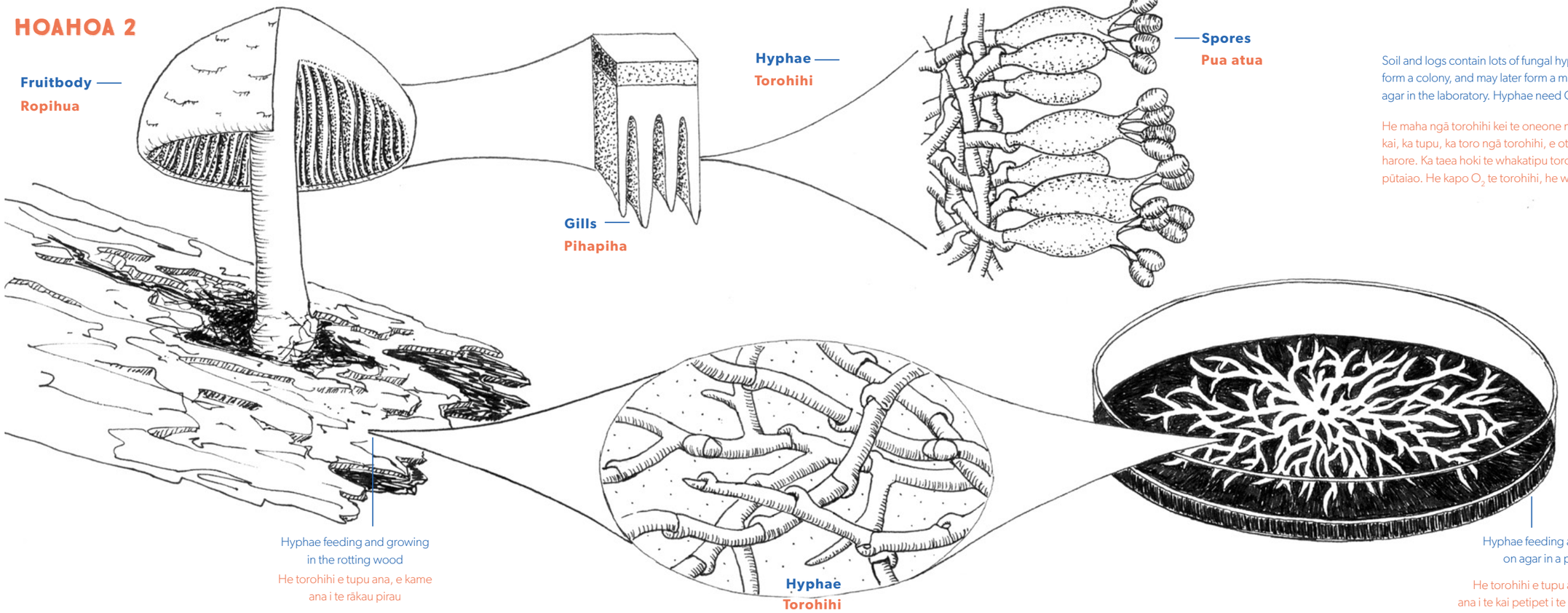
ME PĒHEA E NEKE AI TE HEKAHEKA?

Me he torohihi moroiti koe nō tētahi hekaheka, kāore ō waewae, kāore ō parirau, kāore e taea te nuku ki wāhi kē. Engari mena he kai tāu, he wai tōu, he hāora anō, ka whanake tonu koe, mā te tupu haere i ngā pito o ngā torohihi, me te tokomanga haere anō. Engari nā tō kaha moroiti, he iti noa te tupu, kāore pea koe e tupu kia tae rawa koe ki tētahi puna kai hou.

Ina pau i te hekaheka te kai o te wāhi e noho rā ia, me wehe ki te kimi kai anō. Heoi anō, kaua mā ngā torohihi tēnei mahi, engari mā ngā pua atua. Ko te pua atua, he pūtau tino ririki ka tupu ki ētahi torohihi. Kotahi mano ngā pua atua ka noho pai noa iho ki te pane o te pine tui kaka – inā rawa te mōkitokito. Ā, ko te hua o te moroiti me te māmā o te hanga, ka rere noa i te hau o te takiwā, me te kore e kitea. Ko te hau kei te kawe i ngā pua ki tata, ki tawhiti. Ina whakahā koe, kei te kapohia e ō pūkahukahu ētahi pua atua (kei te whakaputaina hoki), me tō kore anō e mōhio e pērā ana. Kāore hoki te tangata e raru i tēnei āhua.

DIAGRAM 2

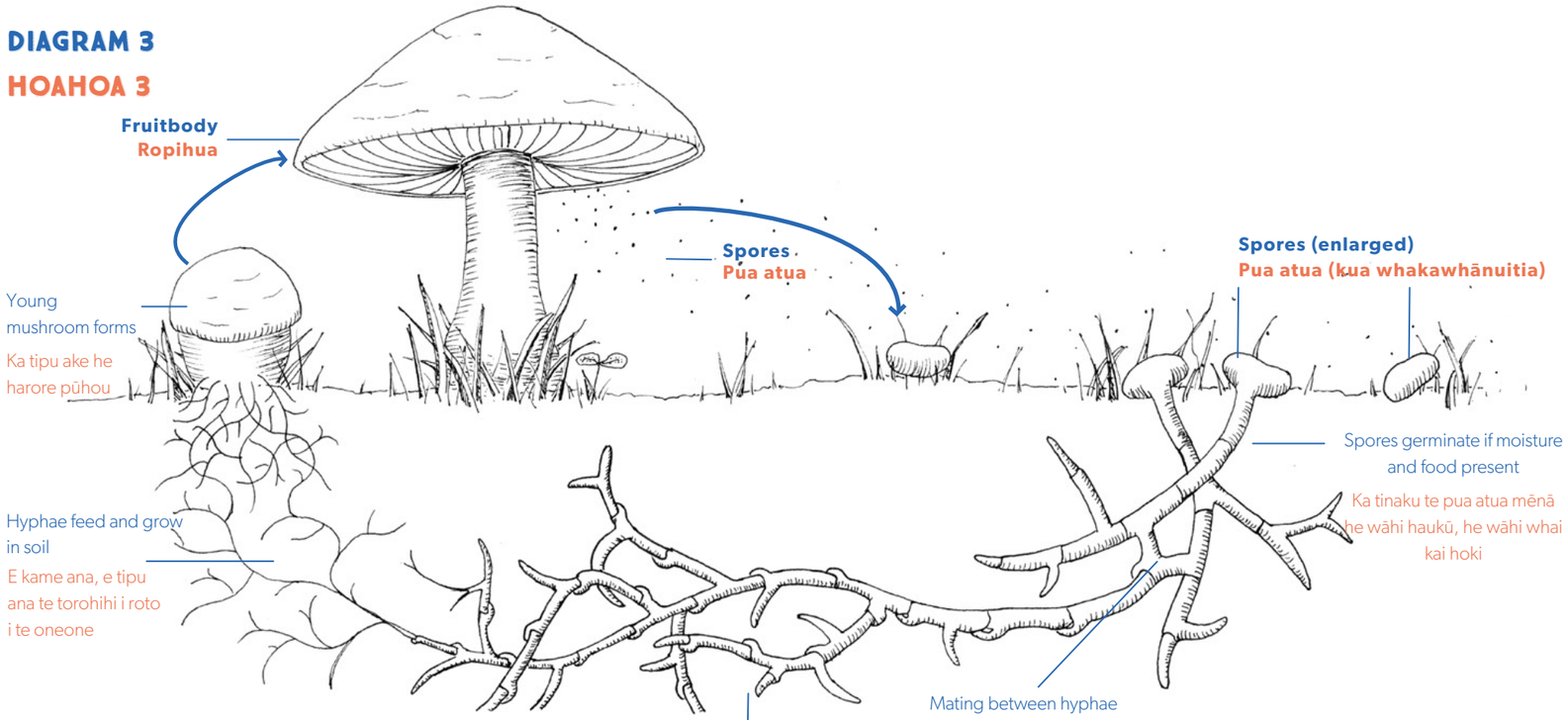
HOAHOA 2



Soil and logs contain lots of fungal hyphae. Hyphae feed, grow and branch to form a colony, and may later form a mushroom. Hyphae can also be grown on agar in the laboratory. Hyphae need O_2 and produce CO_2 like animals.

He maha ngā torohihi kei te oneone me ngā rākau e takoto ana ki te papa. Ka kai, ka tupu, ka toro ngā torohihi, e oti ai he hapori. Ā, tērā pea ka hua mai he harore. Ka taea hoki te whakatipu torohihi ki te pia whakatipu, i te taiwhanga pūtaiao. He kapo O_2 te torohihi, he whakaputa CO_2 , pērā anō i te kīrehe.

DIAGRAM 3
HOAHOA 3



Simplified life cycle of a mushroom. Of the many spores produced by a mushroom only a tiny number will land where they can germinate – to produce hyphae. Hyphae of different species may grow in soil or in wood, and may later form a tiny mushroom "button". This then grows and the stalk and cap expand to become a mushroom. (Some other fungi have quite different life cycles.)

Te hurihanga ora o te harore. He manotini ngā pua atua ka whakaputaina e te harore, engari he ruarua noa ka tau ki te wāhi pai, ka tinaku, ka puta ake he torohihi. Tipu ai ngā torohihi o ētahi momo ki te oneone, ko ētahi atu ka tipu ki te rākau. Nō muri, tērā ka tipu ake he harore porotaka moroiti. Ka tipu tēnei, ka huri te āhua hei harore tūturu.

If a spore, just by chance, lands where there is moisture and food, it may be able to grow (germinate) and produce its hyphae. As the hyphae branch and grow out in all directions from the spore, they form a circle of growth that is called a colony. Many fungi need two of these colonies to grow, by chance, next to eachother and to mate before that fungus is able to form any new spores and so spread further. Fungi need to produce so many spores because most spores simply die where they land, lacking water and food. Some fungal colonies can grow for a very long time and over a very large area.

DID YOU KNOW?

The largest living organism is probably a fungus! Check out the mushroom called *Armillaria solidipes* from USA where one colony was found to be over 2000 years old and growing through the soil in a forest to cover 9 square kilometres (over 1000 rugby fields)! That makes it larger than a blue whale. No-one has looked yet at the size of a colony of *harore* in Aotearoa.

Above right: The stinkhorn fungus *Anthurus* "hatches" out of an egg-like structure and smells like rotten meat to attract flies

Runga, taha matau: Ka puta ake te pihi-haunga *Anthurus* i tētahi hanga pēnei i te hēki te āhua. He rite ki te kiko pirau te haunga, kia taetae mai ai te ngaro

Arā hoki ētahi pua atua ka kawea e ngā pata wai – i te ua, i te kōawa rānei. Ko ētahi anō ka āwhinatia e ngā mea oreore, pēnei i te ngaro. He pai ki te ngaro ngā mea haunga. Nā konā, ko te whakanoho a te hekaheka "pihi-haunga' (arā, te "stinkhorn") i ōna pua atua ki tētahi hāwareware mutunga mai o te keha. Ka kainga tēnei e te ngaro, ka kawea haerehia, ā, ina tiko te ngaro, tukua atu ana aua pua, tau atu ana ki tētahi wāhi hou.

Ki te waimarie, ka tau atu te pua atua ki tētahi wāhi haukū, he kai anō kei reira, tērā pea ka tinaku, ka whakaputa i ōna ake pūhihi. Kia tokomanga haere, kia toro haere ngā torohihi atu i te pua atua, ka oti mai he hapori hou, he hapori porohita. He maha ngā momo hekaheka me rua rawa ngā hapori pēnei, e noho ana tētahi i te taha tonu o tētahi, e pai ai te hono tahi a ngā hapori e rua ki te whakaputa uri hou. Mā reira ka tupu he pua atua hou, me te rere o ētahi ki wāhi kē anō. He tini māioio ngā pua atua ka whakaputaina e te hekaheka, i te mea ko te tino nuinga ka hemo noa i te wāhi e tau atu ai, nā te kore wai, nā te kore kai. Arā ētahi hapori hekaheka ka roa e tipu ana, ka kapi tētahi wāhi rahi tonu i a rātou.

I MŌHIO RĀNEI KOE?

E whakaarotia ana ko te hauropi rahi katoa o te ao, he hekaheka. Tēnā tirohia a *Armillaria solidipes*, he hekaheka nō Amerika. Ko tētahi hapori, kua neke atu i te 2000 tau e ora ana, ā, kua toro ōna kāwai i te oneone o tētahi ngahere kia kapi i a ia tētahi 9 kiromita pūrua (he nui ake i ngā papa whutupōro 1000)! He nui noa atu tērā i te tohorā kahurangi. Kāore anō i tirohia te rahi o ngā hapori *harore* i Aotearoa nei. http://www.nationalgeographic.com.au/nature/the-worlds-largest-living-organism.aspx

Hyphal colony (feeding stage of fungus) growing on agar in a laboratory petri dish.

WHERE DO SPORES COME FROM?

Many fungi form a fruitbody, shaped as a mushroom, a shelf-like bracket, a puffball, a coral, or simply like a splash of paint. The main purpose of the fruitbody is to produce spores so that the fungus can spread. Spores of mushrooms form on special hyphae on the surface of thin "gills" that form in a circle hanging on the underside of the cap. The cap has a curved shape [poroharore] so that the rain droplets run off and the spores keep dry. Mushrooms must shed their spores fast as both mushrooms and spores often live for only a few days. If you pick a mushroom or other kind of fruitbody, the feeding stage of the fungus usually keeps growing in the soil or wood – but you will be stopping the mushroom's spores from spreading to other places.

CAN YOU SEE FUNGAL SPORES?

If you use a microscope to make the spores look much larger, you can see them clearly. But without a microscope it's easy to see a large group of spores. Check out the Activity to learn how to make a print from spores of a mushroom.

Students at Tūai, Te Urewera, using microscopes to look at fungi

He hapori torohihi (te wāhanga kame o te hurihanga ora o te hekaheka) e tipu ana ki te pia whakatipu i roto i te pae porowhita i te taiwhanga pūtaiao.

NŌ HEA NGĀ PUA ATUA?

He maha ngā hekaheka ka tupu ake i a rātou he 'ropihua' – he tinana whakaputa pua atua. Ko ētahi tauira o te ropihua, ko te harore tonu e mōhio nei tātou, ko ngā hanga ka tipu whakawaho i te kahiwi o te rākau, ko te pukurau, ko te wheo, ā, ko ētahi, he rite ki te peita paratī noa te āhua. Ko te kaupapa matua a te ropihua, he whakaputa pua atua kia toro haere ai te hekaheka i te mata o te whenua. Ko ngā pua atua o te harore, ka tipu i ētahi torohihi motuhake kei te mata o ngā 'pihapiha" rauangi ka iri porohita mai i te taha raro o te taupoki o te harore. He poroharore tonu te hanga o te taupoki, kia rere ai ngā pata ua ka tau ki a ia, kāore e mākū ngā pua atua e noho marumaru mai ana ki raro. Heoi anō, me tere tonu te tuku a te harore i āna pua atua, i te mea he poto te ora o te harore me te pua atua – ka ora pea mō ētahi rangi torutoru noa. Ina katohia he harore, tētahi atu rānei o ngā ropihua, ka pūmau tonu pea te kai me te tupu o te hekaheka, i te oneone, i te rākau rānei. Engari ko te kato i te ropihua, he aukati i te rere o ngā pua ki wīwī, ki wāwā.

He ākonga nō Te Kura o Waikaremoana ki Tūai, i Te Urewera, e whakamahi karu whakarahi ana ki te tirotiro hekaheka

KA ĀHEI ANŌ TE TANGATA TE KITE I NGĀ PUA ATUA O TE HEKAHEKA?

Ki te tirohia ki te karu whakarahi, ka rahi noa ake te āhua, ā hei reira āta kitea ai e te whatu. Engari ka kitea tonutia ngā kāhui nui o te pua atua ki te kore ō karu whakarahi. Tirohia te Hei Mahi – he tohutohu kei reira mō te tā i te tauira o ngā pua atua o te harore.

WHEN WILL YOU SEE MOST FUNGI?

Life in Tāne-mahuta changes a lot with the seasons. In spring we see new life among the birds, in summer the forest is alive with the shrill sound of cicadas and other insects, while in autumn it is the turn of the mushrooms and other fungi to "shine". Many fungi produce their fruitbodies in autumn when it rains and temperatures cool after the drier and warm season of summer.

Take special care in autumn when walking through Tāne-mahuta, especially amongst his forests of mānuka, kānuka, and tawai. These trees have many special fungi that live with their roots and in the surrounding soil, helping those trees to absorb nutrients and water from the soil. If you pick a mushroom under these trees in autumn, you will be connected at that moment to the tree roots hidden beneath in the soil. Even with the mushroom picked, the feeding hyphae of the fungus will keep on helping the tree roots to feed. Other different trees of Tāne-mahuta also have fungi living with their roots and helping the tree to feed, but those fungi do not produce mushroom-like fruitbodies.

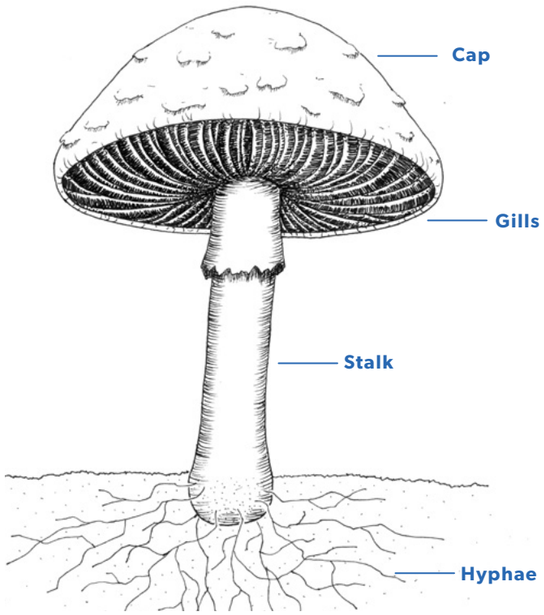
HOW ARE FUNGI IMPORTANT?

Fungi, plants, and animals live together in Tāne-mahuta and all have important roles to play. Fungi live with plant roots helping the plant to get minerals and water from the soil. Fungi like hakeke feed on dead wood causing it to rot and returning its nutrients to the soil. Insects feed on fungi, and fungi like āwheto feed on insects! Some fungi such as pūtawa feed on living trees but without killing them. Our tūpuna had several uses for these and other fungi.

Some fungi especially need your help, just like the rare animals and plants of Aotearoa. They have lost their place to live in Tāne-mahuta or have been affected by other changes, and are now rare. Protection of Tāne-mahuta is important for all his descendants - the fungi, animals, and plants.

Beyond Tāne-mahuta, fungi are also important in our homes, our hospitals, as well as in farms, orchards, and gardens. For example, at home we use yeast (tiny fungi, just one cell each) to make bread rise, and we can see that our food is too old when mould fungi start to grow on it [puruhekaheka]. For eating, several different kinds of edible mushrooms are grown

DIAGRAM 4



Parts of a mushroom fruitbody

in mushroom farms and sold as food, or sometimes edible field mushrooms can be collected in a farmer's field. Marmite, made from yeast, is a popular spread on bread. If you become sick, a doctor may give you a fungal medicine called an antibiotic. Antibiotics were first discovered from fungi. Just like us, fungi need to keep bacteria away, so we've used chemicals invented by fungi for our medicine against bacteria.

MŌ ĀHEA KITEA NUITIA AI A NGĀI HEKAHEKA?

Ka rerekē te āhua o Tāne-mahuta i tēnā, i tēnā kaupeka o te tau. I te kōanga, ko te whānautanga mai o ngā pīpī tētahi o ōna tino tohu. I te raumati, kua hoihoi te wao i te kitā a te kihikihi me te tangi tīkākā a ētahi atu pepeke. Kia ngahuru, ko te wā tēnā e kaha kitea ai ngā hekaheka. He maha hoki ngā momo hekaheka ka whakaputa i ngā ropihua i te ngahuru, i te wā kua nui ake te ua, kua mātao haere te whenua, kua kore te maroke me te wera o te raumati.

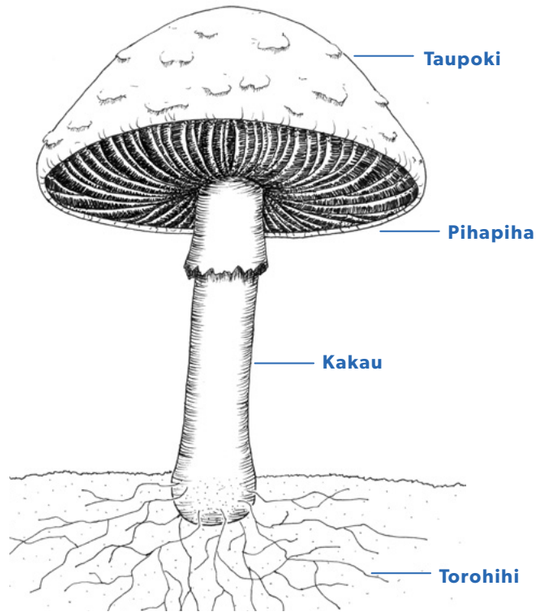
Ki te kuhu koe i te wao a Tāne i te ngahuru, kia tūpato te takahi haere o te waewae. Ā, kia tino pēnei i ngā ngahere ko te mānuka, ko te kānuka, ko te tawai rānei te tino rākau. He maha ngā momo hekaheka ka piri ki ngā pakiaka o ēnei tū rākau me ngā oneone e pātata ana. He āwhina tā ngā hekaheka i aua rākau ki te kapo i te kai me te wai o roto i te oneone. Ki te tupou koe ki te kato i tētahi harore e tipu ana i raro i ēnei tū rākau i te ngahuru, hei te wā ka pā tō ringa ki te harore, kua honoa koe ki ngā pakiaka o te rākau e huna ana i roto i te oneone. Ā, ina oti i a koe taua harore te kato, ka mahi tonu ngā torohihi kai o te hekaheka i tā rātou mahi – ka āwhina tonu i ngā pakiaka ki te kapo oranga mō te rākau. Arā ētahi atu rākau a Tāne he noho tahi ētahi momo hekaheka ki ō rātou pakiaka, he āwhina i te rākau ki te kapo kai māna, engari kāore aua hekaheka e whakaputa ropihua rite ki te harore te āhua.

HE AHA NGĀ PAINGA O TE HEKAHEKA?

Noho tahi ai ngā hekaheka, ngā tipu me ngā hanga oreore ki te poho o Tāne-mahuta. Ka mutu, he mahi nui anō ka kawea e tēnā, e tēnā. He piri tahi te hekaheka ki ngā pakiaka o ngā rākau. He āwhina tā te hekaheka i te rākau ki te kapo kohuke, ki te kapo wai i te oneone. Ka kai hoki ngā hekaheka pērā i te hakeke i ngā kiko o te rākau mate. Mā konei ka pirau te rākau, ka hoki atu ōna taiora ki te whenua. Ka kainga ngā hekaheka e te pēpeke. Ā, arā ētahi pēpeke ka kainga e te hekaheka, pērā i te āwheto! Arā anō ētahi hekaheka pērā i te pūtawa ka kai i te rākau ora, ā, ka ora tonu te rākau. He maha ngā mahinga o ēnei hekaheka i te wā ki ngā tūpuna.

Heoi anō, arā ētahi hekaheka kua noho mōrearea, pērā i ētahi atu puiaki o Aotearoa – manu mai, rākau mai. Kua kore ō rātou kāinga taketake i te wao a Tāne, he āhuatanga anō rānei kua pā ki a rātou, ko tō rātou onge

HOAHOA 4



Ngā wāhanga o te ropihua o te harore

te hua. He mea nui kia manaakitia te wao tapu, kia ora ai ngā tini aitanga a Tāne – te hekaheka, te manu, te ngokingoki, te rākau, te aha atu.

He mahi anō tā ngā hekaheka i ngā kawenga o waho o te wao a Tāne – i te kāinga, i te hōhipera, i ngā mahi ahuwhenua, i ngā māra huarākau, i ngā māra huawhenua. Hei tauira, ko tētahi tino hekaheka i te kāinga, ko te īhi (he hekaheka tino moroiti, he hekaheka pūtau tahi) hei whakapiki i te parāoa. Ā, ko tētahi tino tohu o te kai kua kino, ko te tupu o te puruhekaheka ki tōna mata. Ā, kei wareware, he kai anō ētahi hekaheka. He maha ngā momo harore pai hei kai ka whakatupuria ki te māra harore, ka hokona ki te hunga hiahia kai harore. He wā anō ka tipu ake he harore i ngā pātiki o te hunga ahuwhenua, ka āhei te tangata te kohi harore māna i reira. Ko te māmaiti anō tētahi kai e paingia ana e te tokomaha hei pani ki te parāoa, ko te īhi tētahi o ngā kai o roto. Waihoki ina pāngia koe e te mate, tērā pea he rongoā hekaheka te mea ka tohua e te tākuta hei rongoā i tō mate, arā, he rongoā paturopi, he antibiotic. Ko te hekaheka te takenga mai o te rongoā paturopi tuatahi. Pērā anō i te tangata, ka mahi te hekaheka ki te pare atu i te huakita. Nō reira kua whakamahia ētahi matū i pūtakea mai i te hekaheka i roto i ā tātou pakanga ki ngā huakita kino.

SOME FUNGI THAT WE DON'T WANT

There are also fungi in Aotearoa that we would rather not have. These may have come here with tūpuna and early Pākehā, or as hitch-hikers on plants or in soil from other countries. Like plant weeds and animal pests, there are also fungi that can be weeds and pests. At our airports and sea ports, care is needed to avoid bringing in any unwanted fungi that are new to Aotearoa. So no fruit (that may contain fungi and insects) is allowed in our plane bags, and no soil on our shoes and tent pegs. As tangata whenua "biosecurity" at our ports is important for our mātua and tamariki, to also protect Tāne-mahuta.

Fungal pests include those that cause diseases of our food plants. Kūmara and taewa, for example, can be damaged by disease-causing fungi in the soil. These fungi feed on the kūmara or taewa, causing them to rot. Sometimes, in fields with soil containing these fungi, farmers may need to stop growing kūmara and taewa, and change to other kinds of plants that can grow without being attacked by these fungi.

WHY DOES WOOD ROT?

When branches fall, or a tree dies, the dead wood on the ground is soon alive with other life. Many different kinds of fungi start feeding on the wood. They may arrive as spores in the air or grow up from the soil below, or they may already be in the tree before it dies. As the fungi feed on the cells of the wood, the wood starts to become softer. We describe this softening as "rot". Insects can also begin to feed on the softened wood and on the fungi. This rotting log may continue to be full of life for many years until eventually there's no food left for the fungi, and what little remains of the wood becomes part of the floor and soil of Tāne-mahuta, from which new plants feed and grow.

WHERE DO THE FALLEN LEAVES GO?

Just like wood, fungi and insects feed on fallen leaves. The leaves rot as a result and finally become part of the soil, returning nutrients once in the tree back to the soil. The fungi are thus the great "recyclers" of Tāne-mahuta.

Rotting kūmara, attacked by the disease-causing fungus *Sclerotinia*

He kūmara kua pirau e patua ana e te *Sclerotinia*

ĒTAHI HEKAHEKA KĀORE I PAI KI TE TANGATA

Heoi anō, arā anō ētahi hekaheka i Aotearoa kāore e pīrangitia e te tangata. I tae tahi mai pea ēnei me ngā tūpuna, i te taha rānei o ngā Pākehā tuatahi, i tae matahuna mai rānei i runga, i roto i ngā tipu, i ngā oneone rānei kua kawea mai i whenua kē. Pērā anō i ngā taru kino me ngā mea oreore kino, he hekaheka anō ka whakararu i te taiao, i te tangata. Koinei te take he tūtei kei ngā taunga waka rere, waka moana, e mahi ana ki te haukoti i te uru mai o ētahi hekaheka kino hou ki Aotearoa. Koinei hoki te take kāore e whakaaetia te mau huarākau mai i roto i ngā pēke i te rerenga mai ki Aotearoa, kāore rānei e pai mēnā he oneone e mau ana ki ngā hū me ngā titi here tēneti. E tika ana kia āta hāpaingia te haumaru-koiora i ngā taunga waka rere, waka moana, he mea nui ki te tangata whenua – ki ngā mātua, ki ngā tamariki, hei tiaki anō i a Tāne-mahuta.

Ko ētahi o ngā hekaheka kino, ko ērā e ngaua ai ngā kai o te māra, o te taiao e te mate. Ko te kūmara me te taewa ētahi tino kai ka kino i te noho mai o te hekaheka tuku mate ki te oneone. Ka kai hoki ēnei hekaheka i te kūmara, i te taewa, e pōpopo ai ēnei kai. Mēnā kua pokea te māra e tētahi o ēnei hekaheka, kotahi noa te rongoā, ko te whakamutu i te whakatupu i aua kai ki aua whenua, me whakatupu kē he kai kāore e patua e aua hekaheka.

HE AHA I PIRAU AI, I PŌPOPO AI TE RĀKAU?

Ina whati he manga, ka taka ki te papa, kāore e roa ka muia te rākau mate e te mahi a te hanga ora. He maha tonu ngā momo hekaheka ka kai haere i te rākau. He pua atua pea e whakaangi ana i te hau takiwā, ka tau atu ki te rākau, ka tipu ake rānei i te oneone, kei roto kē rānei i te rākau i te wā e ora ana. Ka kai haere te hekaheka i ngā pūtau o te rākau, ka ngohe haere te kiko o te rākau. Ko tēnei ngohe haere, he pirau, he pōpopo ki a tātou. Tērā anō a ngāi pepeke ka kai haere i ngā rākau kua ngohe haere, kua pōpopo haere, ka kai anō i ngā hekaheka e mau mai ana ki roto. Ka hia tau pea te rākau nei e noho ana hei oranga mō ētahi atu, tae noa ki te wā ka pau ōna kiko i a hekaheka mā, i a ngokingoki mā. Ko te wāhanga iti ōna e toe ana, ka hoki atu ki ngā oneone o Tāne, hei whakatupu rākau hou ā tōna wā.

KA NGARO ATU NGĀ RAU O NGĀ TINI RĀKAU KI HEA?

Pērā anō i te kiko o te rākau, ka kai hoki te hekaheka me te pepeke i ngā rau kua taka ki te papa. Me te aha, ka pōpopo, ka huri anō hei oneone, e hoki ai ngā kai o roto i te rākau i ōna wā ki te oneone. E kitea ana i konei te pono o te kōrero, o ngā tini a Tāne, kāore i tua atu i ngā hekaheka mō te "hangarua".

Searching for fruitbodies of fungi that decay fallen logs and dead leaves

Te kimi i ngā ropihua o ētahi hekaheka whakapopo i ngā rākau me ngā rau mate

MĀORI KNOWLEDGE AND USES OF FUNGI

SUBJECT INDEX

NGĀ MĀTAURANGA ME TE WHAKAMAHI A TE MĀORI I NGĀ HEKAHEKA

RĀRANGI KAUPAPA

1 Fungi for

TATTOOING

VEGETABLE CATERPILLAR

Ophiocordyceps robertsii (te āwheto)

Our ancestors found different ways to make colour for tattooing. Black is an important colour, and one of the ways to make black was using a fungus. But the special fungus used, called āwheto, is light brown not black, and is not often seen today. Somehow our clever ancestors learnt where it lives and collected lots of it. To get the black colour, they burnt it. Unlike wood that turns into grey ash when burnt, āwheto becomes black and can then be ground up into a black powder. This powder was mixed with bird fat to make the black colour for tattooing.

Āwheto is a very different kind of fungus from a mushroom, and is different from all other fungi used by our ancestors. It needs an insect as its food, but not just any insect. Only the large caterpillars of two kinds of native moth are the food that āwheto needs to grow. So how does āwheto, that can't move, find these special two kinds of caterpillar? It only happens by luck, or if you are the caterpillar by bad luck! Āwheto makes many tiny fungal spores, so that one might be eaten by a caterpillar, maybe along with some leaves, or one might become stuck to its body. Āwheto spores somehow 'know' when they have found a caterpillar and they start to grow using the caterpillar's insides as its food. You might guess what happens to the caterpillar!

This kind of caterpillar lives in a burrow in the soil when it's not feeding, with its head up and tail down, but it seems to also go there when not feeling well. When the fungus feeds on the body of the caterpillar, the dead caterpillar doesn't become soft and rot but instead become hard – rather like a human "mummy". To make its spores the fungus needs to grow out of the caterpillar and spread its spores above the soil. Somehow the fungus "knows" that the shortest way above ground is from the head of the caterpillar, so it always starts growing out from there. It forms a straight stick-like fruiting body that grows up out of the soil and into the air. At its tip, spores are formed.

Āwheto that have just been dug up

He āwheto kātahi anō ka karia mai i te oneone

1 Te hekaheka ka whakamahia mō te

TĀ MOKO

TE ĀWHETO

Ophiocordyceps robertsii (vegetable caterpillar)

He maha ngā tikanga i whāia e ngā tūpuna hei hoatu tae ki te moko. Ko te pango tētahi o ngā tino tae i roto i ēnei mahi, ā, ko te hekaheka nei, ko te āwheto, tētahi o ngā puna waingārahu. He uaua te kitea o te āwheto i ēnei rā. Engari i mōhio ō tātou tūpuna ko hea te kāinga o te āwheto, i kaha anō hoki tā rātou kohi āwheto. Hei whakapango, ka mea kia kainga ngā āwheto e te ahi. Ina tahuna, ka mangu, ka taea hoki te kauoro kia oti mai he hungahunga pango. Ka whakaranua tēnei paura pango ki te hinu o te manu, kātahi anō ka waingārahu, ka rite mō te tā moko.

He rerekē noa atu te āwheto i te harore, he rerekē hoki i ērā atu momo hekaheka katoa o te ao o ngā tūpuna. He ngārara tāna kai, ka mutu, e rua noa ngā momo ngārara ka kainga e ia – ko ngā anuhe o ētahi pūrerehua māori e rua. I konei, ka ara ake pea te pātai, ki te kore e taea e te āwheto te nekeneke haere, me pēhea e toroa ai e ia ērā momo anuhe e rua? He mea tūpono noa. Ka mutu, mehemea ko koe te anuhe, he tūpono kino! Ka whakaputaina e te āwheto ngā pua atua manomano, mei kore e kainga tētahi e te anuhe – ka kainga tahitia pea me ētahi rau. Tērā rānei ka piri noa tētahi o ngā pua atua ki te tinana o te anuhe. Te āhua nei he mōhio te awheto mehemea kua tau atu ia ki te momo anuhe koia tōna oranga, i te mea ka tīmata i reira tana tupu, ko te anuhe tana pātaka kai. Kei te mōhio pea koe ka ahatia rā te anuhe!

Ko tēnei momo anuhe, he noho ki tōna anō rua i te oneone i ngā wā kāore ia i te kai. Ina noho ia ki te rua nei, ko tōna upoko kei runga, ko te tou kei raro. Te āhua nei ka hoki anō ia ki tōna rua i ngā wā e māuiui ana. Kia kai a āwheto i te tinana o te anuhe, kāore te tinana e ngohe pērā i te kiko o te rākau ka pirau. Ka mārō kē – he āhua rite ki ngā tūpāpaku o nehe i Ihipa i whakamarokehia, ka mārō. Hei whakaputa i ōna pua atua, me toro te hekaheka ki waho o te tinana o te anuhe. Ka tukuna ōna pua atua kia toro ki runga ake o te mata o te whenua. He mōhio anō te āwheto ko te ara tukutata ki te mata o te whenua, ko te ahunga whakarunga atu i te upoko o te anuhe. Ka tīmata i reira tana tipu, tana kake ki runga. Oti mai ana he ropihua

Chinese *Ophiocordyceps*

He *Ophiocordyceps* nō Haina

Mauī: Gottfried Lindauer
The Tohunga-ta-moko at Work
oil on canvas
Auckland Art Gallery Toi o Tāmaki,
gift of Mr H E Partridge, 1915

Left: Te āwheto is made up of the caterpillar of this native moth *Dumbletonius* that is killed by the *Ophiocordyceps* fungus

Mauī: Ka hua ake te āwheto i te anuhe o tēnei pūrerehua, a *Dumbletonius*, nā te hekaheka *Ophiocordyceps* i whakamate.

So what do you look for when trying to find āwheto? Simply a small brown 'stick' coming out of the soil with a slightly pointed tip. If you are lucky enough to find it and carefully dig down into the soil, you will find the hard dead body of the caterpillar. Both the caterpillar mummy and fungus fruitbody were collected by our ancestors. But how did they find so many to use for tattooing?

Development of the āwheto fruitbody is a natural process of interaction between fungus and caterpillar. Research seeking to artificially cultivate fruitbody development has been unsuccessful. Overseas, considerable effort has been applied, also without success, to artificially cultivate a high value āwheto-like fungus that inhabits the alpine grasslands of Himalayas and Tibet. *Ophiocordyceps sinensis* produces its fruitbodies on caterpillars of the ghost moth, and is harvested by local communities in vast, unsustainable quantities (est. 82 tons per year) for the Chinese herbal medicine market. With declining harvests likely resulting from over-exploitation, this has become one of the world's highest-priced natural biological products, with an average retail price of US $45,000 to 90,000 per kg. Its value and reputation as an aphrodisiac and tonic has attracted interest in other species of *Ophiocordyceps* such as āwheto. But to date āwheto appears to lack key bioactive chemicals and is distinctly larger in appearance.

See further information, a video and an animation about the Life Cycle of Āwheto - at the Science Learning Hub: https://www.sciencelearn.org.nz/resources/1435-vegetable-caterpillar

torotika, rite ki te rākau iti te hanga, ka puta ake i te oneone ki te ao mārama. I te pito whakarunga, ka tipu he puta atua.

Nō reira, he aha ngā tohu mēnā kei te kimi āwheto koe? Ko tētahi 'rākau' parauri iti e tipu ana i te oneone, he āhua koi tōna pito. Ki te tau te waimarie ki a koe, ka kitea tētahi, āta karia te oneone. Te tikanga kei reira te tinana mārō o te anuhe i mate rā i te ngau a āwheto. I kohia ko ngā anuhe me ngā ropihua o ngā awheto i ngā rā o nehe. Engari ko te mea whakamīharo, i pēhea i kitea ai te maha ka mātua hiahiatia hei mahi waingārahu mō te tā moko?

Ka tipu ake te ropihua o te āwheto i tētahi tukanga māori e hono tahi ai te hekaheka me te anuhe. Kua rangahaua ētahi huarahi hei whakatipu horihori i te ropihua, engari taka mai ki tēnei wā, kua pūhore ēnā mahi. Kua nui ngā mahi i tāwāhi ki te whakatipu horihori i tētahi hekaheka āhua rite ki te āwheto, he nui tōna uara taha moni, ko ngā whenua pātītī i ngā maunga o ngā Himalaya me Tibet tōna kāinga tūturu, engari kua pūhore anō ērā mahi. He tuku a *Ophiocordyceps sinensis* i āna ropihua ki ngā anuhe o te 'pūrerehua kēhua'. Ka 'hauhakea' ngā anuhe tini ngerongero (ko tōna 82 tana i te tau) e te iwi kāinga, hei hoko atu ki Haina mō te mahi rongoā māori. Ko te mate, ka mimiti, ka whatungarongaro tēnei puna anuhe, inā te nui e hauhakea ana ia tau. I te mimiti haeretanga o te puna nei i ngā tau, kua noho koia tētahi o ngā rawa koiora māori inati katoa te utu, puta noa i te ao. Ko te utu toharite hei hoko i te mea nei i te toa, kei te takiwā o te $45,000 ki te 90,000 – tāra Merikana nei – mō te kirokaramu kotahi. E uaratia ana, e araara ana tōna whakakaha ake i te hiahia ki te ai, me tōna whakapiki i te ora o te tangata. Nō konā, ko te tahuri a ētahi ki te tirotiro i ētahi atu momo *Ophiocordyceps*, pērā i te āwheto. Engari ko ngā kitenga mō te āwheto ā mohoa noa nei, kāore i tēnei o ngā huānga kaitā o te puninga *Ophiocordyceps* ngā matū ngau-koiora e arumia ana.

Mō ētahi atu pārongo, tirohia te ataata me te pakiwaituhi e pā ana ki te mataora o te āwheto: https://www.sciencelearn.org.nz/resources/1435-vegetable-caterpillar

TE PŪTAWA, TE PUKU TAWAI

Laetiporus portentosus

The pūtawa fungus feeds on the wood of living beech trees in Tāne-mahuta. Its fruitbodies are bracket-shaped and often form high up on trunks. They grow quickly to a large size, but only last a few weeks to months before becoming old and falling. When collected on the ground, they need to be dried out before they can be used.

Pūtawa was important as tinder – to help start a fire, or as a way of carrying fire. When lit, a piece of the dried fruitbody can smoulder for a long time without bursting into flame, so it could be partly buried during the day and lit at night, or carried till needed. It could also be used as a torch at night because it burns for a long time. Pūtawa also occurs in Australia where the Aborigines used it for this same purpose.

For medical use, pūtawa was cut into flexible strips and used to surround and protect wounds. A hole larger than the wound was cut in the strip, and the pūtawa tied in place as a protective pad.

Te pūtawa growing on a native beech tree

ACTIVITY:

Next time you are in a beech forest, look on the ground near the base of trees in case you find a fallen fruitbody of this fungus, the pūtawa or puku tawai. They can be quite large and are often white and wet. They were dried thoroughly before being used as firelighters.

TE PŪTAWA, TE PUKU TAWAI

Laetiporus portentosus

Noho ai, kai ai te pūtawa i te kiko o ngā tawai ora i te wao a Tāne. Ko ōna ropihua, he toro whakawaho i te kahiwi, i te ikeiketanga o te rākau. Ka tere tonu te tipu, ka tipu hoki kia rahi. Engari ka piri ki te rākau mō ētahi wiki noa, mō ētahi marama noa rānei, kātahi ka ruha, ka taka ki te papa. Ina kohia i te papa, me mātua whakamaroke i mua i te whakamahi.

Ko tētahi tino āhuatanga o te pūtawa, ko tōna pai mō te tahu ahi – i pai hei tutungi i te ahi, hei kawe anō i te ahi ki wāhi kē. Ina tahuna, ka roa e popō ana, kāore e mura noa ake. Nō reira kua pai te tanu i te awatea, me te tutungi anō i te pō, kua pai rānei te mau haere ki tōna wāhi i hiahiatia ai. He pai anō hei rama i te pō, i te mea ka roa e kā ana. Kei Ahitereiria anō te pūtawa, waihoki i whakamahia e ngā tāngata whenua o reira hei tahu ahi, pērā tonu i te Māori.

I te taha rongoā, he mea tapahi te pūtawa ki ōna anō ngakunga roa, ngakunga tāwariwari, ā, ka whakapiria atu ēnei hei karapoti i ngā tūnga. Ka tapahia he kōhao rahi ake i te tūnga, ā, ka whakamaua atu te pūtawa hei pare ka āta tiaki i te tūnga.

He pūtawa e tipu ana ki te tawai

HE MAHI Ā-TAIAO:

Ina haere anō koe ki tētahi ngahere tawai, tirohia te papa huri katoa i te pūtake o ngā tawai. Tērā pea ka kitea te ropihua o te hekaheka nei, o te pūtawa/puku tawai. He āhua rahi tonu, he mā i te nuinga o te wā, he mākū anō. I āta whakamaroketia i mua i te whakamahi hei taonga tahu tahi.

3 Fungi as

FOOD (AND MEDICINE)

Tāne-mahuta is an important source of food, with different foods collected at different times of the year. Fungi mostly form their fruitbodies in autumn or early winter. Our ancestors knew which fungi tasted good, and knew also to eat only those that weren't poisonous. They also knew how to identify them and where to find them. Some of these edible fungi were also used for medicine.

Only some of the fungi known as edible to our ancestors are shaped like mushrooms with a stalk and cap. Others have different shapes – for example looking like an animal ear, or as hanging coral, or even like an egg.

HONEY MUSHROOM

Armillaria novae-zelandiae (te harore)

This fungus feeds on wood, and forms its edible mushrooms mostly on different kinds of fallen wood such as tawa and tawai, or at the base of dead trees. It appears in late autumn to early winter, and can often be collected in large numbers throughout Aotearoa. Its white mycelium may be seen under the bark of affected wood as the wood rots. It also forms black bootlace-like cords under the bark and growing out through soil, and can use these to grow to a new source of food.

Recent records indicate that some Tūhoe continue to collect this as a food in Te Urewera. Maybe this mushroom could also be cultivated on logs or sawdust as a wild food? There is more than one species of *Armillaria* in Aotearoa, and at least some, such as *Armillaria limonea,* are bitter in taste and not edible. Distinguishing words in Te Reo for these fungi of similar appearance but inferior use are not known.

The word harore is used in three senses – firstly (as above) it is the name of this widely eaten edible mushroom; secondly it is commonly used as a generic word for mushrooms whether edible or not. It can also mean a generic term for 'fungi' in science classification (though 'hekaheka' is the standard word for this purpose).

The weak glow of harore (known as "bioluminescence") was discovered in 2015 by a photographer who travels the world photographing fungi. But did our ancestors know this already? Wood decayed by harore sometimes glows at night because the hyphae of harore can be

Te harore the edible *Armillaria novae-zelandiae*

3 Te hekaheka hei

KAI (HEI RONGOĀ ANŌ HOKI)

He tino whata kai a Tāne-mahuta. He kaupeka anō, he kai anō ka horahia e ia. Whakaputa ai te nuinga o ngā hekaheka i ā rātou ropihua i te ngahuru, i te tīmatanga rānei o te takurua. I mōhio ngā tūpuna ki ngā hekaheka reka, i mōhio anō me kai ko ngā hekaheka anake kāore he paitini i roto. I mōhio hoki rātou ki te tautuhi i ia momo, ko hea anō te kāinga o tēnā, o tēnā. Ko ētahi o ngā hekaheka i kainga, he rongoā anō.

Ko ētahi noa o ngā hekaheka i kainga i neherā he harore, arā, he kakau, he taupoki anō tōna. Ko ētahi i rite ki te taringa te āhua, ko ētahi he rite ki te wheo tautau, ki te huamanu rānei.

TE HARORE

Armillaria novae-zelandiae (honey mushroom)

Kai ai tēnei hekaheka i te rākau. Kitea ai ngā ropihua – te wāhi ōna ka kainga – i ngā manga o ngā rākau pēnei i te tawa, i te tawai kua taka ki te papa, i te pūtake rānei o ngā rākau e tū tonu ana engari kua mate. Ka tupu ake i te mutunga o te ngahuru, i te tīmatanga rānei o te hōtoke. Arā ētahi wāhi puta noa i Aotearoa e ranea ai te tupu, ka kohia kia rahi tonu. Ka kitea ōna pūhihi mā i raro i te hiako o ngā rākau kua nohoia e ia, i te wā e pōpopo haere ana te rākau. Ka whakatupu hoki te harore i ētahi 'taura' pango, rite ki te here pūtu te āhua. Ka toro haere ngā taura nei ki raro i te hiako, ka puta atu hoki ki te oneone toro haere ai ki te kimi puna kai hou māna.

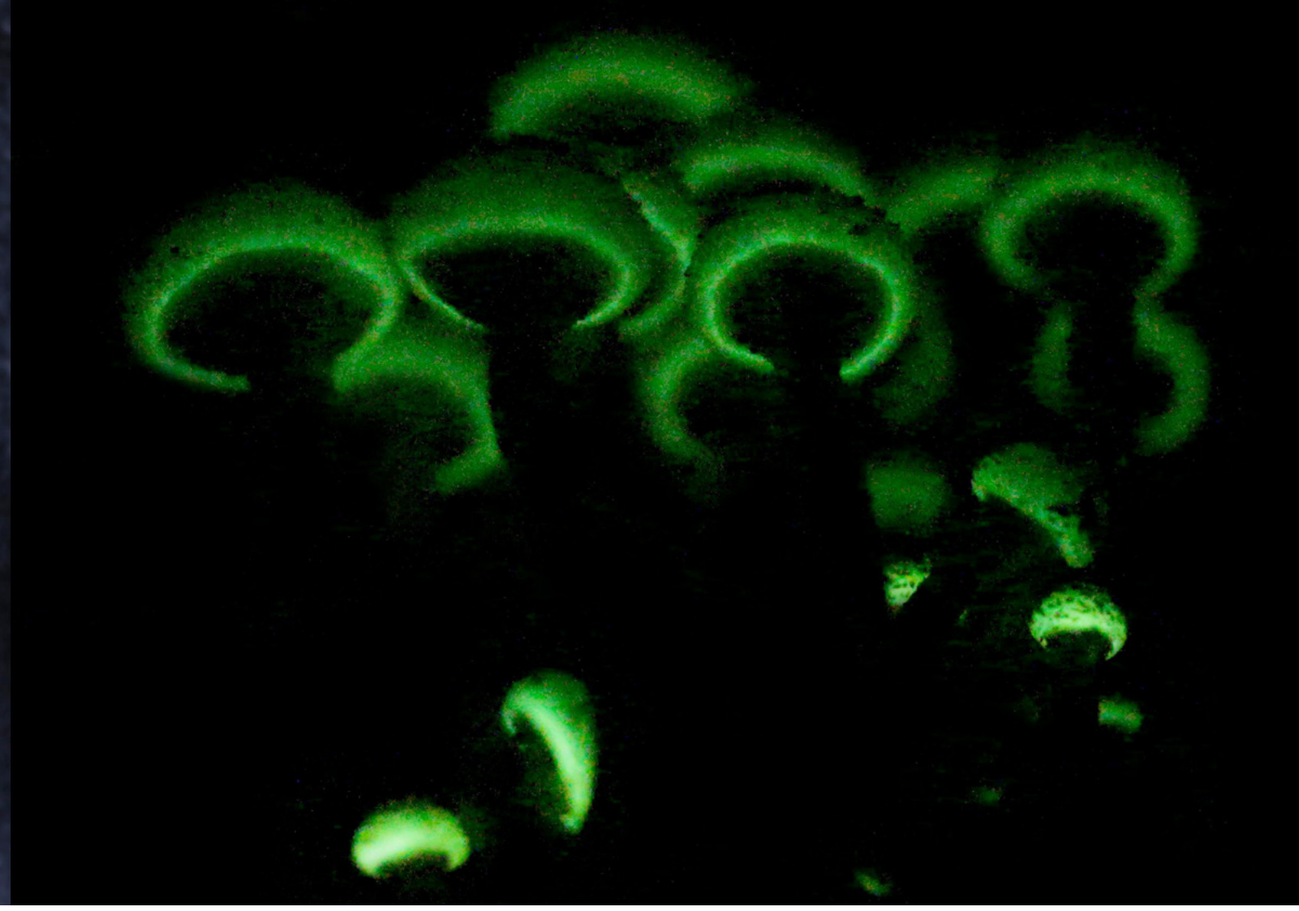
E ai ki ngā kōrero, arā ētahi o Ngāi Tūhoe kei te kohi tonu i tēnei kai i Te Urewera. Tērā pea ka taea anō hoki tēnei kai te āta whakatipu, ki te poro rākau, ki te maramara rākau rānei, hei 'kai nō te wao'. He neke atu i te kotahi ngā momo *Armillaria* i Aotearoa. Heoi anō, ko ētahi, pērā i te *Armillaria limonea*, he kawa, ka kapea e te arero. Kāore e mōhiotia ana ngā ingoa o ēnei huānga o te harore kāore nei i rite ki a ia te pai.

Me paku whakamarama ake i konei, e toru ngā tikanga o te kupu 'harore' – tuatahi ake, koia te ingoa o tēnei momo hekaheka kua kōrerotia ake nei. Tuarua, koia anō te kupu Māori mō te whānau hekaheka whai kakau, whai taupoki kikokiko, arā, mō te 'matiru'. Ā, kei te whakamahia anō hei kupu mō te karangatanga hekaheka whānui, mō te Mātāmuatanga Hekaheka, e ai ki ngā tikanga whakapapa o te pūtaiao Pākehā.

Te harore *Armillaria novae-zelandiae,* he kai tēnei hekaheka

The mushroom *Armillaria limonea* that lives on wood, here photographed using a flashlight

Te harore *Armillaria limonea* e piri ana ki te rākau; he mea whakaahua tēnei ki te rama kohiko.



The same *Armillaria limonea* mushrooms photographed in darkness using their own light (bioluminescence)

Ko aua harore *Armillaria limonea* anō, he mea whakaahua i te pōuriuri, nōna ake tōna hinātore.

bioluminescent. Bioluminescent mushrooms, however, have not been recorded for any other species of *Armillaria* elsewhere in the world, so this discovery in Aotearoa was unexpected.

In Tāne-mahuta, harore is not considered a seriously damaging parasite. But for some introduced crop plants, harore has been recorded as a disease-causing fungus. It can infect and kill pine tree seedlings when they are planted on land formerly covered by native forest. Harore also killed some early plantings of kiwifruit by attacking kiwifruit roots that grew close to infected roots of shelterbelt trees. Spores of harore first infected the exposed stumps of felled shelterbelt trees and then grew out through the dead roots to contact the living kiwifruit roots.

In Oregon, USA, a relative of harore called *Armillaria solidipes* has been found to be the largest living organism, far larger and older than a blue whale. See in section 'How do fungi move?'

MUSHROOMS THAT GLOW AT NIGHT

Recently, a photographer found that young mushrooms of harore glow weakly at night at the edge of the cap. It is not known why this happens, and why only some parts of the mushroom glow. Many fungi related to harore occur in other countries, but none of these relatives glow.

I kitea tuatahitia te hinātore o te harore (ka kīia he "bioluminescence" ki te reo Pākehā) i te tau 2015, e tētahi ringa kāmera ka huri haere i te ao ki te whakaahua hekaheka. Engari i mōhio noa atu pea ō tātou tūpuna. I ōna wā anō ka hinātore hoki te rākau kua pirau i te harore, i te mea he hinātore anō ngā pūhihi. Heoi anō, kāore e mōhiotia ana tētahi atu uri pūhana o te puninga *Armillaria*, huri i te ao. Nō reira, i āhua mīharotia te kitenga o te hinātore o te harore i Aotearoa.

Kāore te harore e kīia he pirinoa kino i a ia i te poho o Tāne, engari arā ētahi kai o tāwāhi kua kawea mai hei āta whakatipu, kua raru, kua wheori i te harore. Tērā ka pokea ngā punua paina e te harore ki te whakatōkia ki te whenua he ngahere māori i reira i mua, ā, tērā e mate aua punua rākau. I mate hoki i te harore ētahi o ngā huakiwi i whakatōkia tuatahitia ki Aotearoa – i ngaua e te harore ngā pakiaka o ngā huakiwi e pātata ana ki ngā pāhauhau paina kua ngaua ō rātou nā pakiaka e te harore. I urutomo atu ngā pua atua o te harore ki ngā pūtake o ngā paina o te pāhauhau i tuaina, ā, atu i reira ka toro atu mā ngā pakiaka mate o aua rākau ki ngā pakiaka ora o ngā huakiwi.

Tērā tētahi whanaunga o te harore kei Oregon, i Amerika, e noho ana, ko *Armillaria solidipes* te ingoa. E kīia ana koia te rauropi ora rahi katoa o te ao – he rahi noa ake, he kaumātua noa ake anō hoki i te tohorā kahurangi. Kei runga ake te roanga o ngā kōrero mō tēnei.

HE HARORE KA PŪHANA I TE PŌ

Tērā tētahi tangata hopu whakaahua i kitea e ia i nā tata nei he hīnātore tonu te nīao o ngā punua harore i te pō. Kāore e mōhiotia te take i pēnei ai, he aha rānei te take ko te tapa noa te mea ka hinātore. He whanaunga ō te harore i ētahi whenua anō o te ao, engari kāore tētahi e hinātore pērā i a ia.

POPLAR MUSHROOM

Agrocybe parasitica (te tawaka)

This large mushroom (up to dinner-plate size) grows on living tawa and other trees, often appearing high up on the tree trunk in late summer to autumn. The mushroom has a long stalk with a hanging skirt (see photo) that is coloured brown because it is coated with brown spores. When the mushroom was young in the button stage, this skirt was also attached to the edge of the cap covering the brown gills.

In addition to its use as a food, cooked tawaka was also considered to have medicinal benefit, being reportedly given to patients suffering fever and for health of expectant mothers. Tawaka was also given to invalids who were ". . . recovering from poisoning by karaka or tutu . . ." (Riley 1994: 137)

On the other hand, there was an alleged negative impact of those who had eaten tawaka and then entered a garden growing gourd plants, apparently causing gourds to decay or fail to mature. Fishing success was also reduced for those who had consumed tawaka (Best 1924: 432).

If you are interested in growing tawaka yourself, cultivation kits are currently available. Infected wooden dowels can be purchased for inoculation and growth of tawaka on poplar and plane tree logs - http://www.mushroomgourmet.co.nz/index.php/poplar-mushrooms

FLOWER FUNGUS

Aseroe rubra (te puapuatai)

Looks pretty; smells awful! This bright red fungus looks like a flower or maybe a starfish? It is found on the ground in Tāne-mahuta and probably was not eaten often. When fully formed, the red arms of puapuatai are covered at their base by a dark-coloured slime that smells like rotten meat – this fungus is one of the "stinkhorn" fungi. The slime attracts flies that feed on it and so spread the spores. It is likely that puapuatai was only eaten in its young egg-like stage before the "egg" hatches and the smelly red arms expand. See the photo of puapuatai on a NZ 90c stamp from 2004.

Today, puapuatai is not common, but a related red stinkhorn fungus has become common on mulch in home and public gardens. This also has red arms and a bad smell. It is not native to Aotearoa, however, and is probably not edible.

Left: Te tawaka, edible *Agrocybe parasitica* with a hanging skirt on the stalk

Right: Te puapuatai, a kind of stinkhorn fungus

QUESTION

Why do you think the fruitbody of this fungus, the puapuatai, is red and has long 'petals' or 'arms'?

TE TAWAKA

Agrocybe parasitica (poplar mushroom)

He hekaheka nui tēnei (ka tupu ētahi kia 'pereti-tina' te rahi) ka tupu ki ngā tawa ora me ētahi atu rākau. Kitea ai e toro tiketike mai ana i te kahiwi i te paunga o te raumati me te ngahuru. He roa te kakau, he 'panekoti' parauri anō tōna (tirohia te whakaahua). I parauri ai i te mea e kapi katoa ana i te pua atua parauri. I te wā e iti ana, e porotaka ana tōna taupoki, e hono kē ana te 'remu' o te panekoti ki te nīao o te taupoki, ā, ko ngā pihapiha parauri e noho huna mai ana ki roto.

Āpiti atu ki ōna painga hei kai, he rongoā te tawaka ina tunua. I whakamahia hei patu i te kirikā, hei hāpai anō i te hauora o ngā wāhine e hapū ana. I hoatu anō te tawaka ki ngā tūroro i paitinihia e te karaka, e te tutu rānei (Riley 1994).

Engari he taha kino anō tō te tawaka, e ai anō ki te kōrero. Ki te kai tawaka te tangata, kātahi ka tomo ia i te māra hue, ka pirau ngā hua o te hue. Ka hē anō ngā haere ki te hao, ki te hī ika – he iti te ika ka mau i te tangata kua kai i te tawaka (Best 1924: 432).

Mēnā e minamina ana koe ki te whakatipu tawaka māu, e taea ana te hoko kete whakatipu. Ka hokona he toko kua kuhuna ngā pua o te tawaka ki roto hei whakatō, hei whakatupu ki te poro rākau – ki te poplar, ki te plane rānei. Tirohia te http://www.mushroomgourmet.co.nz/index.php/poplar-mushrooms

TE PUAPUATAI

Aseroe rubra (flower fungus)

He ātaahua hei kai mā te mata. Engari ka aroha kē te haunga! He āhua rite te hanga o te hekaheka whero nei ki te putiputi, ki te pātangaroa rānei. Kei te papa o te ngahere e tipu ana, ā, kāore pea i kaha kainga e te tangata. Kia pakari, he hāwareware uriuri kei te pūtake o ia kawekawe – he rite te piro ki tō te kiko pirau. He uri hoki tēnei hekaheka nō te whānau pihi-haunga. He whakawai tā te hāwareware i te ngaro. Kai ana te ngaro i te hāwareware, riro ana koia te kaikawe i ōna pua atua ki tawhiti. Tērā pea i kainga te puapuatai e te tangata i te wā e pūhouhou ana, he hēki kē te hanga. Kia pao te hua, hei reira toro ai ōna kawekawe keha. Tirohia te whakaahua o te puapuatai kei te pane-kuīni 90 hēneti o Aotearoa i puta i te tau 2004.

Kāore e tino kitea te puapuatai i ēnei rā, engari e kitea nuitia ana tētahi o ōna uri tata, he hekaheka pihi-haunga whero anō, i ngā maramara rākau, otaota ka horahia ki te whenua i ngā māra tūmataiti, tūmatanui anō. He haunga anō ngā kawekawe whero o tērā. Engari ehara i te hekaheka taketake o Aotearoa, ā, kāore pea e kainga.

Mauī: Te tawaka, a *Agrocybe parasitica,* me tana panekoti e iri mai ana i tōna kakau

Matau: Te puapuatai, he momo pihi-haunga

HEI KŌRERO

Ki ōu nā whakaaro, he aha te take he whero, he roa hoki ngā kawekawe o te ropihua o te puapuatai?

BASKET FUNGUS

Ileodictyon cibarium (te matakupenga, te kōpurawhetū, te tūtaewhatitiri, te whareatua)

Once seen and smelt, this fungus is not forgotten! It is another stinkhorn fungus like puapuatai. It was collected by our ancestors when young and like an egg, but only the outer part was eaten. Later it opens to become like a white basket or net. A smelly slime on the inside of the net attracts flies that then spread the spores.

Our ancestors in different parts of Aotearoa had over 35 different names for this fungus, suggesting that it was well known. Some names like Tūtae-whatitiri refer to its apparent sudden appearance after thunder storms; Whatitiri is a name of our thunder god. In the South Island, Whareatua "house of the devil" was linked to its net-like appearance.

Above: Te kōpurawhetū

Right: Former children's climbing frame from Hagley Park, Christchurch

ACTIVITY:

If you find a basket fungus in good condition, hold your nose!, and blow up a round balloon inside the basket. Tie off the balloon, and let the basket dry against the balloon. Then pop and remove the balloon, and see if your friends can guess what your net-like hollow ball is.

WOOD EAR

Auricularia cornea (te hakeke, te hakeka)

Fruitbodies of hakeke grow on wood and look like a thin soft rubbery ear. There is no stalk or gills. Instead, the upper surface of the ear is hairy, and the spores form on the smooth lower surface. In Tāne-mahuta, hakeke is common on many different kinds of dead wood, like tawa and mahoe, and can be collected during spring, summer and autumn. When old it dries out and becomes hard. Its taste is … not much (!), though it does have a soft crunch when cooked and eaten. It was often cooked with vegetables and other foods to give it flavour.

Hakeke is the only fungus from Tāne-mahuta that has been collected and exported overseas. Our ancestors including women and children collected and dried it for the export "fungus trade" to China. It thus became an important source of income, especially from 1870 to 1900. From 1872–1883, almost 2,000 tons (dry-weight) was exported, an enormous amount considering that hakeke loses 90% of its fresh weight on drying.

Like tawaka, hakeke was also sometimes given to invalids who were ". . . recovering from poisoning by karaka or tutu . . ." (Riley 1994: 137). In Chinese and Asian medicine, hakeke has multiple uses including for colds and fevers, by reducing the heat of the body, and to strengthen blood vessels and the cardio-vascular system.

Forests in China also contain hakeke, and a method for cultivation was developed there on sawdust in bags. As a result, the export trade of hakeke from Aotearoa to China has been replaced by importation of hakeke from China and other Asian countries where it is now commercially cultivated. Today it is rarely collected in Tāne-mahuta, but is readily available in Aotearoa in Asian food shops.

Right: Te hakeke

ACTIVITY:

Look for this fungus for sale in dried form - in Asian supermarkets for example.

TE MATAKUPENGA, TE KŌPURAWHETŪ, TE TŪTAEWHATITIRI, TE WHAREATUA,

Ileodictyon cibarium (basket fungus)

Kia kite ngā whatu, kia rongo te ihu i tēnei hekaheka, e kore a ia e wareware! Koia anō tētahi o te whānau pihi-haunga, pērā i te puapuatai. I kohia e ngā tūpuna i te wā e pūhouhou ana, e hēki ana te hanga, engari ko te wāhi o waho anake i kainga. Ina waiho kia tipu tonu, ka puta ake ko te kupenga mā. He hāwareware keha kei te mata whakaroto o te kupenga, hei tō mai i te ngaro ki roto, ā, mā te ngaro e tītari haere ōna pua atua ki wīwī, ki wāwā.

E 35 neke atu ngā ingoa Māori puta noa i Aotearoa mō tēnei hekaheka, nō reira he momo i mōhio whānuitia. Ko ētahi ingoa, pērā i te tūtae-whatitiri, e tohu ana i tōna putanga ohorere mai i muri i te āwhā he uira, he whatitiri ōna hoa haere. I Te Waipounamu, ko te whareatua tētahi o ōna ingoa – ko te whare o te kino tōna whakamārama – e kōrero ana mō tōna hanga rite ki te kupenga.

Runga: Te kōpurawhetū

Matau: Taputapu pikipiki i Hagley Park, Ōtautahi

HE MAHI Ā-RINGA:

Ki te tūpono koe ki tētahi matakupenga pai nei te āhua, kinia tō ihu! Pupuhitia atu he hau ki tētahi poihau kua kuhuna ki roto i te matakupenga. Herea te kakī o te poihau. Werohia te poihau kia kore katoa te hau o roto, ka tango mai ai. Te tikanga kua porotaka te hanga o te matakupenga. Pātai atu ki ō hoa he aha te mea nei he rite nei tōna hanga ki te pōro kua mahia ki te kupenga.

TE HAKEKE, TE HAKEKA

Auricularia cornea (wood ear)

Kitea ai ngā ropihua o te hakeke e tipu ana i te rākau, he āhua rite ki te taringa angiangi, rapa nei te hanga. Kāore he kakau, kāore he pihapiha. He huruhuru kei te mata whakarunga o te taringa, ā, ko te mata momore i tōna taha raro te wāhi e tipu ai ngā pua atua. I te ao o Tāne, he maha ngā momo rākau mate ka tupuria e te hakeke – ko te tawa, ko te māhoe ētahi. Ka āhei te tangata te kohi hakeke mai i te kōanga ki te ngahuru. Kia roa e tipu ana, ka maroke, ka mārō. Ko tōna tāwara … kāore i pērā rawa te reka! Engari kia tunua, ka āhua pakapaka ina ngaua. I tunua tahitia ki ētahi huawhenua, ki ētahi atu kai, kia pai ai ki te korokoro.

Ko te hakeke anake te hekaheka o te ao a Tāne kua kohia, kua tukuna hoki hei taonga hoko ki tāwāhi. I āta kohia e ngā wāhine me ngā tamariki i tētahi takiwā i mua, ka whakamarokehia, kātahi ka hokona atu ki Haina. Nō reira he rawa i kohia e te Māori hei mahi moni māna. I tino pēnei mai i ngā 1870 tae noa ki te tau 1900. I ngā tau 1872–1883, he tata ki te 2,000 tana o te hakeke (kua oti te whakamaroke) i hokona ki tāwāhi. He inati tēnei rahi, ina whakaarohia ko tētahi 90% o te taumaha o te hakeke kātahi tonu ka katohia, ka ngaro i te whakamaroketanga.

Pērā anō i te tawaka, i mua rā he wā anō ka hoatu te hakeke ki ngā tūroro hei patu i te ngau kino o te karaka me te tutu. (Riley 1994). E ai ki ngā mātauranga whakaora o Haina me ētahi atu wāhi o Āhia, he maha ngā hua taha rongoā o te hakeke. E pai ana hei patu i te maremare, he pai hoki hei patu i te kirikā, he whakaheke i te werawera o te tinana, he pai hoki hei whakakaha i ngā ioio toto me te pūnaha ia-manawa.

Kei ngā ngahere anō o Haina tēnei mea te hakeke, ā, i kitea i reira he tikanga whakatipu i te hakeke ki te kotakota rākau e mau ana ki te pēke. Nā konā, ko te korenga o te hoko hakeke atu i Aotearoa ki Haina. Ko tātou kē kei te hoko hakeke mai i Haina me ētahi atu whenua o Āhia e whakatipu ana i tēnei hekaheka hei taonga hokohoko mā rātou. Kua kore i tino kohia i ngā ngahere o konei, engari e taea ana te hoko i ngā toa hoko kai Āhia.

HE MAHI Ā-KĀINGA:

E hokona ana te harore nei kua oti te whakamaroke i ētahi toa, pērā i ngā wharehoko kai Āhia. Tēnā haere ki te kimi.

Far left: Te pukurau, larger than a football – held by Graham Beever, son of the late Ross Beever (photographer)

Left: Te pukurau, a smaller kind of puffball

Taha mauī: He pukurau nui atu i te whutupōro – ko Graham Beever tēnei, tamaiti a te kaitango whakaahua, a Ross Beever

Mauī: Tētahi momo pukurau iti

PUFFBALLS

eg. Lycoperdon utriforme and Calvatia gigantea (te pukurau)

There are different kinds of pukurau, some growing in Tāne-mahuta and others on farmland. Their hyphae feed on plant matter in the soil. When the moisture and temperature is right, the puffball fruitbody grows rapidly above the soil surface – sometimes up to a very large size (see photo). Edible kinds were eaten when young and firm, and when the inside of the puffball is white. Later, the inside part softens and turns brown and powdery as thousands of spores develop. The spores are spread in the wind after being puffed out of the puffball by the impact of raindrops or an animal.

Pukurau were also used by our ancestors in medicine, for example to stop bleeding from wounds and for pain relief from scalds and burns. Pukurau grows widely in Aotearoa, but may have been especially common around the Tukituki River in Hawke's Bay. The name of the Hawke's Bay town Waipukurau is linked to the fungus pukurau. Tīpuna tell of pukurau growing on a nearby hill pā. These were collected and taken to a pool known as Te Waipukurau-a-Ruakūhā to soften or treat the flesh.

ACTIVITY:

Look carefully on farmland in autumn for the large football-sized puffballs. They grow to a large size rather quickly.

TE PUKURAU

eg. Lycoperdon utriforme and Calvatia gigantea (puffballs)

He maha ngā momo pukurau. Ko ētahi kei te wao a Tāne e tipu ana, ko ētahi kei ngā papa ahuwhenua. Kai ai ngā pūhihi i ngā maramara otaota kei te oneone. Kia rite te haukū me te paemahana, ka tere tipu te ropihua o te pukurau ki runga ake o te whenua. Ko ētahi ka tino kaitā (tirohia te whakaahua). Ko ngā mea pai hei kai, i kainga i te wā e pūhouhou ana, e mārō ana, ko roto o tōna puku e mā tonu ana te tae. Kia roa e tipu ana, ka ngohe a roto, ka parauri, ka hungahunga, i te pakari haeretanga o ngā pua atua manotini. Ko te pā noa atu o te pata ua, o te kararehe, ko te puhanga mai o ngā pua atua, waiho ana mā te hau e kawe ki hea, ki hea.

He rongoā anō te pukurau i neherā. I pai hei haukoti i te rere o te toto i ngā tūnga, i pai hei patu i te mamae i te weranga o te kiri i te wai wera, i te ahi rānei. Kei te motu whānui tēnei o ngā hekaheka e tipu ana, engari ko te takiwā kei te awa o Tukituki i Te Matau a Māui, koia pea tētahi wāhi i kaha ai te tipu. He hononga tō te ingoa o te tāone o Waipukurau ki te hekaheka nei, ki te pukurau. He kōrero tā ngā tīpuna mō ngā pukurau e tipu ana ki tētahi puke ki reira. Kohia ai ēnei hekaheka, mauria ai ki tētahi hōpua wai i karangatia ko Te Waipukurau-a-Ruakūhā, kia ngohe ai, kia pai ai hei whakamahi.

HE MAHI Ā-TAIAO:

I te ngahuru, kitea ai ngā pukurau rite pea ki te whutupōro te rahi i ngā pāmu. Me puta anō pea ki te kimi i ētahi. He tere te tipu o te pukurau.

FUNGUS ICICLES

Hericium coralloides (te pekepekekiore)

Pekepekekiore has soft and fragile fruitbodies that look like hanging coral or icicles. They were featured on a NZ $1.30 stamp in 2004. This fungus feeds on dead wood, and its fruitbodies form only on softened, well-rotted trees. There are few reports of our ancestors eating pekepekekiore, but a closely related fungus in Asia is widely eaten. *Hericium erinaceus* is a delicious and popular mushroom grown on sawdust in several Asian countries. Small trials have recently started in Hawke's Bay to cultivate pekepekekiore for restaurants.

Above: Te pekepekekiore
Right: Te pekepekekiore
Far right: Te angiangi

ACTIVITY:
Look for this delicate fungus, the pekepekekiore, especially in large, old rotten logs in the forest.

USNEA SPECIES

te angiangi, te hawa

A number of lichens (fungi) and mosses (plants) were collected by our ancestors for use as a soft covering for wounds and to stop bleeding. Angiangi and hawa are names that may refer to several different kinds of lichens and mosses found in Tāne-mahuta. A lichen is a fungus that has partnered with tiny cells of algae; the fungus gives a home to these plant cells that can use light to produce sugars for use by both the algae and the fungus. So lichens can live in harsh places, even on concrete footpaths, fence posts, and roads, where neither the fungus nor the algae could live on their own. Mosses are not fungi at all; they are plants.

ACTIVITY:
Look for lichens on fence posts, power poles, and even on the footpath and road. Lichens can occur even in these harsh environments, but the angiangi is only found in forests

TE PEKEPEKEKIORE

Hericium coralloides (fungus icicles)

He ngohe, he kōpīpī ngā ropihua o te pekepekekiore. Ko te āhua ki te titiro atu, he wheo tautau, he tiotau rānei. I whakaahuatia mō te pane-kuīni NZ $1.30 i te tau 2004. Kai ai tēnei hekaheka i te rākau mate, ā, ka tipu ōna ropihua ki ngā rākau kua tino pirau, kua ngohe. Arā ētahi kōrero ruarua mō te kai a ngā tūpuna i te pekepekekiore. Arā hoki tētahi o ōna uri tata i Āhia e kainga nuitia ana. Ko te *Hericium erinaceus* tētahi harore tino reka, e manako nuitia ana e te tangata, e whakatipuria ana ki te pēke kotakota rākau i ētahi whenua maha o Āhia. Kua tīmata ētahi whakamātauranga iti i Te Matau a Māui ki te whakatipu i te pekepekekiore hei hoko ki ngā wharekai.

Runga: Te pekepekekiore
Matau: Te pekepekekiore
Taha matau: Te angiangi

HE MAHI Ā-TAIAO:
Rapua tēnei hekaheka, te pekepekekiore, i ngā kahiwi o ngā rākau kua pirau, kua takoto ki te papa i te ngahere

TE ANGIANGI, TE HAWA

Usnea species

Arā ētahi momo pukoko (he hekaheka) me ētahi pūkohu (he tipu) i kohia e ngā tūpuna hei uhi ngohe mō ngā tūnga, hei haukoti anō hoki i te rere o te toto. Tērā pea ko te angiangi me te hawa, he ingoa mō ētahi momo pukoko maha kei te wao o Tāne. Ko te pukoko, he hekaheka kua takahoa atu ki ngā pūtau mōkitokito o tētahi kapoke; ko tā te hekaheka, he noho hei kāinga mō ngā pūtau o te kapoke. Ka kapohia e aua pūtau kapoke te pūngao o te aho hei mahi huka (mā te mahi ahotakakame), hei kai mā rāua tahi – mā te kapoke, mā te hekaheka anō. Nō reira ka ora tonu te pukoko i ngā wāhi noho kino – i te ara raima, i te pou o te taiapa, i te ara, i ngā wāhi ka hemo ko te hekaheka me te kapoke ki te kore rāua e piri tahi. Ehara te pūkohu i te hekaheka – he momo tipu kē te pūkohu.

HE MAHI Ā-TAIAO:
Kimihia ngā pukoko e piri ana ki ngā pou taiapa me ngā pou hiko, ki te ara hīkoi, ki te huarahi anō. Arā ētahi pukoko ka tupu i ngā taiao maha, tae atu ki ngā taiao kino, engari ko tēnei momo, te angiangi, ko te ngahere anake tōna kāinga noho.

4

Fungi-infected wood for

WOOD CARVING

TŌTARA WOOD

Infected by Inonotus lloydii

Tōtara is a tree of great importance including for building waka and for carving. Kaikākā refers to totara heartwood in the centre of old trees that has been decayed by one kind of fungus. The fungus, *Inonotus lloydii*, rots parts of the wood to form narrow honeycomb-like pockets, giving rise to an attractive effect in carvings. The decay weakens the affected wood and reduces its value for waka or building, but kaikākā wood can still be used for carvings and for fence posts. When reproducing, the fungus forms bracket-shaped fruitbodies on totara trunks.

RESEARCH:

Look out for examples of carved totara wood, maybe in the wharenui, that has a honeycomb-like pattern - caused by a wood decay fungus when the tree was alive. Does the kaikākā enhance the carving?

Te kaikākā. This type of decay makes an attractive pattern for wood turning and carving

4

Ngā rākau kua whakanikohia e te hekaheka, ka whakamahia mō ngā

MAHI WHAKAIRO, TĀRAI TAONGA

TE KAIKĀKĀ, TE MATAKUPENGA

te kiko o te tōtara kua tomokia e te Inonotus lloydii

He rākau tino whaitake te tōtara. He rākau pai mō te tārai waka, hei whakairo anō. Ko te kupu kaikākā, e whakaahua ana i te taikākā o te tōtara kua tino roa e tū ana, kua kaumātua, kua pirau haere i te ngau a tētahi momo hekaheka. Ko te *Inonotus lloydii* te ingoa Rātini o te hekaheka nei, ka pirau i a ia ētahi wāhi iti o te rākau, e oti mai ai he tauira e hiahiatia e te kaiwhakairo. Ko te matakupenga te ingoa mō te tōtara kua pēnei tōna āhua. Ka iti ake te kaha o te rākau i tēnei pirau, nō reira kāore i tino pai hei hanga waka, hei hanga whare rānei, engari ka pai tonu hei mahi whakairo, hei tārai taonga, hei hanga pou mō te taiapa. Ina whakaputa uri te hekaheka, ka kitea ōna ropihua e toro whakawaho ana i te kahiwi o te tōtara.

HE MAHI Ā-KĀINGA:

Kimihia ētahi tauira o te tōtara kua whakairohia (i te wharenui pea), he matakupenga tōna āhua. Nā tētahi hekaheka whaka-pirau i te kiko o te rākau i te wā e ora ana i pērā ai tōna āhua. Ki ōu nā whakaaro, he whakanikoniko tā te kaikākā i te āhua o te rākau, he pēhea kē rānei?

Te kaikākā – he tōtara kua pirau haere, e kitea ai te matakupenga. He pai mō te whakairo me te tārai taonga

5 Fungi in KŌRERO AND WHAKATAUKĪ

The following mushroom was not used for a special purpose but was known to our ancestors for other reasons including Kōrero and Whakataukī:

SKY BLUE MUSHROOM

Entoloma hochstetteri (te werewere-kōkako)

This mushroom is always a prize for the eyes, and the camera, on any bushwalk where its bright blue colour stands out against the greens and browns of Tāne-mahuta. It develops on the forest floor, from its feeding stage of hyphae that grow on or in leaves and other plant material in the soil. Autumn is the best time to see this mushroom, but you need luck on your side. While the mushroom is blue, the spores that form on the gills are pink; you can see this if you make a "spore print" (see making a spore print in Activities). The spores are spread by the wind.

Have you seen a picture of this mushroom on our Aotearoa banknotes and stamps? Check out the Tūhoe kōrero in pictures on our $50 note, explaining how the kōkako bird gets its bright blue colour on its cheek. According to the kōrero, the kōkako rubs its cheek against werewere-kōkako to get the blue colour. Our $50 banknote is the only banknote in the world to include a picture of a mushroom. It has just been entered in the world competition for the 2016 "Banknote of the Year Award". Werewere-kōkako was also on a 2004 NZ 80c stamp.

Left: Sky blue mushroom
Mauī: Te werewere-kōkako

5 Te hekaheka i roto i ngā KŌRERO ME NGĀ WHAKATAUKĪ

E ai ki ngā mōhio, kāore he painga ki te tangata, taha tinana nei, o ēnei harore e whai ake nei. Engari i uru tonu ki ngā kōrero, ki ngā whakataukī:

TE WEREWERE-KŌKAKO

Entoloma hochstetteri (sky blue mushroom)

Kātahi te kai mā te mata, mā te kāmera, ko tēnei harore. Kitea ai pea i a koe e hīkoi ana i te wao, hahae ana tōna kikorangi kitakita, ko ngā kākāriki me ngā parauri o Tānemahuta hei tuarongo. Kei te papa e tipu ana, ko ōna torohihi kei ngā rau me ērā atu otaota pōpopo kei te oneone. Ko te ngahuru te tino wā e pihi ake ai tōna ropihua kikorangi, engari he waimarie te tangata ka kai atu ōna mata i a ia. I te wā e kahurangi ana te harore, he māwhero kē ngā pua atua e tipu ana i ōna pihapiha. Ki te mahia he 'tānga pua atua' (kei tua ake ngā kōrero mō tēnei Hei Mahi), hei reira kitea ai. He puananī ngā pua, arā, ko te hau te kaikawe.

Āe rānei kua kite koe i te harore nei i ngā tāra me ngā pane-kuīni o Aotearoa? He kōrero tā Tūhoe mō te werewere-kōkako, e whakaataria ana ki te tāra $50. E ai ki taua kōrero, ko te kahurangi o ngā werewere o te kōkako, nō te harore nei. Ka mukumuku te kōkako i tōna pāpāringa ki te werewere-kōkako, kikorangi tonu atu ōna werewere. Ko tā tātou tāra $50 anake te tāra puta noa i te ao he harore kei runga. Kua whakaurua hoki te tāra nei ki te whakataetae mō te "Tino Tāra o te Ao" 2016. I whai wāhi anō te autaia werewere-kōkako nei ki tētahi pane-kuīni 80 hēneti o Aotearoa i te tau 2004.

Left: NZ$50 banknote (2016 design) with the Tūhoe story of the werewere-kōkako and kōkako in Pureora Forest
Above: 2004 set of 6 fungi stamps

Mauī: He tāra $50 nō te tau 2016, e whakaahua ana i te kōrero a Tūhoe mō te kōkako me te werewere-kōkako i te ngahere i Pureora.
Runga: He huinga pane-kuīni he whakaahua hekaheka kei runga, nō te tau 2004

6 Fungi as

FOOD FOR KERERŪ

CYTTARIA SPECIES
(beech strawberry)

Our ancestors will likely have seen this fungus in beech forest during spring while hunting kererū. The fungus grows on branches of living beech trees, causing the affected branch to become deformed and form odd-shaped lumps (called galls). On these galls during spring the fungus forms lots of strawberry or golfball-shaped fruitbodies that produce spores for dispersal by wind. Maybe the fungus is also spread by birds as these "strawberries" are a popular food for kererū. The Māori name for *Cyttaria* is not known. Maybe you could ask if any kaumatua know? In South America, related *Cyttaria* fungi there are collected as a traditional food by Indian people.

ACTIVITY:
Ask a kaumātua if there is a Māori name that refers to the shapes of this fungus

The name of this fungus is not known in Māori. The fungus forms on galls on branches often high up in native beech trees.

6 Te hekaheka hei

KAI MĀ TE KERERŪ

HE MOMO *CYTTARIA*
(beech strawberry)

Ko te tikanga i kite ō tātou tūpuna i te hekaheka nei i ngā ngahere tawai i te kōanga, i a rātou e mahi kererū ana. Ka tipu te hanga porotaka nei ki ngā manga o te tawai, me te aha, ka hē te āhua o te tipu o te rākau, ka puta ētahi pukuwhenewhene ki tōna mata. Ā, i te kōanga, ka tipu ake ngā ropihua maha o te hekaheka nei ki aua pukuwhenewhene. He rite te hanga ki tō te poi haupōro. He whakaputa pua atua ngā ropihua, ā, ka riro anō mā te hau ngā pua e kawe haere ki te kimi kāinga hou. He tino kai tēnei nā te kererū, nō reira tērā tonu pea ko te kererū anō tētahi kaitītari i te hekaheka nei. Kāore e mōhiotia ana te ingoa Māori mō te whānau nei, o *Cyttaria*. Me ui atu pea ō kaumātua, me he ingoa Māori i rongo rā rātou e whakahuatia ana mō te hanga nei. I Amerika ki te Tonga, mai rā anō he kohikohi tā ngā tāngata whenua i ētahi hekaheka *Cyttaria* o reira hei kai mā rātou.

HEI MAHI:
Me ui atu pea ō kaumātua, me he ingoa Māori i rongo rā rātou e whakahuatia ana mō te hanga nei.

Kāore e mōhiotia ana te ingoa Māori o tēnei hekaheka. Ka tupu ki ngā pukuwhenewhene i ngā peka teitei o te tawai.

GENERAL INFORMATION ABOUT FUNGI

Fungi were used as an indicator of the coming season. Our ancestors considered that when harore was common a lean season would follow, when other foods such as birds and vegetables would be scarce.

People who only made a small effort were called *'he harore rangitahi'* (a mushroom that only lasted a day).

'Tēnei taku waka te waiho hei poupou harore' is translated as "This is my canoe left as a post of fungus" This whakataukī refers to the role of fungi in wood decay (Brougham & Reed 1987).

A CHANT (Taylor c. 1848)

Who will consume the mushroom

Who will consume the mushroom

Who will consume the fruit of the tawa

Who will consume the fruit of the tawa

Who will consume the hinau the food of the rat

My consuming mouth

My consuming mouth

My mouth that consumes the sweet potato of Whakatete

Tuwhare will tell of its taste

Returning to Parikanihi

Sitting above, on the wharawhara plant

A SONG ABOUT FAMINE

What, what shall we eat?

Wood ear fungus

that clings to the karaka

or, convolvulus

that stretches over the land?

Who will dig the convolvulus

in the winter?

Te kōrero whānui

MŌ NGĀ HEKAHEKA

Ko ngā hekaheka tētahi waitohu o te āhua o te tau, o te kaupeka e heke mai ana. E ai ki ngā tūpuna, mēnā i nui te hua o te hekaheka, o te harore, he tau tūpuhi ka whai i muri mai, e iti ai ērā kai pērā i te manu, i te huawhenua.

'He harore rangitahi': Kīia ai ngā tāngata kore take ki te mahi, he 'harore rangitahi' (Keane 2007).
Arā, kotahi rā noa pea e mahi ana, e whaihua ana te mahi, kua pau te hau.

'Tēnei taku waka te waiho hei poupou harore': E mea ana tēnei whakataukī 'kua riro taku waka hei kai mā te harore', ā, e kōrero ana mō te wāhi nui ki te harore i roto i ngā mahi whakapopo, whakapirau rākau (Brougham & Reed 1987).

HE NGERI (Taylor c. 1848)

Mā wai e kai te harore,

Mā wai e kai te harore,

Mā wai e kai te tawa puta,

Mā wai e kai te tawa puta,

Mā wai e kai te hīnau te kame a te kiore,

Taku waha kai kai,

Taku waha kai kai,

Taku waha kai kūmara whakahoro o Whakatete,

Ka puta te rongo i a Tuwhare,

Auraki kau ake ki Parikanihi,

Kei runga, kei te wharawhara, kei te noho.

HE TAU MO TE KAI-KORE

He aha he kai mā tāua?

He hakekeke,

piri ki te karaka

ā, he pōhue,

toro ki te whenua;

Mā wai e keri

i te makariri

SOME FUNGI OF IMPORTANCE TO MĀORI

English name	Latin name	Use
vegetable caterpillar	*Ophiocordyceps robertsii*	black pigment for tattooing
honey mushroom	*Armillaria novae-zelandiae*	food
poplar mushroom	*Agrocybe parasitica*	food
flower fungus/stinkhorn	*Aseroe rubra*	food
basket fungus	*Ileodictyon cibarium*	food
wood ear	*Auricularia cornea*	food
puffballs	*Lycoperdon utriforme, Calvatia gigantea*	food
fungus icicles	*Hericium coralloides*	food
lichens	*Usnea* species	treating wounds
a bracket fungus	*Laetiporus portentosus*	starting and carrying fire; treating wounds
kaikok	Tōtara wood infected by *Inonotus lloydii*	wood carving
sky blue mushroom	*Entoloma hochstetteri*	story
beech strawberry	*Cyttaria* species	fungal food for kererū

ĒTAHI HEKAHEKA NUI KI TE MĀORI

Ingoa Māori	Ingoa Rātini	Mahinga
āwheto	*Ophiocordyceps robertsii*	he waingārahu tā moko
harore	*Armillaria novae-zelandiae*	he kai
tawaka	*Agrocybe parasitica*	he kai
puapuatai	*Aseroe rubra*	he kai
matakupenga, kōpurawhetū, whareatua, tūtae-whatitiri	*Ileodictyon cibarium*	he kai
hakeke, hakeka	*Auricularia cornea*	he kai
pukurau, tūtae atua	*Lycoperdon utriforme, Calvatia gigantea*	he kai
pekepekekiore	*Hericium coralloides*	he kai
angiangi, hawa	*Usnea* species	hei rongoā tūnga
pūtawa, puku tawai	*Laetiporus portentosus*	hei tutungi ahi, hei kawe ahi, hei rongoā tūnga
kaikākā, matakupenga	Tōtara wood infected by *Inonotus lloydii*	he rākau whakairo
werewere-kōkako	*Entoloma hochstetteri*	he puna kōrero
kāore e mōhiotia ana	*Cyttaria* species	he kai mā te kererū

KUPUTAKA/ GLOSSARY

KŌRERO MĀORI	KŌRERO PĀKEHA
Aho	Light
Ahotakakame	Photosynthesis
Anuhe	Caterpillar
Ara raima	Concrete path
Hapori	Colony
Harore	Mushroom(s)
Hau takiwā	Atmosphere
Hauhā	Carbon dioxide
Haumaru-koiora	Biosecurity
Haurehu	Gas
Hāwareware	Slime
Hekaheka	Fungi
Here pūtu	Bootlaces
Hiako	Bark
Hīnatore	Luminescence
Hōtoke	Winter
Hungahunga	Powder
Īhi	Yeast
Kahiwi	Trunk
Kaikākā	Tōtara heartwood decayed by fungus
Kaitītari	Carrier
Kakau	Stalk
Kāmera	Camera
Kapoke	Algae
Karu whakarahi	Microscope
Kauoro	Grind

KŌRERO MĀORI	KŌRERO PĀKEHA
Kaupeka o te tau	Season
Kawekawe	Arms or tentacles
Keha	Smelly
Kihikihi	Cicada
Kīrehe	Animal
Kōanga	Spring
Kōpīpī	Fragile
Māmaiti	Marmite
Manga	Bough/branch
Mōkitokito	Microscopic
Momo	Species
Momore	Smooth
Moroiti	Microbe/ micro-organism
Mura	Flame
Ngahuru	Autumn
Ngakunga	Strips
Nīao	Edge
Oneone	Soil
Otaota	Grasses and small plants
Pae porowhita	Petri dish
Paemahana	Temperature
Paitini	Poison
Pakiaka	Roots (of trees)
Pane o te pine tui kaka	Pin-head
Pane-kuini	Postage stamp
Pata wai	Water droplet

KŌRERO MĀORI	KŌRERO PĀKEHA
Pātangaroa	Starfish
Paturopi	Antibiotic
Pēke kotakota rākau	Bag of sawdust
Pepeke	Insects
Pereti-tina	Dinner plate
Pia whakatipu	Agar culture medium, a jelly like substance
Pihapiha	Gills
Pihi-haunga	Stinkhorn
Poi haupōro	Golf Ball
Popō	Smoulder
Pōpopo	Decay
Pua atua	Spores
Puananī	Wind-dispersed
Pūhana	Glow
Pūhouhou	Juvenile
Pūkahukahu	Lungs
Pūkohu	Moss (plants)
Pukoko	Lichen
Pukuwhenewhene	Galls (lumps)
Puna koiora puiaki	Biodiversity-rich resource
Puruhekaheka	Mould
Pūtau	Cell
Rama	Torch
Ranea	Abundant
Rapa	Rubber
Raumati	Summer
Remu	Hem
Ropihua	Fruitbody
Taikākā	Heartwood
Taiora	Nutrients
Takurua	Winter
Tānga pua atua	Spore print

KŌRERO MĀORI	KŌRERO PĀKEHA
Tanu	Bury
Taupoki	Cap
Tāwara	Taste
Tāwariwari	Flexible
Tinaku	Germinate
Tiotau	Icicle
Tipu	Plant
Tītari	Distribute
Titi here tēneti	Tent pegs
Torohihi	Hyphae
Tuku mate	Disease-causing
Tūnga	Wounds
Tutungi	Tinder, firelighter
Uriuri	Dark-coloured
Whakapiki	Leaven (bread)
Wheo tautau	Hanging coral

ACTIVITIES

QUESTIONS ABOUT FUNGI

Find the answers to these questions using the Hekaheka text resource

ALL ABOUT FUNGI

1. What are two reasons why most fungi are difficult to see?
2. What is one major biological function carried out by plants but not fungi?
3. What is one major feature of animals not shared by fungi?
4. What are the names of the three main types of structures formed by fungi?
5. How do fungi find their food?
6. By means of what can we see fungal spores?
7. Why is the cap of the common mushroom shaped as it is?
8. What kind of place makes a good home for fungi?
9. Which season is best for seeing native fungi growing vigorously on the forest floor?
10. What are three kinds of native forest tree around AND IN whose roots fungi often grow?
11. How do fungi help trees by growing within and around their roots?
12. What is one kind of biological relationship between fungi, plants and animals in the forest?
13. Why is yeast used in making bread?
14. What is the purpose of biosecurity?
15. What is one agricultural problem caused by fungi in Aotearoa?

MĀORI KNOWLEDGE AND USES OF FUNGI

16. Which kind of fungus can be used to make black pigment for tattooing?
17. What does the āwheto feed on?
18. To see the āwheto what should you look for, where and when?
19. How can black pigment be made from āwheto?
20. Which kind of fungus can be used to store and carry fire?
21. What does the pūtawa feed on?
22. What does the pūtawa look like and where does it live?
23. How can the pūtawa be used to store and carry fire?
24. Which structure of the harore do we eat?
25. Several kinds of fungi are useful for injured people for putting around what?
26. What is a remarkable feature of young harore fruitbodies visible only at night?
27. Which type of fungus looks like a flower?
28. The puapuatai and the matakupenga belong to which family of fungi?
29. Suggest why there are many Māori names known for the matakupenga fungus?
30. Which fungus has a fruitbody shaped like an ear?
31. Where does the hakeke grow?
32. How does the pukurau release its spores?
33. What does the fruitbody of the pekepekekiore look like?
34. How do fungi and algae grow together as lichens and why?
35. Explain the meaning of the word ‘kaikākā’ and the role played by the fungus?
36. Where does the name of the ‘werewere-kōkako’ come from?

HEI MAHI

HE PĀTAI MŌ TE HEKAHEKA

Rapua ngā whakautu ki ēnei pātai i roto i te rauemi mō te Hekaheka

TĒNEI MEA TE HEKAHEKA

1. He aha ētahi take e rua he uaua te kite i te nuinga o ngā hekaheka?
2. He aha tētahi tino mahi koiora a te tipu e kore e taea e te hekaheka?
3. He aha ētahi tino āhuatanga o te kīrehe kāore i rite ki ō te hekaheka?
4. He aha ngā hanga/wāhanga matua e toru o tēnei mea te hekaheka?
5. Me pēhea te hekaheka e kimi kai ai māna?
6. Mā pēhea e kitea ai te pua atua o te hekaheka?
7. Mō te harore e mōhio nuitia ana, he aha te take e pērā ana te āhua o tōna taupoki?
8. He pēhea te āhua o te kāinga noho pai ki te hekaheka?
9. Ko tēhea kaupeka o te tau te wā pai mō te kite i ngā hekaheka māori e tupu kaha ana ki te papa o te ngahere?
10. He aha ētahi momo rākau e toru o te ngahere māori he kaha te tupu o te hekaheka ki ngā pakiaka, i te oneone rānei e pātata ana ki ngā pakiaka?
11. He pēhea te āwhina a te hekaheka i te rākau, mā te noho pātata atu, ki roto tonu rānei i ōna pakiaka?
12. He aha tētahi hononga koiora i waenganui i ngā hekaheka, ngā tipu me ngā kīrehe o te ngahere?
13. He aha te mahi a te īhi i te mahi parāoa?
14. Hei aha te haumaru-koiora?
15. He aha tētahi pānga kino ki te ahuwhenua e takea mai ana i te hekaheka i Aotearoa nei?

NGĀ MĀTAURANGA ME TE WHAKAMAHI A TE MĀORI I NGA HEKAHEKA

16. Ko tēhea te hekaheka i whakamahia hei wai pango mō te tā moko?
17. He aha te kai a te āwheto?
18. Kia kitea ai te āwheto, me rapu i te aha, ki hea, ā, mō āhea rapua ai?
19. I pēhea te mahi mai i te wai pango mai i te āwheto?
20. Ko tēhea te hekaheka i whakamahia hei pupuri, hei kawe i te ahi?
21. He aha te kai a te pūtawa?
22. He pēhea te āhua o te pūtawa? Ka noho ia ki hea?
23. I pēhea te whakamahi i te pūtawa hei pupuri, hei kawe i te ahi?
24. Ko tēhea wāhanga o te harore ka kainga e te tangata?
25. Ina whara te tangata, he pai ētahi momo hekaheka hei karapoti i te aha?
26. He aha tētahi āhua whakamīharo o te harore ka kitea i te pō?
27. He aha te hekaheka e rite ana ki te putiputi te āhua?
28. Nō tēhea whānau hekaheka te puapuatai me te matakupenga?
29. He aha pea te take he nui ngā ingoa Māori tūturu mō te matakupenga?
30. Ko tēhea te hekaheka he rite ki te taringa te āhua o te ropihua?
31. Ko hea te wāhi tupu o te hakeke?
32. Ka pēhea tā te pukurau tuku i ōna pua atua?
33. He pēhea te āhua o te ropihua o te pekepekekiore?
34. He pēhea te āhua o te tupu tahi a te hekaheka me te kapoke hei pukoko? He aha hoki te take ka pēnei tā rāua tupu tahi/piri tahi?
35. Whakaahuatia te tikanga o te kupu ‘kaikākā’. He aha te wāhi ki te hekaheka?
36. E ahu mai ana te ingoa o te ‘werewere-kōkako’ i te aha?

ACTIVITIES

QUESTIONS ABOUT FUNGI

Answers

ALL ABOUT FUNGI

1. Because some are microscopically small, and others are hidden within their habitats.
2. The ability to make their own food using the sun's rays and carbon dioxide in the atmosphere.
3. The ability to move around to find their food.
4. Hyphae, fruitbodies and spores.
5. By growing hyphae or by releasing spores to be carried to somewhere else.
6. By using a microscope, or by making a spore print.
7. So raindrops flow off it, to shelter the spores underneath from getting wet.
8. A moist place where there is food available.
9. Autumn.
10. Mānuka, kānuka and beech.
11. By capturing water and minerals from the soil.
12. Food webs.
13. To leaven the bread so it is light and soft.
14. To provide a barrier so no harmful animals, plants, fungi, or micro-organisms enter Aotearoa.
15. Damaging vegetable crops such as kūmara and potato.

MĀORI KNOWLEDGE AND USES OF FUNGI

16. Āwheto.
17. The caterpillar of two native moths.
18. On the forest floor in the autumn, look for a small brown 'stick'-like structure growing up from the soil.
19. Lots of āwheto and hosts were collected, burnt in the fire, then ground into a black powdery substance. This was mixed with bird fat to make the pigment for tattooing.
20. Pūtawa.
21. The wood of a living beech tree.
22. It is shaped like a plate or shelf and it grows outward from the trunk of the beech tree.
23. If it is set alight when dry, it smoulders for a long time and can be left until needed, or carried to another place to make a new fire.
24. The fruitbody.
25. To dress wounds.
26. They produce a weak glow of light (bioluminescence).
27. Puapuatai.
28. The stinkhorn family.
29. It was a well-known species and to the old people it was a sign of storms and acts of the gods.
30. Hakeke.
31. Dead trees in the forest.
32. The ball-shaped fruitbody has a hole at the top and when impacted by a raindrop (or an animal) some spores are released to fly away on the wind. In some puffball species, the fruitbody explodes or breaks open to release its spores.
33. It is beautiful and white and shaped like a hanging coral or an icicle.
34. In a lichen, the fungus acts as a home for the cells of the algae, which make sugar by photosynthesis to feed and nourish them both.
35. Kaikākā is the term used for totara wood that has been infected by a type of fungus. It causes the wood to become softer and produces a pattern effect in the wood, so is valued for carving.
36. From the colour of its fruitbody, which is a bright blue like that of the wattles of the kōkako.

HEI MAHI

HE PĀTAI MŌ TE HEKAHEKA

Ngā whakautu

TĒNEI MEA TE HEKAHEKA

1. Nā te mea he tino moroiti ētahi, kei te noho huna rānei ki ō rātou kāinga noho.
2. Te hanga i āna ake kai mā te aho o Tamanuiterā me te hauhā o te hau takiwā.
3. Te neke haere ki te kimi kai māna.
4. Te torohihi, te ropihua me te pua atua.
5. Mā te tuku torohihi rānei, te tuku pua atua rānei kia rere ki wāhi kē.
6. Mā te karu whakarahi rānei, mā te tānga pua atua rānei.
7. Kia kore ai e mākū ngā pua atua e noho marumaru ana ki raro – kia rere atu ai ngā pata ua.
8. He wāhi haukū, he kai kei reira.
9. Ko te ngahuru.
10. Ko te mānuka, te kānuka me te tawai.
11. He kapo i te wai me ngā taiora o roto mai i te oneone.
12. Te māwhaiwhai kai.
13. He whakapiki i te parāoa kia māmā/ngohe ai.
14. Hei ārai, hei pā tūwatawata mō Aotearoa, kia kore ai e uru mai he koiora kino, arā, he kīrehe, he tipu, he hekaheka, he moroiti kino.
15. He whakakino i ngā huawhenua pērā i te kūmara me te taewa.

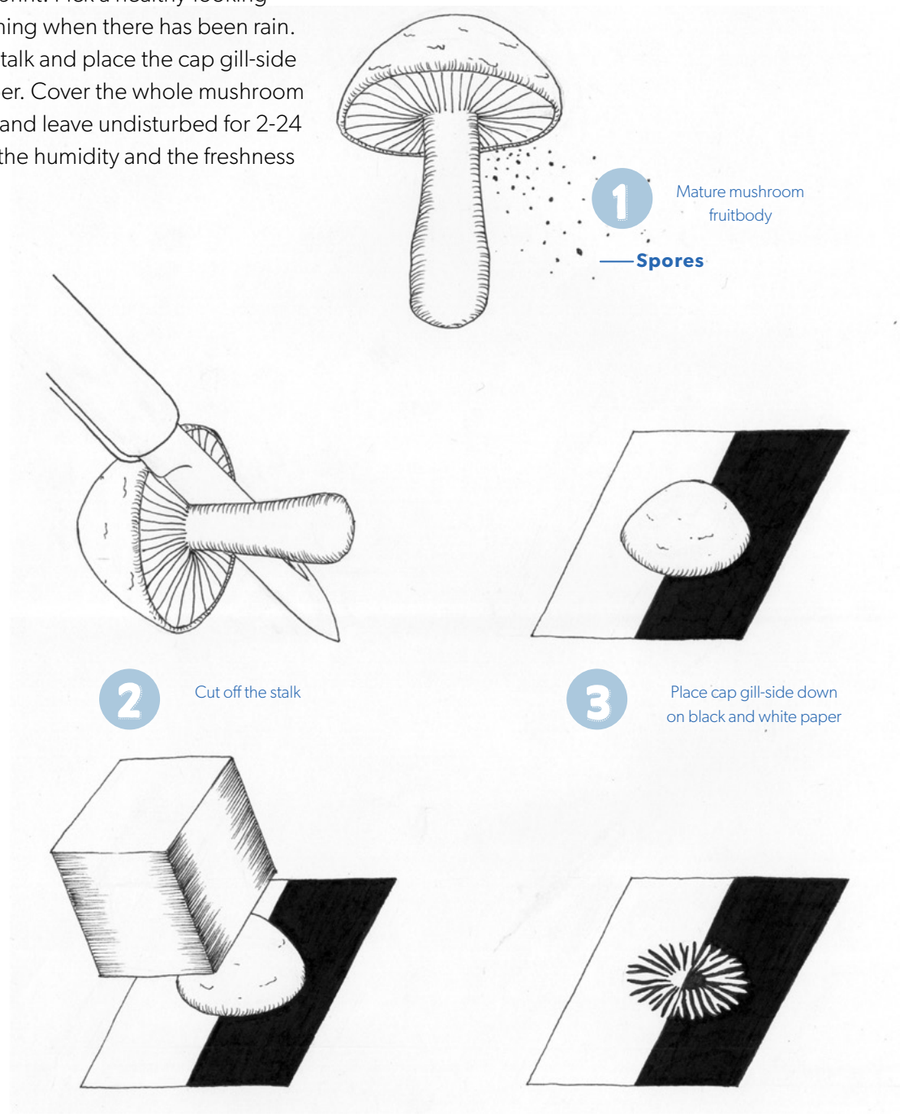
NGĀ MĀTAURANGA ME TE WHAKAMAHI A TE MĀORI I NGA HEKAHEKA

16. Ko te āwheto.
17. Te anuhe o ētahi pūrerehua māori e rua.
18. I te ngahuru, me rapu tētahi 'rākau' parauri iti e tipu mai ana i te oneone i te papa o te ngahere.
19. Ka kohia kia nui ngā āwheto, ka tahuna ki te ahi, ka kauorotia kia oti mai ai he paura pango. Ka ranua te paura nei ki te hinu o te manu hei waingārahu mō te tā moko.
20. Ko te pūtawa.
21. Te kiko o te rākau tawai ora.
22. He pēnei i te pereti, i te paenga te āhua, he toro whakawaho i te kahiwi o te tawai.
23. Ina maroke, ka tahuna, ka roa e popō ana, ā ka taea te waiho, te kawe rānei ki wāhi kē hei tutungi ahi hou.
24. Ko te ropihua.
25. Hei karapoti tūnga.
26. Ka pūhana/ hinātore mai.
27. Ko te puapuatai.
28. Nō te whānau pihi-haunga.
29. He momo i mōhio whānuitia – ki a rātou mā, he tohu o te āwhā, o te mahi atua.
30. Ko te hakeke.
31. Ko te rākau mate i te wao o Tāne.
32. Ko te hanga o te ropihua he pōro, he puare a runga. Kia pā te pata ua (te kīrehe rānei) ki te pukurau, ka tukuna he pua atua kia rere ki te hau. Ko ētahi momo pukurau ka pahū, ka pakaru rānei te ropihua, e tukuna ai ōna pua atua ki te ao.
33. He hanga mā, he ātaahua hoki. He rite ki te wheo tautau, ki te tiotau rānei.
34. I te pukoko, ka noho te hekaheka hei kāinga mō ngā pūtau ora o te kapoke. Ka hanga huka te kapoke mā rāua tahi, mā te mahi ahotakakame.
35. Ko te kaikākā te ingoa mō te kiko o te tōtara kua ngaua e tētahi momo hekaheka. Nā te ngau a te hekaheka ka iti ake te mārō o te rākau, ā, ka oti mai ai he tauira, nō reira e paingia ana hei mahi whakairo.
36. I te tae o tōna ropihua, he kikorangi muramura rite ki tō ngā werewere o te manu nei, o te kōkako.

ACTIVITIES

MAKING A SPORE PRINT

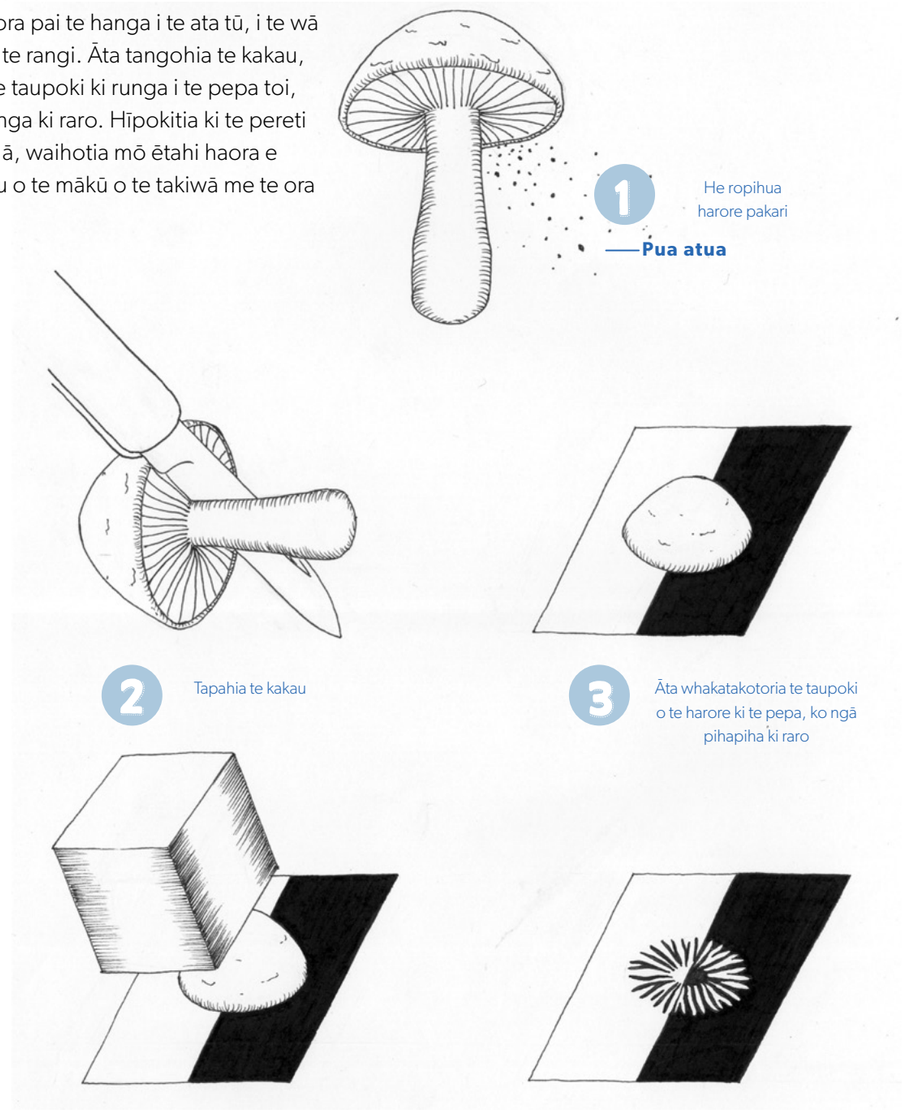
This activity provides a way to visualise mushroom spores: make a spore print. Pick a healthy-looking mushroom in the morning when there has been rain. Carefully remove the stalk and place the cap gill-side down on drawing paper. Cover the whole mushroom with an inverted bowl and leave undisturbed for 2-24 hours, depending on the humidity and the freshness of the mushroom.



HEI MAHI

HE MAHI-Ā-RINGA: TĀNGA PUA ATUA

He mahi tēnei kia kitea ai ngā pua atua o te harore: hangaia he tānga pua atua.
Katohia tētahi harore ora pai te hanga i te ata tū, i te wā e haukū ana te āhua o te rangi. Āta tangohia te kakau, me te whakatakoto i te taupoki ki runga i te pepa toi, ko ōna pihapiha me anga ki raro. Hīpokitia ki te pereti pūrini, ki te oko rānei, ā, waihotia mō ētahi haora e 2-24 – kei te āhua tonu o te mākū o te takiwā me te ora o te harore.



ACTIVITIES

MAKING A POSTER ABOUT FUNGI

Using the Hekaheka resource pack and your own additional research, design and create a poster (A1 size) that uses a combination of text and graphics arranged creatively but clearly to capture the attention and inform the viewer about one of the following topics:

- Endemic Aotearoa fungi
- Traditional Māori uses of fungi
- Benefits and drawbacks of fungi
- Fungi in cuisine
- The biggest fungus in the world.

ASKING QUESTIONS OF WHĀNAU ABOUT FUNGI

If possible ask your parents, grandparents and old people in your whānau if they know about any of the special old uses by tūpuna of the various native fungi, including those in the book:

Āwheto: Has anyone seen this fungus, or collected it for tā moko?

Pūtawa, puku tawai: Has anyone used this fungus to light or carry fire?

Harore: Has anyone ever seen a mushroom or decayed wood in the forest glowing in the dark?

Werewere-kōkako: Has anyone ever seen this bright blue mushroom (pictured on the $50 note) in the forest? When and where was it seen, and in what kind of forest?

Has anyone used fungi as rongoā or to bandage wounds?

Has anyone gathered and eaten harore or any other forest fungi?

Does anyone know a Māori name for the hekaheka eaten by kererū (kūkupa)?

If you or your classmates collect any information from your whānau about traditional Māori uses of fungi, write a letter about it and (with your teacher's help) email it to: buchananp@landcareresearch.co.nz, or post to:

Peter Buchanan
Manaaki Whenua – Landcare Research
Private Bag 92170
Auckland 1142

HEI MAHI

HE MAHI RANGAHAU: TE HANGA PĀNUI WHAKAAHUA MŌ TE HEKAHEKA

I runga i ngā kōrero kei te rauemi nei mō te hekaheka, me te rangahau anō, waihangatia tētahi pānui whakaahua (kia A1 te nui). Āta whakaritea ngā tuhituhi me ngā pikitia hei whakamahi: āta whakaurua kia pai ai te hanga, kia mārama, kia whaitake anō ki te kaititiro. Whiriwhiria tētahi o ngā kaupapa i raro nei hei kaupapa, hei ārahi i tō mahi:

- Ngā hekaheka motuhake o Aotearoa
- Te whakamahi hekaheka i te ao Māori
- Te hekaheka: ngā painga me ngā āhua kino
- Te hekaheka kei roto i ngā kai
- Te hekaheka tino nui o te ao.

HE MAHI Ā-KĀINGA, Ā-WHĀNAU-HE MĀTAURANGA Ā-IWI MŌ TE HEKAHEKA

Ina taea, uia atu ō mātua, ō kaumātua, ētahi atu taipakeke rānei o te whānau mēnā e mōhio ana rātou ki ētahi painga/mahinga o ngā hekaheka māori i te wā ki ngā tūpuna, tae atu ki ngā mea kua kōrerotia i te pukapuka nei. Arā:

Āwheto: Kua kite tētahi i tēnei hekaheka? Kua kohia e tētahi mō te tā moko?

Pūtawa, puku tawai: Kua whakamahia tēnei hekaheka hei pupuri ahi, hei kawe ahi, hei tahu ahi?

Harore: Kua kitea tētahi hekaheka, tētahi rākau pirau rānei i te ngahere e hinātore mai ana i te pō/pōuri?

Werewere-kōkako: Kua kite anō tētahi i tēnei harore kikorangi muramura i te ngahere (kei te $50 hoki tōna whakaahua)? I kitea i hea? Nōnahea i kitea ai? I kitea i tēhea momo ngahere?

Kua whakamahia he hekaheka hei rongoā, hei tākai rānei i tētahi tūnga?

Kua haere ētahi ki te kohikohi harore, tētahi atu rānei o ngā hekaheka a Tāne? Kua kai anō i ēnei kai?

Kei te mōhio tētahi ki te ingoa Māori/kupu Māori mō te hekaheka ka kainga e te kererū/kūkupa?

Ki te riro mai i a koe, i ō hoa rānei i te akomanga ētahi kōrero mai i ō koutou whānau mō ngā whakamahinga a te Māori i ngā hekaheka i ngā rā o mua, tēnā koa tuhia ki te reta, ka tuku mai ai (mā tō pouako koe e āwhina) ki a:

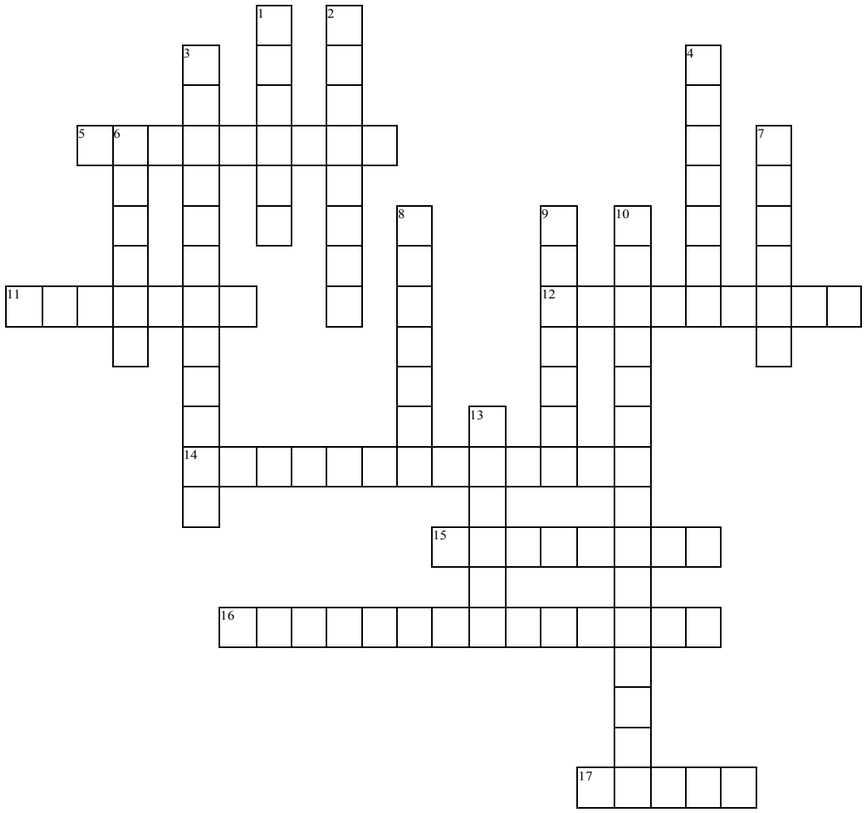
buchananp@landcareresearch.co.nz

Tukua mai rānei mā te poutāpeta ki a:

Peter Buchanan
Manaaki Whenua – Landcare Research
Private Bag 92170
Auckland 1142

HEI MAHI

HE MAHI PANGAKUPU



WHAKAPAE

5. tētahi hekaheka āhua rite ki te kete
11. he tōtara kua ngaua e tētahi hekaheka
12. tētahi o ngā pihi-haunga
14. he taonga e kitea ai ngā mea tino iti
15. te wāhanga hekaheka ka tupu ki te rapu kai, he io tarapī tokomanga te āhua
16. hekaheka kikorangi
17. tētahi huawhenua nui ka ngaua e te hekaheka

WHAKARARO

1. hekaheka hei kawe ahi
2. momo rongoā
3. kia roa te noho o te parāoa ka pēnei
4. hekaheka rite ki te pōro te āhua
6. hekaheka rite ki te taringa te āhua
7. hekaheka hei tā moko
8. kawea e te hau ki wāhi kē
9. te wāhanga hei whakaputa pua atua
10. te mahi a te īhi
13. hekaheka nui hei kai

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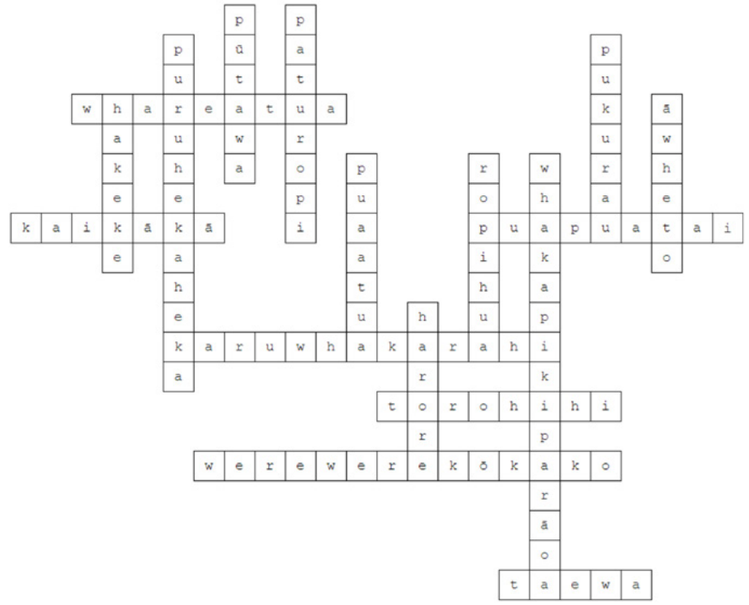
Ngā whakautu p. 56



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