



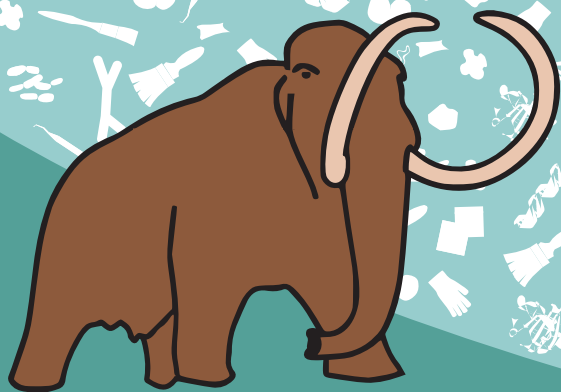
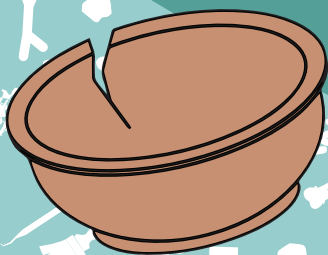
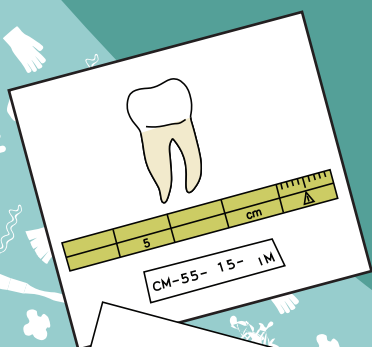
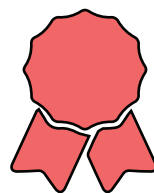
Maitemogelo mo

BOITSEANAPE JWA THUTAMAROPE

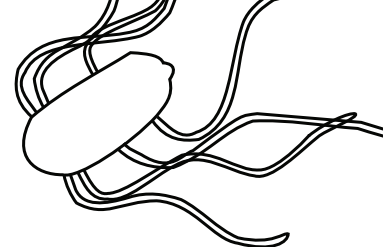
Buka e ke ya ga:

Leina

Katiso ya moitseanape
wa thutamarope
wa isagwe



Kgatiso ya buka ya mebala ka
Setheo sa tlabologo ya
thutomofo sa Max Planck



Maitemogelo mo

BOITSEANAPE JWA THUTAMAROPE

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Leina

**Katiso ya moitseanape
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Kgatiso ya buka ya mebala ka

Setheo sa tlhabologo ya
thutomotheo sa Max Planck

Mophasalatsi: Setheo sa tihabologo ya thutomotho sa Max Planck

Morunyi: Christina Warinner

Mothusa morunyi: Jessica Hendy

Baetleletsi:

Zandra Fagnäs

Jessica Hendy

Allison Mann

Åshild Vågane

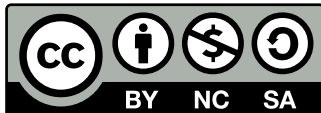
Ke Wang

Christina Warinner

Phetolelo mo Setswaneng ka:

Maina a bafetoledi: Katlego Sejo, Vilicia Phungwako le Kgomotso Theledi

Buka e ya metako ya mebala e tlhagisitswe jaaka karolo ya thupelelo ya ditshwantsho tsa saense.



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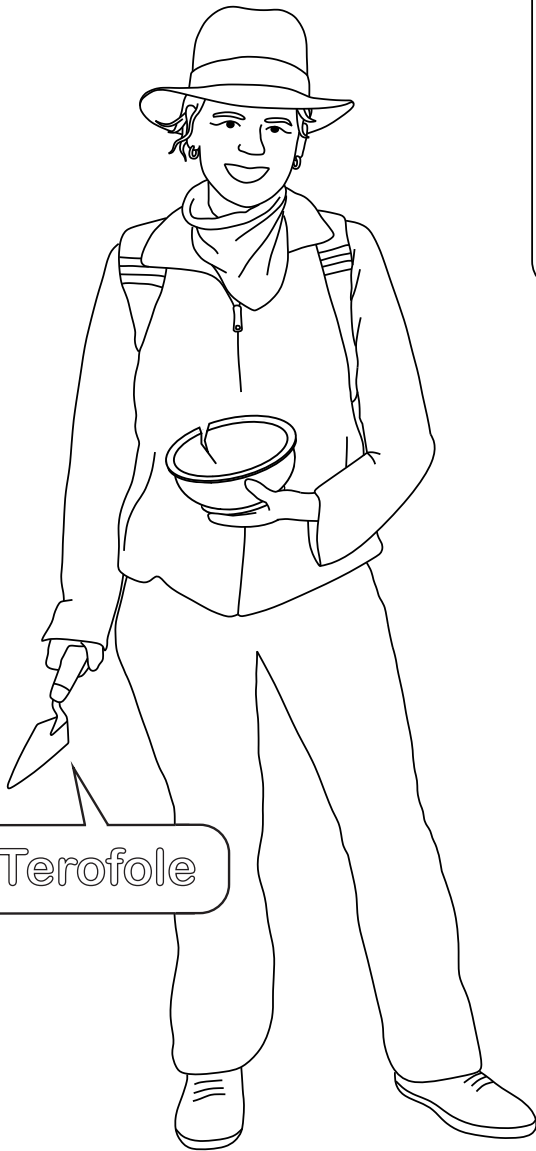
DOI: 10.17617/2.3513447

2023



RE BOMANG?

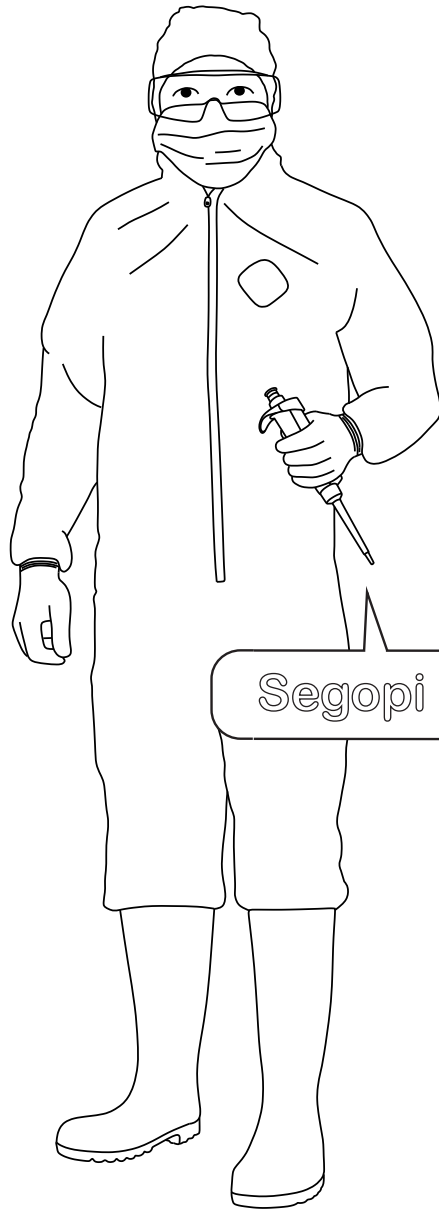
Baitseanape ba thutamarope ke babatlisi ba ba dirisitseng mekgwa ya boitseanape le ditsela tse dišwa tsa a go ithuta ka dipotso tsa lemorago la motho.



Terofole

Mo lefelong la tlhathobelo...

Fa go tshwaraganwe le DNA ya bogologolo, baitseanape ba tshwanetse go direla mo phaposing e e phepa gape ba apare diaparo tse di kgethegileng, diatlana le ditlhako tse di tswalegileng go sireletsa ditshupo kgotsa dingotelo tsa bogologolo kgatlhanong le go silafadiwa ke DNA ya segompieno. Baitseanape ba dirisa mefuta e mentsi e e farologaneng ya didiriso le didiriswa tsa go ithuta ditshupo tsa bogologolo.



Segopi

Kwa ntle...

Baitseanape ba dirisana le badiri ba kwa ntle ba thutamaropeng go epolola le go kgobokanya ditshupo tsa go tswelletsa thuto mo lefelong la tlhathobelo. Se se ka akaretsa dingotelo tsa dipoloko, go kgobokanya masaledi a dipitseng tsa bogologolo, go senola marapo a diphologolo mo masaleleng (mesima ya matlakala), kgotsa go fefera magweregwere go bona masaledi a dimela.



KEPOLOLO YA KWA NTLLE

Baitseanape ba thutamarope ba tsamaya lefatshe ka bophara go tlhohlomisa ka ga ditiragalo tsa motho le tshimologo ya ditiragalo. Go tlaletsa didiriso tsa kepololo, mafelo a mangwe a tlhoka go nna le didiriswa tse di kgethegileng. Sekao, kwa Himalayas, modira ka thutamarope o tshwanetse a nne le tetla ya go tsamaya ka maoto mo sekgweng le diaparo tsa go palama thaba.

Department of Immigration
TREKKING PERMIT
in accordance with the rule 33 of the Nepal Tourism Act, 2018
the permission is granted for the trekking in the area of Mustang District (except for the area reserved to 19

NATIONAL TRUST FOR NATURE CONSERVATION
Entry Permit (ACAMCA/GCA)
Schedule - 2 (Relating to Sub-Rule (1) of Rule 19)
Receipt No. **0281630**
Entry Permit No.
Full Name:
Date of Birth:
Passport No.
Nationality:
Purpose of Visit:

NTNC-ACAMCA ENTRY FEE RECEIPT
Ticket No. **0281630**
Date
Nationality
Authorized Signatory

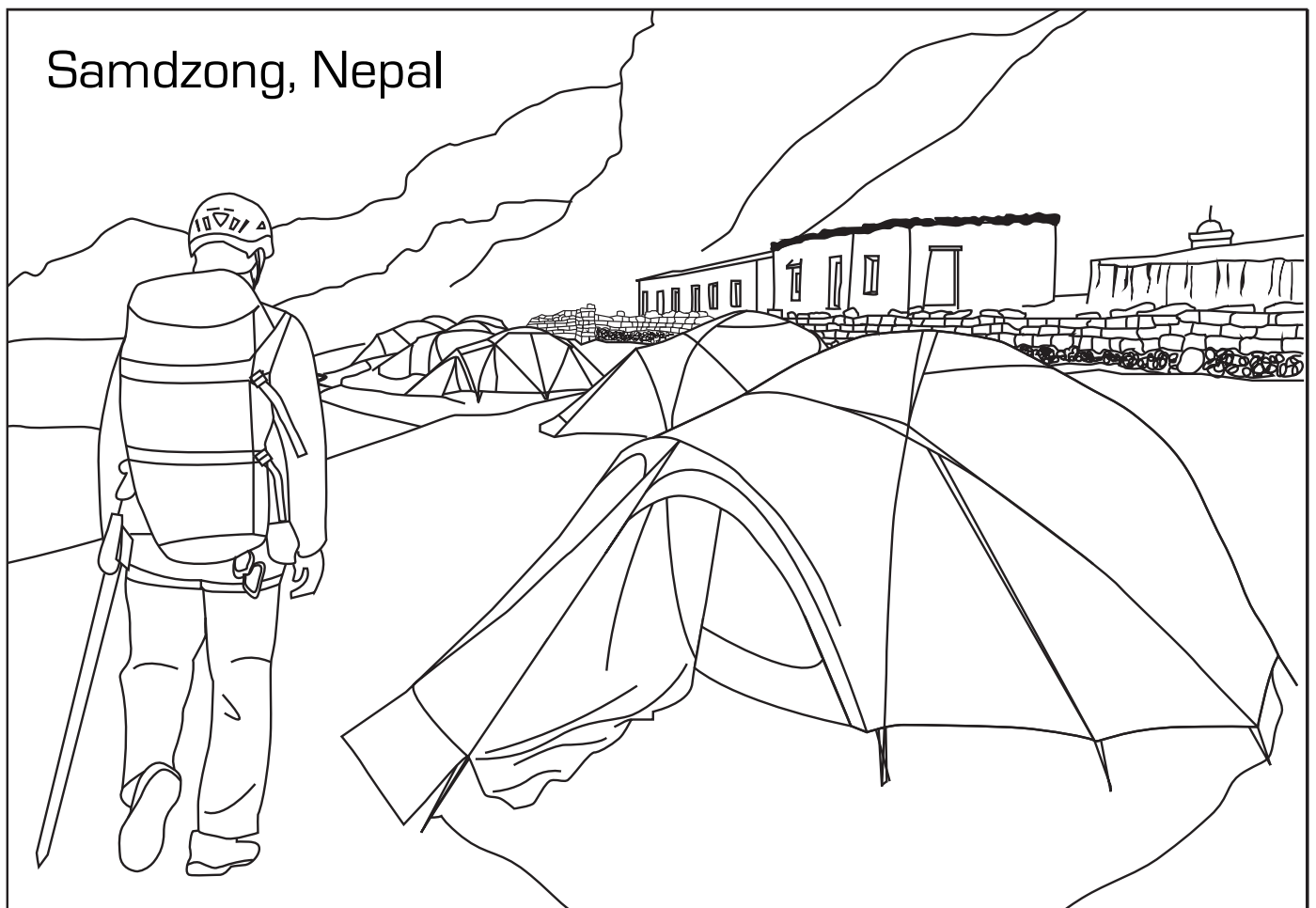
TOURIST COPY

Department of Immigration
Date:
Entry Permit Issuing Authority
Signature
Full Name:
Designation:

Agency Name: **SHERPA SHARDA**

Immigration Officer
No

Samdzong, Nepal



Leswe le le omeletseng mo menong

Gape le itsege ka go bola ga leino (tooth tartar), leswe le le omeletseng mo menong ke lone fela karolo ya mmele e itirang masalela fa o tshela. Le thusa go tshwara dijo le megare e bile le ka dirisiwa go thusa go aga sešwa pholo le lenaneo la dijo.

Marapo le Meno

Marapo le meno di na le manathwana a DNA a ka dirisiwang go sala morago diphudugo tsa batho ba bogologolo le go senola mekgwa, jaaka moriri le mmala wa leithlo, le phetolo ya tsalo. Meno a batho ba ba tlhokafetseng ka nako tsa leroborobo le ona a na le DNA ya megare e e ba tshwaeditseng.

Masaledi dipitseng tsa letsopa

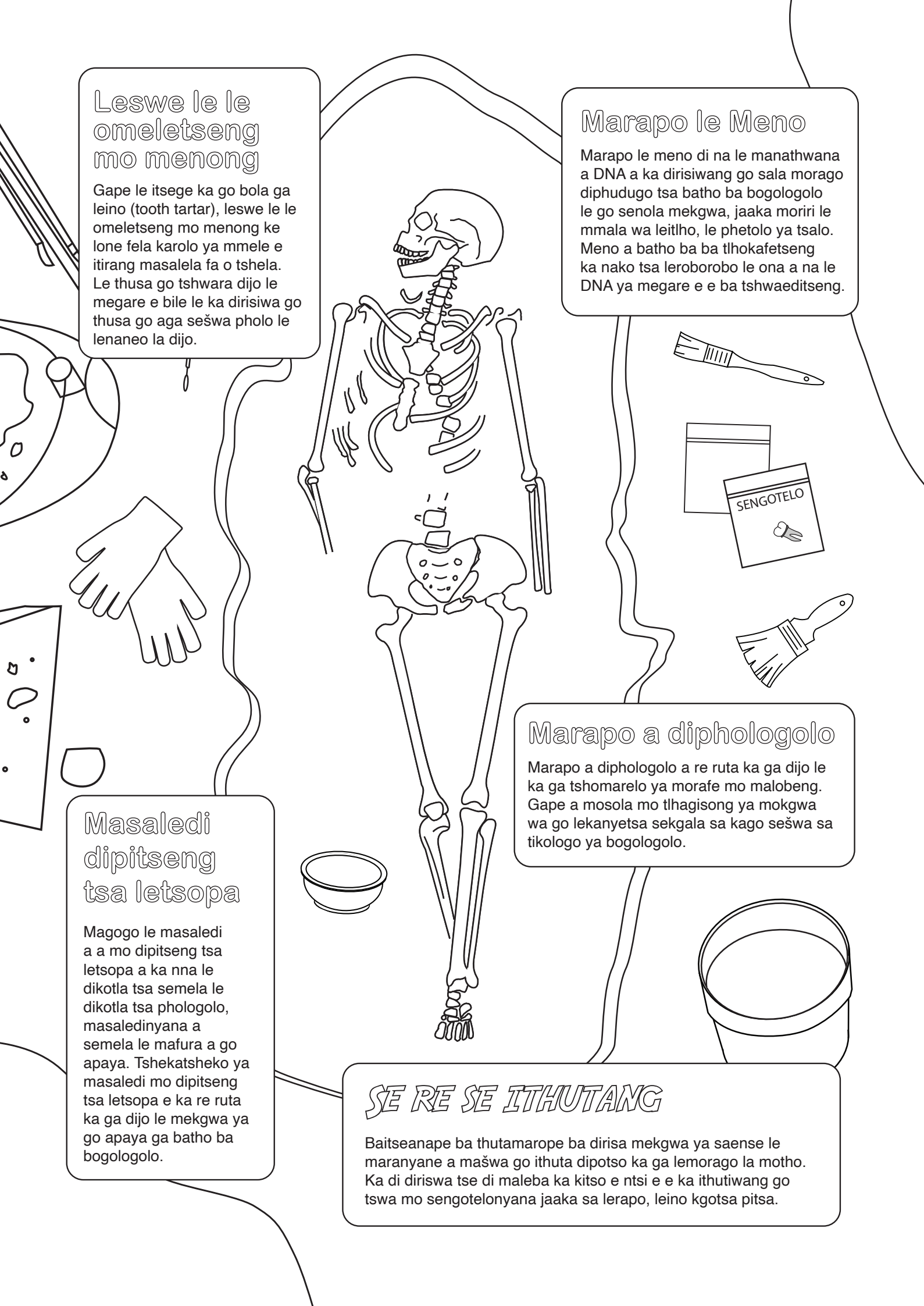
Magogo le masaledi a a mo dipitseng tsa letsopa a ka nna le dikotla tsa semela le dikotla tsa phologolo, masaledinyana a semela le mafura a go apaya. Tshakatsheko ya masaledi mo dipitseng tsa letsopa e ka re ruta ka ga dijo le mekgwa ya go apaya ga batho ba bogologolo.

Marapo a diphologolo

Marapo a diphologolo a re ruta ka ga dijo le ka ga tshomarelo ya morafe mo malobeng. Gape a mosola mo tlhagisong ya mokgwa wa go lekanyetsa sekgala sa kago sešwa sa tikologo ya bogologolo.

SE RE SE ITHUTANG

Baitseanape ba thutamarope ba dirisa mekgwa ya saense le maranyane a mašwa go ithuta dipotso ka ga lemorago la motho. Ka di dirisiwa tse di maleba ka kitso e ntsi e e ka ithutiwang go tswa mo sengotelonyana jaaka sa lerapo, leino kgotsa pitsa.



A O NE O ITSE?

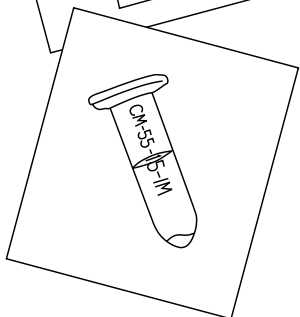
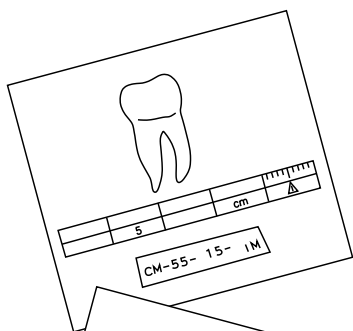
Dingwaga di le 40, 000 tse di fetileng Ba-Neanderthal ba ne ba nyelela, fela DNA ya bone e a tshela mo karolong tsa segotsa mo bathong ba le bantsi ba e seng Ma-Aforika.

TSHIMOLOGO YA MOTHO

DNA ya bogologolo e re thusa go tshloganya thuto-tlhagelelo ya bontsalaarona: Ba-Neanderthal.

Diphetogo

Go ithuta meno le marapo a batho ba bogologolo, re ka bona mokgwa o badimo ba neng ba tshela ka ona, le gore go tiile jang gore re be re le jaana gompiono.



DIPHUDUGO TSA BOGOLOGOLO

DNA ya bogologolo e e ribolotsweng mo marapong le mo menong e ka dirisiwa go aga sešwa tshimologo ya hisetori ya diphudugo. Fa e kopanngwa le mokgwa wa tshekatsheko wa isotope (isotopic analyses), jaaka mo tthagisong ya mokgwa wa go lekanyetsa sekgala sa khabone le seterodiamo (strontium) le tshekatsheko ya mowa wa isotope (oxygen isotope analysis), phudugo e ka lebelediswa ka nako le sekgala.

Basethia, bogare jwa Ešia
Ngwaga wa Tshipi,
dingwaga di le 700 pele
go tsalo ya Morena Jesu

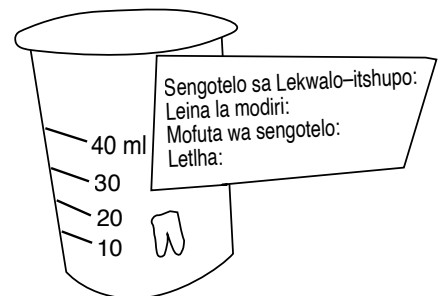


A O NE O ITSE?

Radiocarbon, kgotsa ^{14}C , ke isotope e e sa nonofang ya khabone e e dirisiwang ke dimela mo moweng go dira dijo ka maatla a letsatsi. Diphologolo di tsenyeletsa radiocarbon mo ditogwaneng fa di ja dimela. Radiocarbon e di senya go fetelela. Ka go lekanya tlhwathwa ya ^{14}C mo sengotelong sa bogologolo, go na le kgonagalo ya go ka fopholetsa sebaka sa nako e setshidi se e fitlheletseng.



Mo tthagisong ya mokgwa wa go lekanyetsa sekgala sa khabone

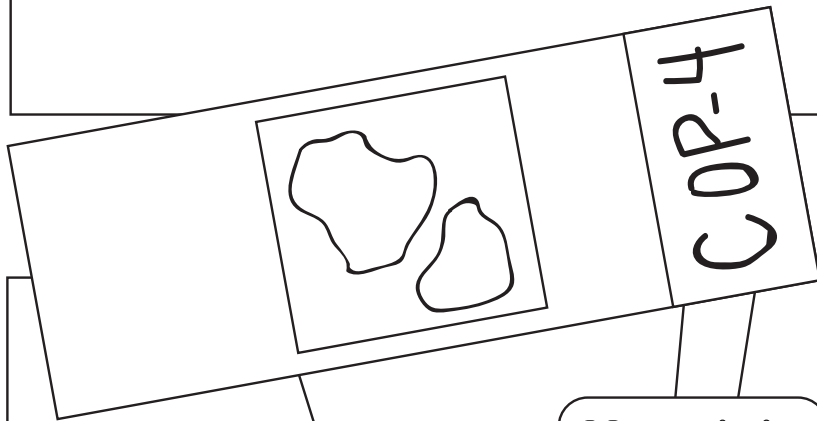


Tthagiso ya mokgwa wa go lekanyetsa sekgala sa khabone (Radiocarbon dating) ke tsela e e ka dirisiwang go bona dingwaga tsa diphologolo le dimela go fitlhelela dingwaga di le 40,000 tse di fetileng.

DIJO TSA BOGOLOGOLO

Baitseanape ba dirisa maekorosekopo go bona diphatsa tse dinnye tsa dijo mo dipitseng le mo menong a batho ba bogologolo. Tshekatsheko ya masaledi a mannye thata a bogologolo a re rutile ka ga dijo tse di neng di jewa ke batho ba bogologolo ba Maya ya Mesoamerica dingwaga di le 2,000 tse di fetileng.

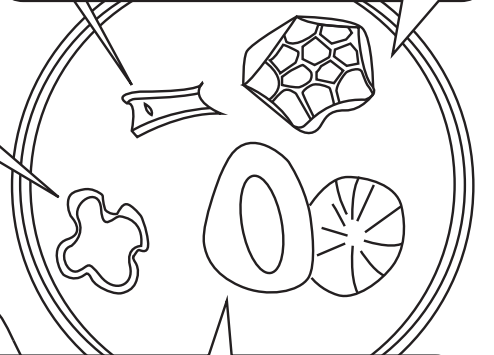
Copan, Honduras
Maemo a ntlha a Maya,
dingwaga di le 300 morago
ga loso la Morena Jesu



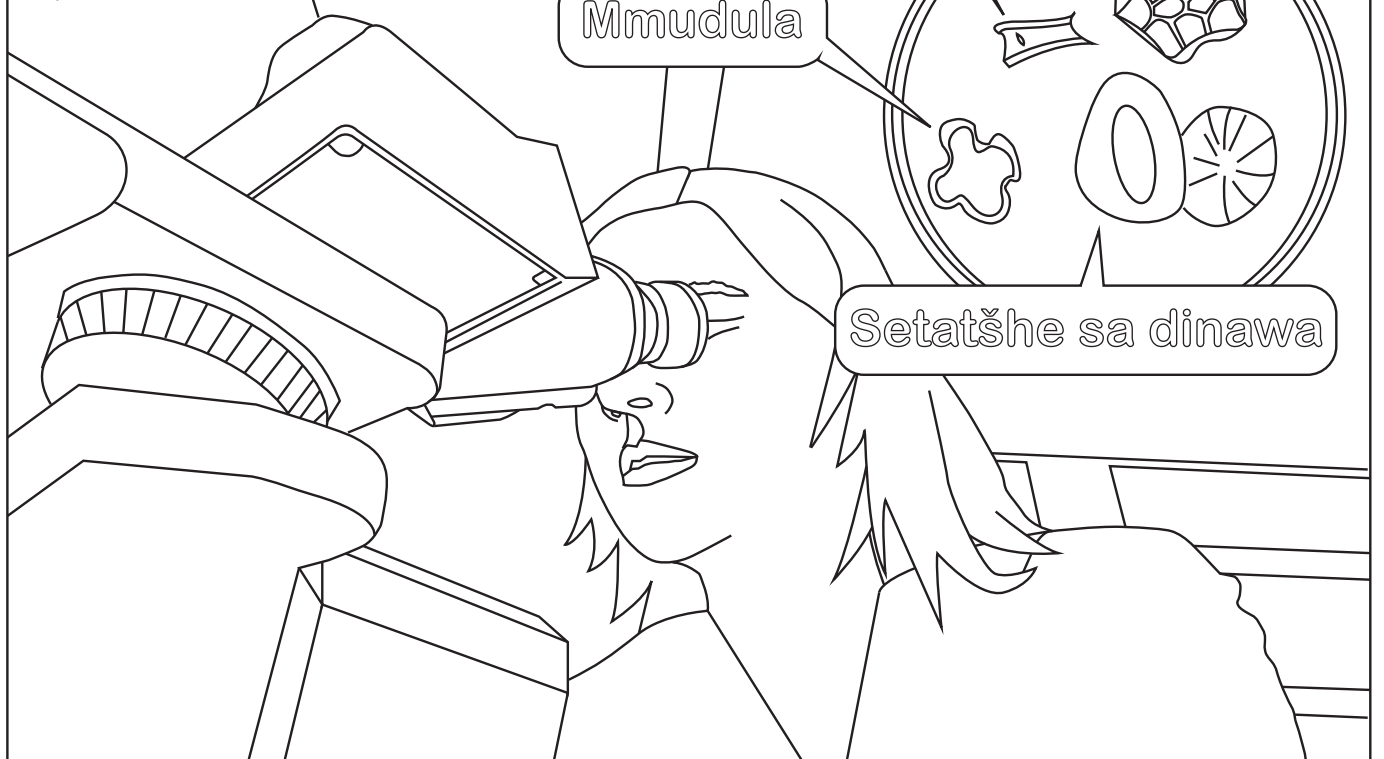
Faetolifi (phytolith)
ya mmopo

Manathwana a peo

Mmudula



Setatšhe sa dinawa

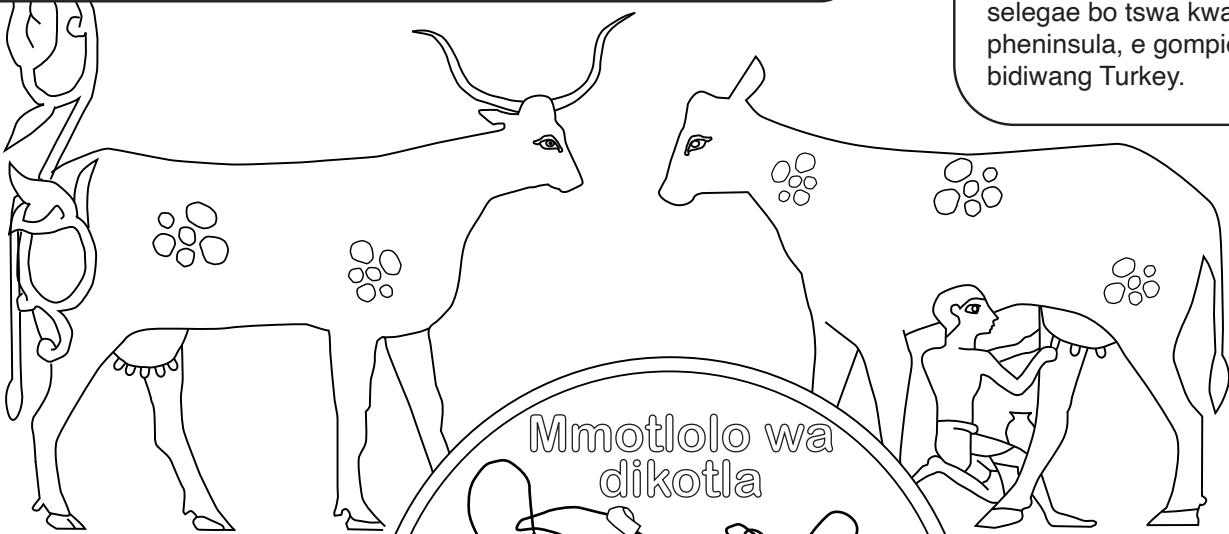


SELEGAE

Go feta dingwaga di le 10, 000, batho ba ne ba tlhopha kgodiso ya dimela le diphologolo tsa boleng jo bo rileng. Dikgomo e nnile tsona diphologolo tsa ntlha tsa go nna tsa selegae, gape batho ba pele ba ne ba di dirisetsa go goga megoma, nama, mašwi le letlalo.

A O NE O ITSE?

Dikgomo tsa selegae tsa go tswa mo dipōng, tse di kgolo tsa naga di tlhole di le teng. Bosupi jwa bogologolo jwa diphologolo tse di tshaotsweng go nna tsa selegae bo tswa kwa Anatolia pheninsula, e gmpieno e bidiwang Turkey.

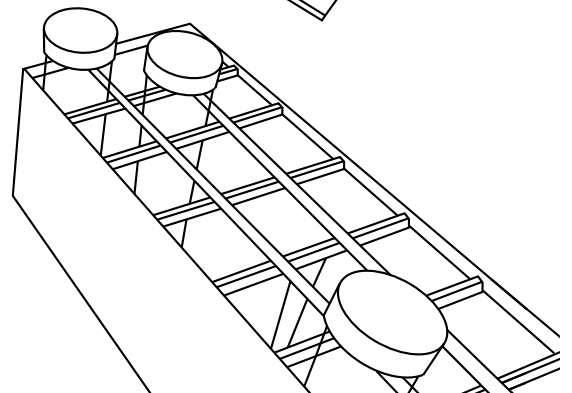
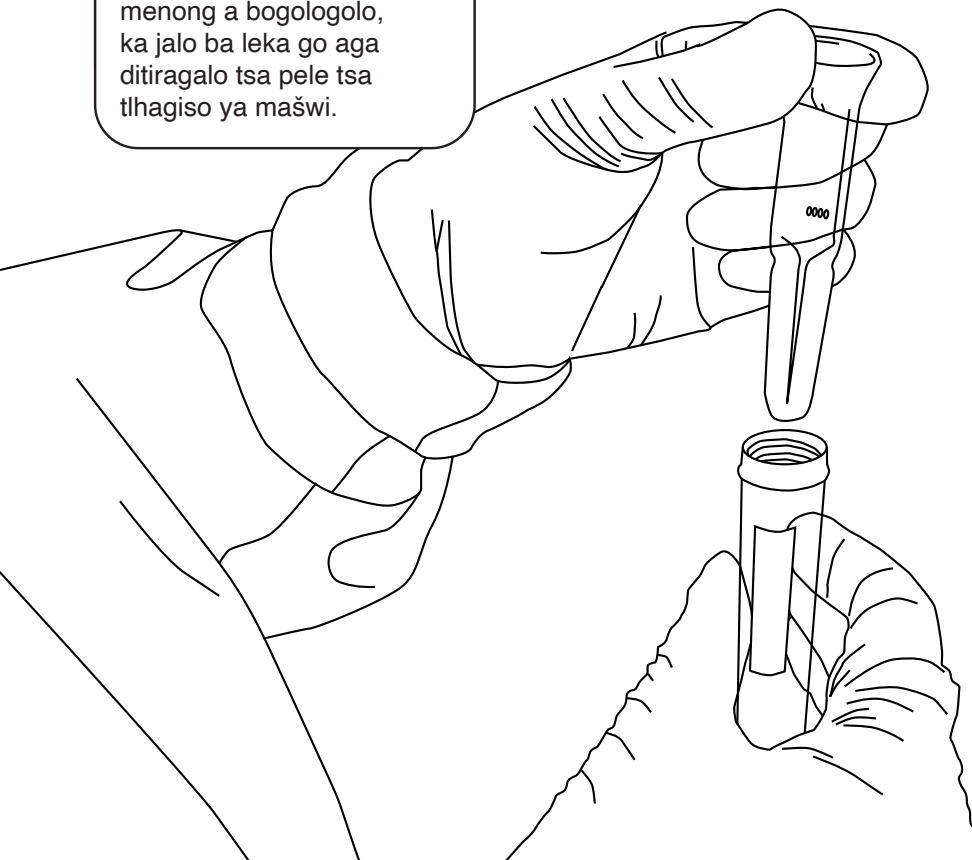
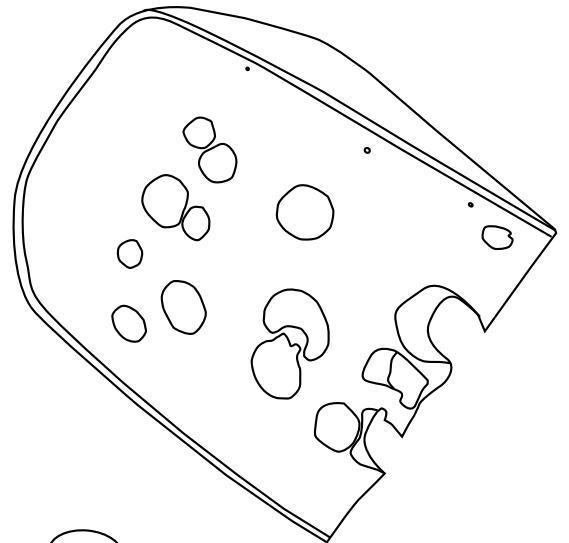
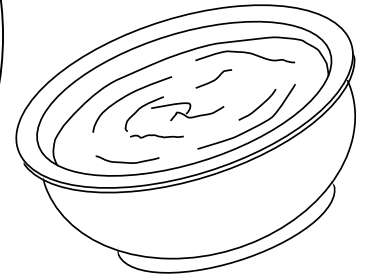


Mmotlolo wa dikotla



Tshimologo ya tlhagiso ya mašwi

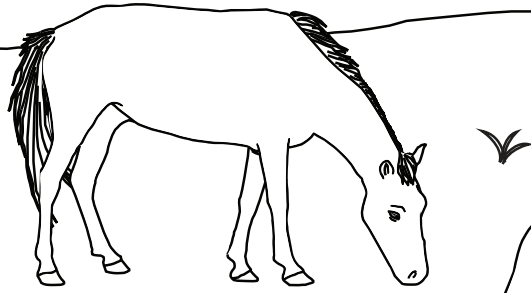
Tshimologo ya tlhagiso ya mašwi ga e itsege sentle, fela baitseanape ba thutamarope ba dirisa tsela ya 'boima jwa seditso sa sepeterometri (mass spectrometry)' go tlathloba dikotla tsa mašwi mo menong a bogologolo, ka jalo ba leka go aga ditiragalo tsa pele tsa tlhagiso ya mašwi.



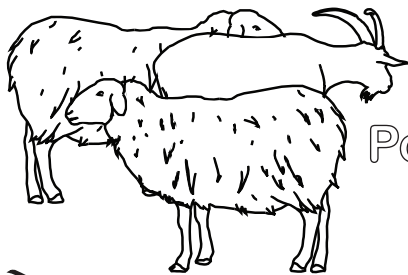
Mongolia

Bontsi jwa diphologolo tse di farologaneng tse di nnang mo dipoeng tse di ikadileng ka bojang tsa Mongolia, di akaretsa dipitse, dikgomo, dipholo, dinku, dipodi, dikgama le dikamela. Badisa ba bakgarakgatshegi ba tlhagisa dikuno gotswa mo mašwiing a diphologolo tse.

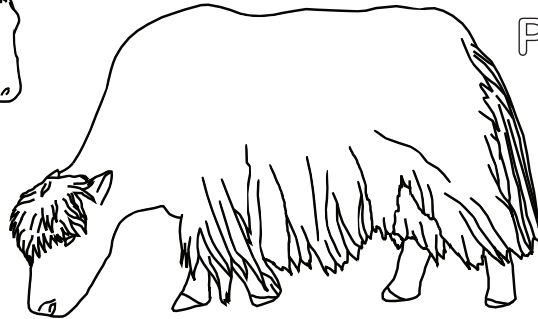
Pitse



Nku

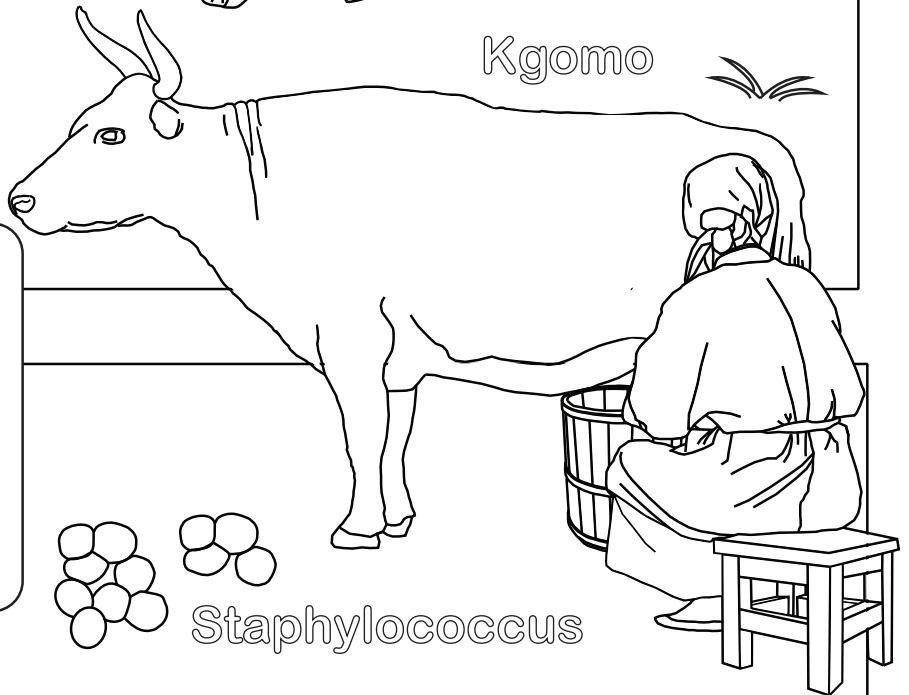


Podi



Pholo

Kgomo

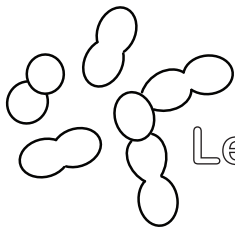


DIJO TSA MAŠWI

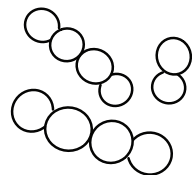
Dijo tsa mašwi ke karolo e e bothokwa thata ya botshelo jwa dikuno tsa mašwi kwa Mongolia. Go tswa mo dipatlisong tsa thutamarope re itse gore ngwao e otloga bobotlana dingwaga di le 3,500 tse di fetileng.



Staphylococcus



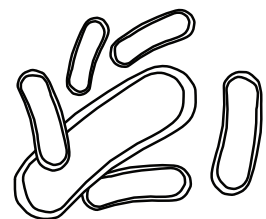
Leuconostoc



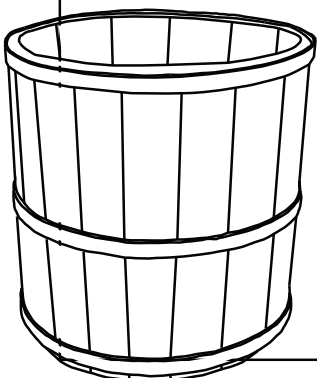
Lactococcus

Megare ya mašwi

Megare - segolobogolo ka megare le sebediso – di tsaya karolo e kgolo mo go bopeng mefuta e e farologaneng ya dijo tse di tlwaelegileng thata tsa mašwi, jaaka yokate, botoro le kase, gape le dijo tse di sa tlwaelegang thata jaaka aaruul ya Mongolia (kase e e omisitsweng) le airag (bojalwa jwa mašwi a pitse).



Lactobacillus



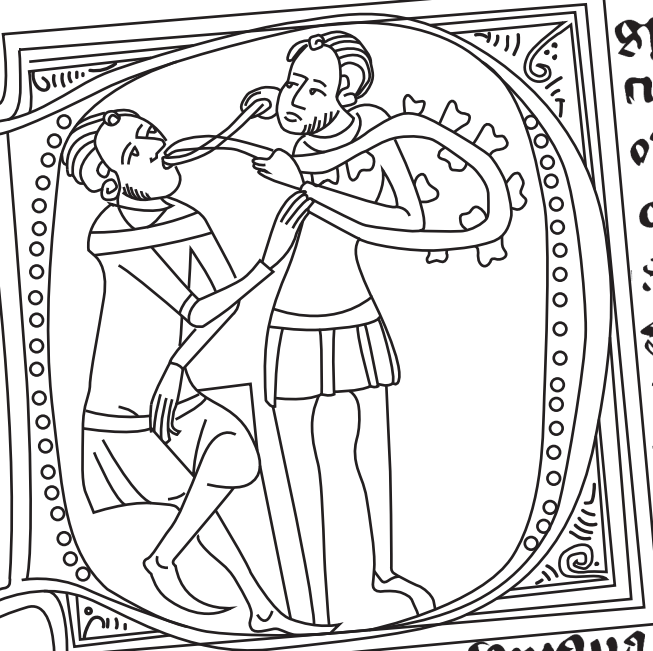
am hilantia...
deuone decantare...
Aut Acidia

MALWETSE A BOGOLOGOLO

Marapo, meno le leswe le le omeletseng mo menong di boloka bopaki jo bo bothokwa ka kalafi ya batho ba bogologolo. Sekao, DNA le dikotla tse di bolokegileng mo lesweng la meno di thusa baitseanape go tihaloganya tshimologo ya malwetsi a marinini le go bola gwa meno.

colorum oculis...
b; capiat nec...
nec diuim; molle...
nat; ramentum...
fale est. explicare...
sup. iohem...
in utrimque...
sugger...

non...
p. archid. in...
tenib; p. Garthm...
entes fin...



entes fin...
gros d...
nnt q...
odente...
omni...
apost...
diuid...
tes...
dent...
dicit...
sunt deu

quod...
tes in medio...
sedite opib;...
pentione...
omni deuotionis...

Omne Bonum

Omne Bonum ke ensaetlelopedia ya lekgolo la bo lesome le bone (14th century) ya Selatini e e buang ka botshelo jwa Yuropa methheng ya dingwaga tsa bogareng e e tshwerweng kwa laeborari ya Borithani. E akaretsa ditiragalo ka ga bongaka jwa meno le kalafi e e re thusang go ranolola pholo le malwetsi a nako ya bogareng botoka.

tes fm...
uiaz; 2 m...
m...

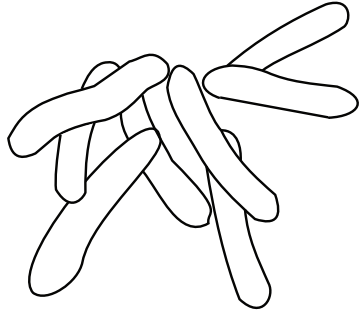
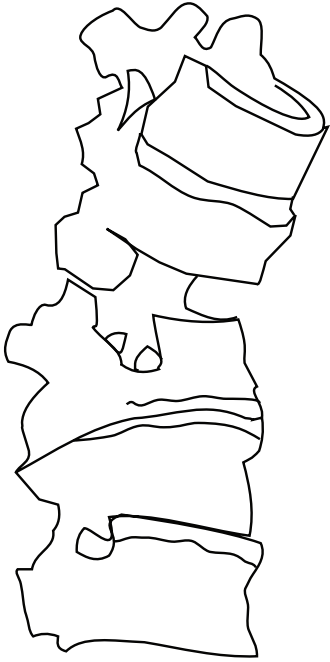


quod priores...
ad hangendū

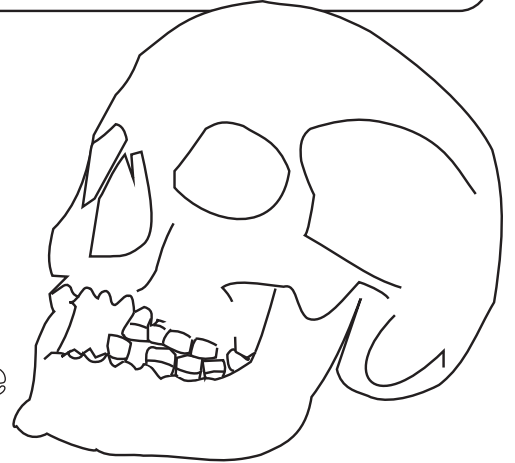
tantis...
a dulcora...

BOLWETSE JWA MAFATLHA LE LEPERA

Bolwetse jwa mafatlha le lepera bo tlohlwa ke mogare o di amanang le ona: *Mycobacterium tuberculosis* le *Mycobacterium leprae*. Bobedi ba tsona bo kgona go tshwaetsa marapo, e bile masalela a DNA a saletseng kwa morago mo marapong a thusa baitseanape go bopa sešwa malwetse a e neng e le a bogologolo.

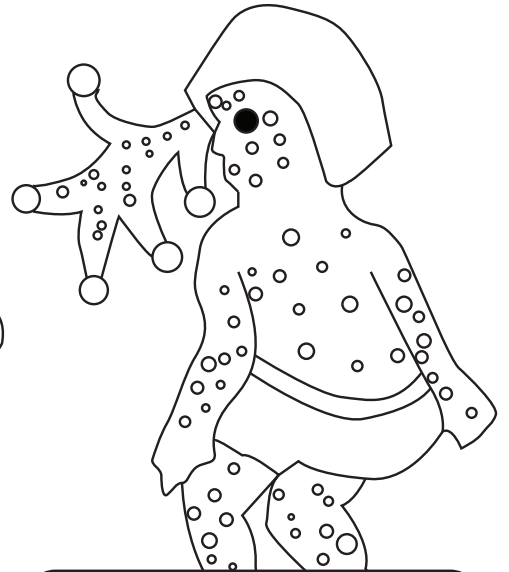


Mycobacterium leprae

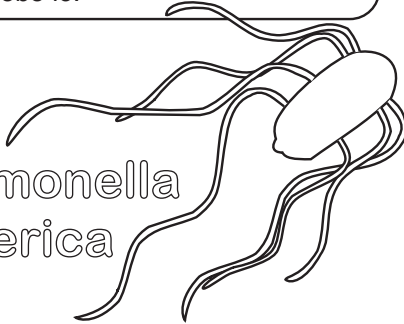


COCOLIZTLI

Leroborobo le le sa itsewang – le le bidiwang cocoliztli ke Ba-Aztec - le bolaile 60-90 % ya morafe wa Mexico mo magareng ga 1545 le 1550 morago ga loso la Morena Jesu. Gajaana, DNA e e tswang mo ditwatsing tsa *Salmonella enterica* Paratyphi C e ne ya bonwa mo menong a batswasetlhabelo ba leroborobo le.

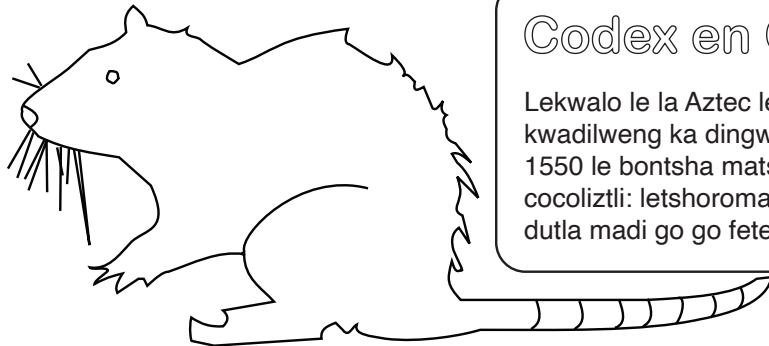


Salmonella enterica



Dr. Schnabel

Dingaka tse di alafang batswasetlhabelo ba kgogodi mo dingwageng di le makgolo a lesome le bosupa (17th century) di ne di apara dimonkwana tse di tshwanang le dinonyane go itshireletsa go tswa go “mowa o maswe.”

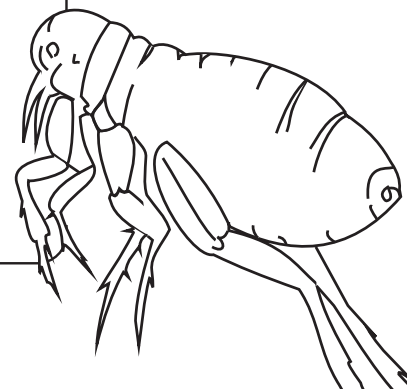


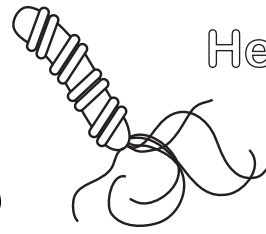
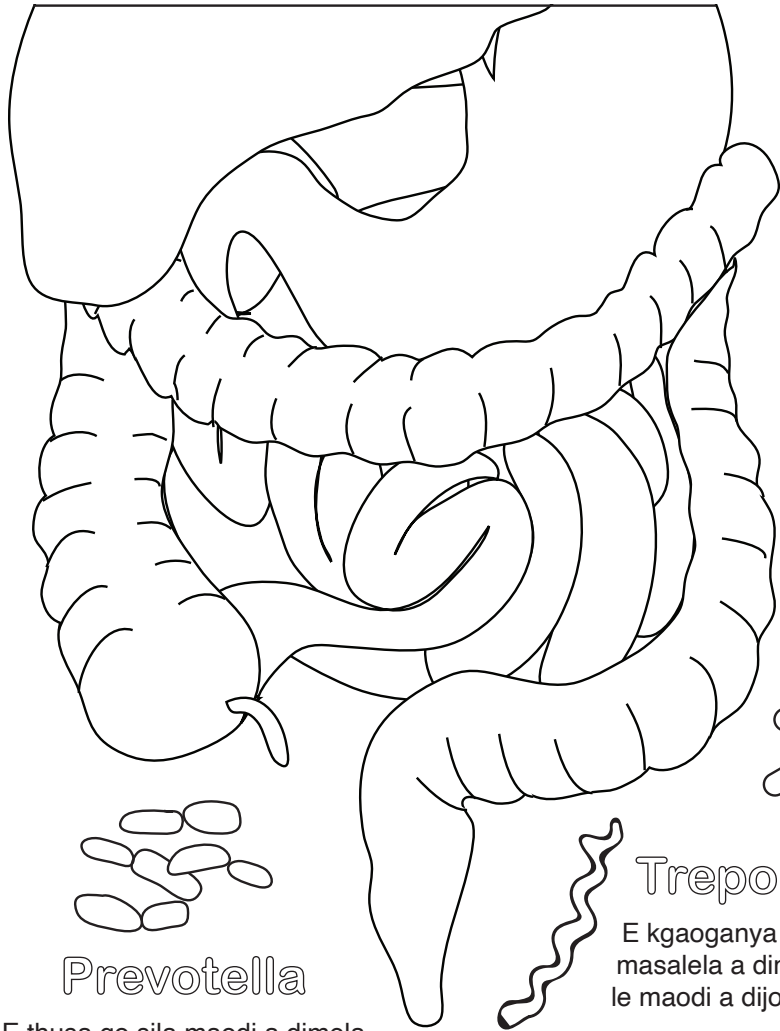
Codex en Cruz

Lekwalo le la Aztec le le kwadilweng ka dingwaga tsa bo 1550 le bontsha matshwao a cocoliztli: letshoroma, diso le go dutla madi go go feteletseng.

KGOGODI

Kgogodi e bakwa ke mogare wa *Yersinia pestis*, o o anamisiwang ke tshwaetso ya matsetse a a bonwang mo magotlong. Batho ba ba lomiwang ke matsetse a ba nna le kgogodi ya beboniki (bubonic plague). Kgogodi e ne e le sebakwa sa kgogodi e e tlohlwang ke Loso lo lo ntsho la (AD 1346-1353) leo le bolaileng seripa sa batho kwa Yuropa.





Helicobacter pylori

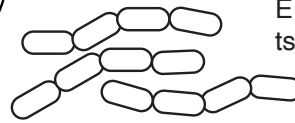
E nna mo maleng e bile e kgona go baka diso le dingwe tsa dikankere



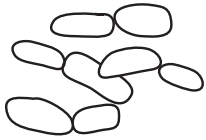
Bifidobacterium

E thusa masea go sila mašwi

Faecalibacterium



E tthagisa dijo tsa disele tsa mala



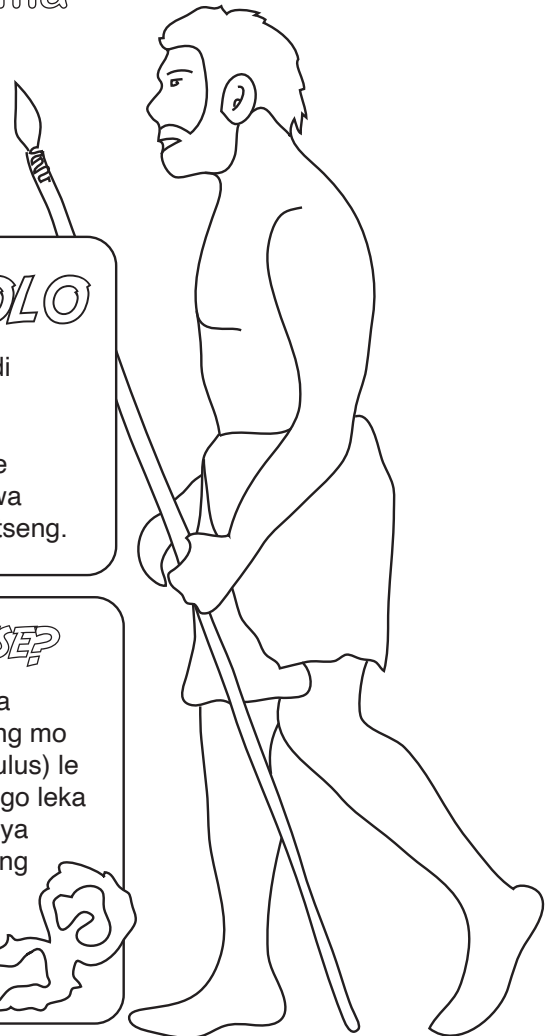
Prevotella

E thusa go sila maodi a dimela



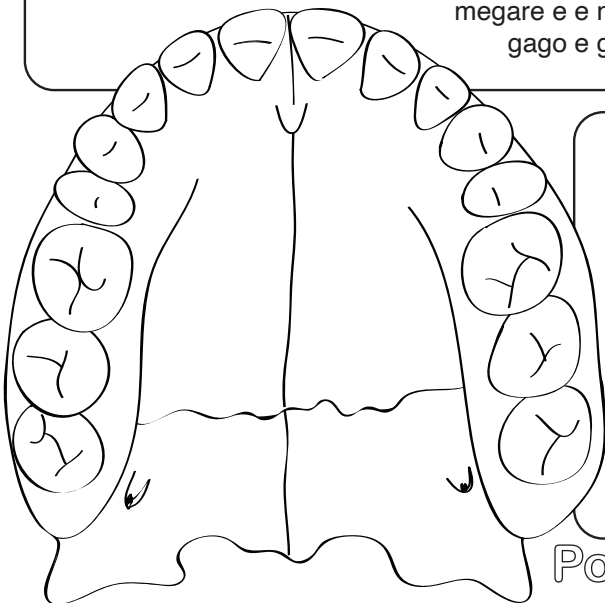
Treponema

E kgaoganya masalela a dimela le maodi a dijo



DIBOKWANA TSA BAGOLOGOLO

Mmele wa gago ke legae la methapo ya megare ya **ditrilione** tse fa di kopane di bidiwang dibokwana (microbiome). Megare e e n nang mo maleng a gago e go thusa go ometsa dijo le go matlafatsa masole a mmele. Megare e e mo letlalong la gago e thusa gore o nne phepa, le megare e e n nang mo molomong wa gago e go sireletsa mo malwetseng.



A O NE O ITSE?

Baitseanape ba ithuta leswe le le omeletseng mo menong (dental calculus) le mantle a bogologolo go leka go tthalosa palogare ya dibokwana mo bathong ba bogologolo le go tthaloganya botoka sebakwa sa malwetse.



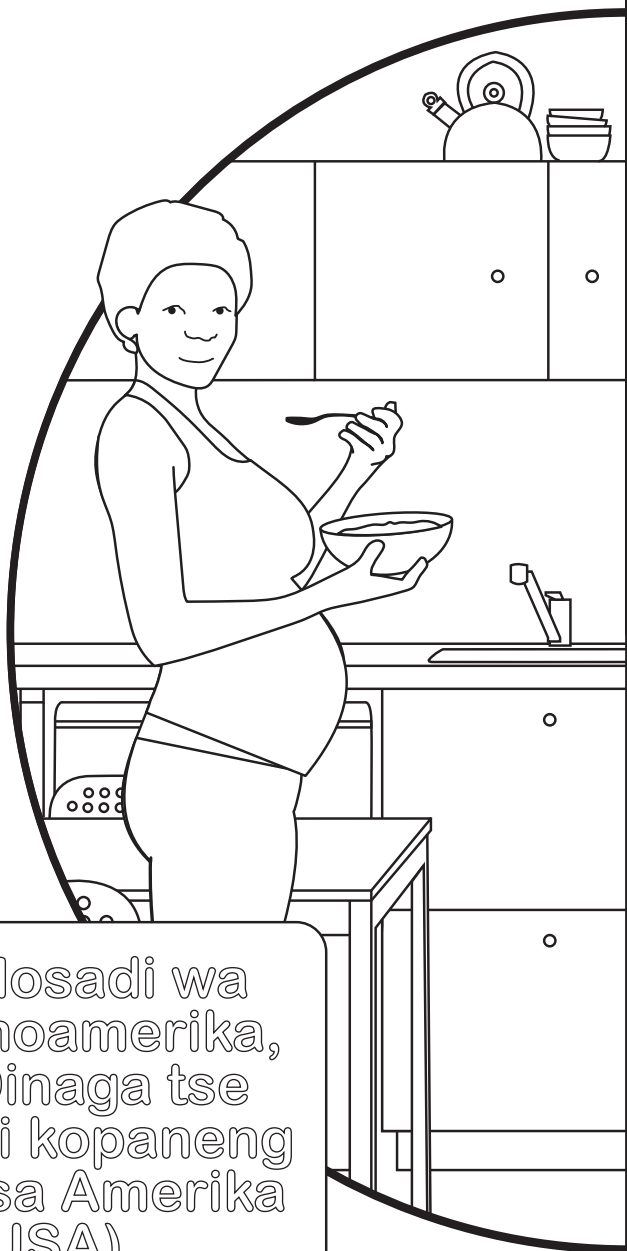
Porphyromonas

BATSOMI

Batsomi, ba itsege jaaka bafodi, ba ja dijo tsa naga e bile dijo tsa bone di farologana go ya ka ditlha.

Pele go tshimologo ya temothuo dingwaga tsa bo10, 000 tse di fetileng, batho botlhe mo lefatsheng e ne e le batsomi.

Batsomi gompiono ba na le dibokwana tse di farologaneng go feta batho ba ba tshelang mo merafeng e e tswelatseng.



Mosadi wa moamerika, Dinaga tse di kopaneng tsa Amerika (USA)



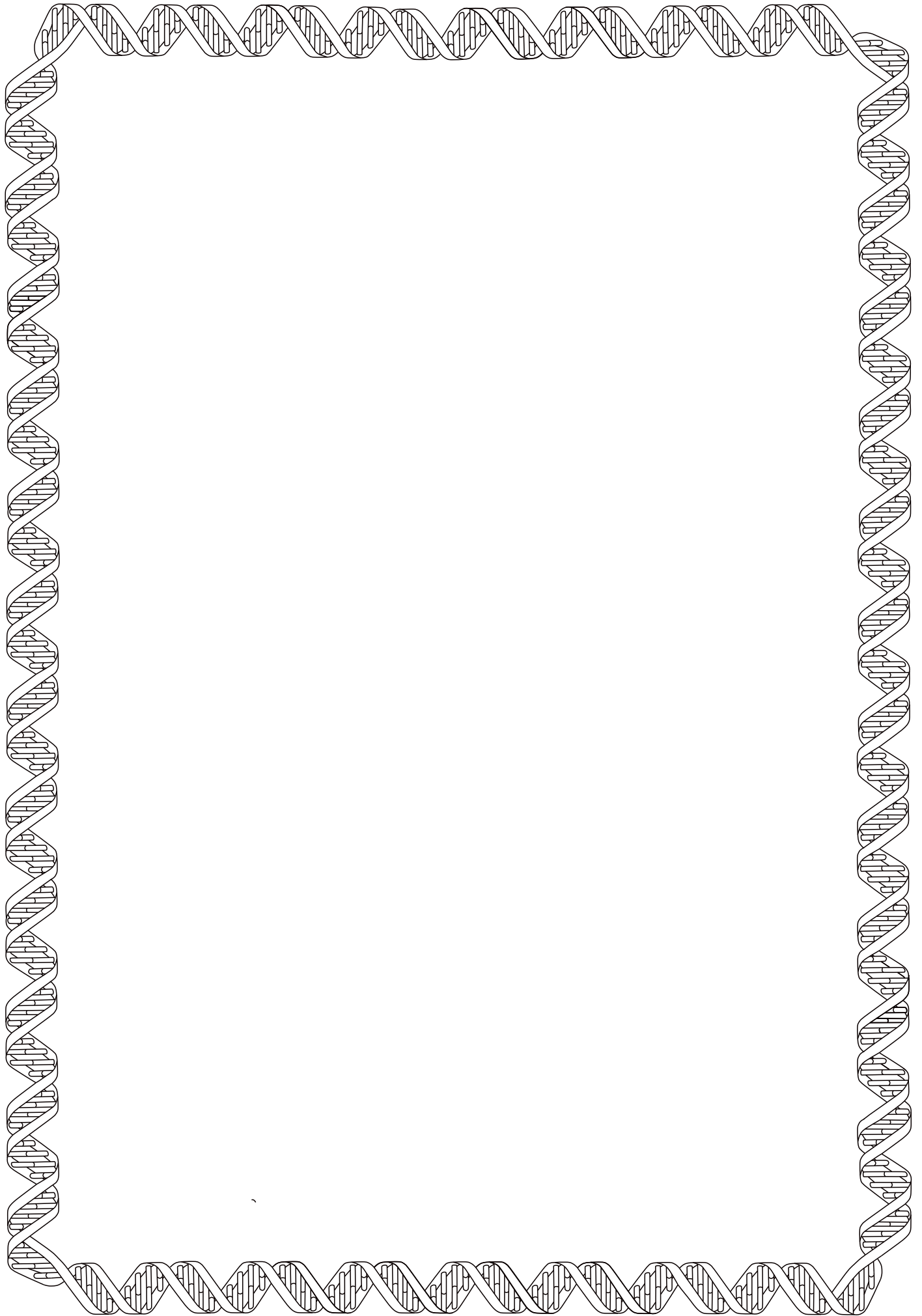
Mosadi wa mohadza le ngwana, Tanzania

MERAFE E E TSWELETSENG

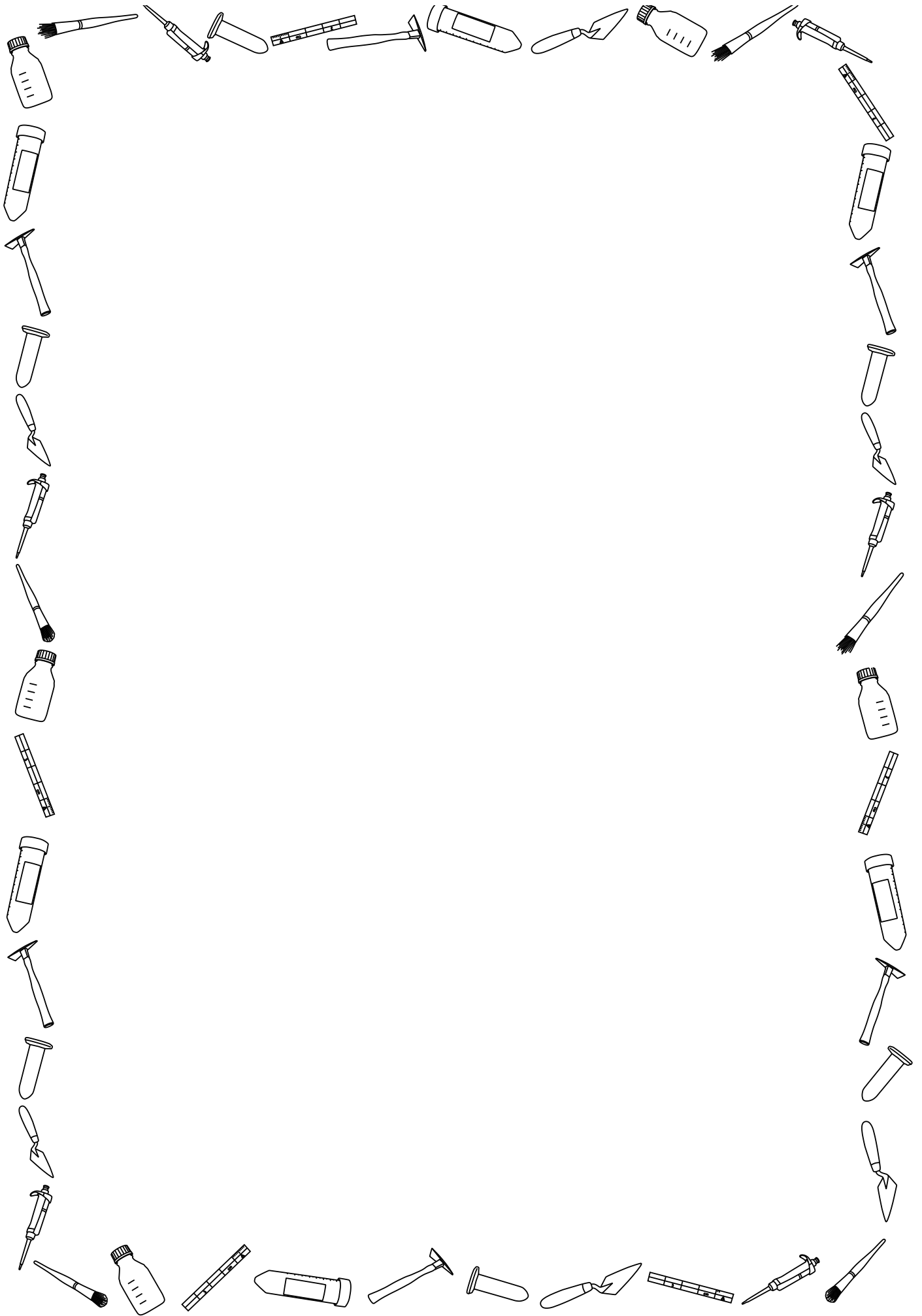
Merafe e e tswelatseng gantsi e ja dijo tse di itemetsweng, gape tlhagiso ya tsona ke tiro e e kgethegileng e e dirwang ke batho ba se mmalwa.

Tsamaiso, tshireletso le poloko ke nngwe ya dintlha mo kgolaganong ya dijo tsa sešweng, e bile gantsi dijo di tsaya tsela e e motsopodia pele di ka jewa.

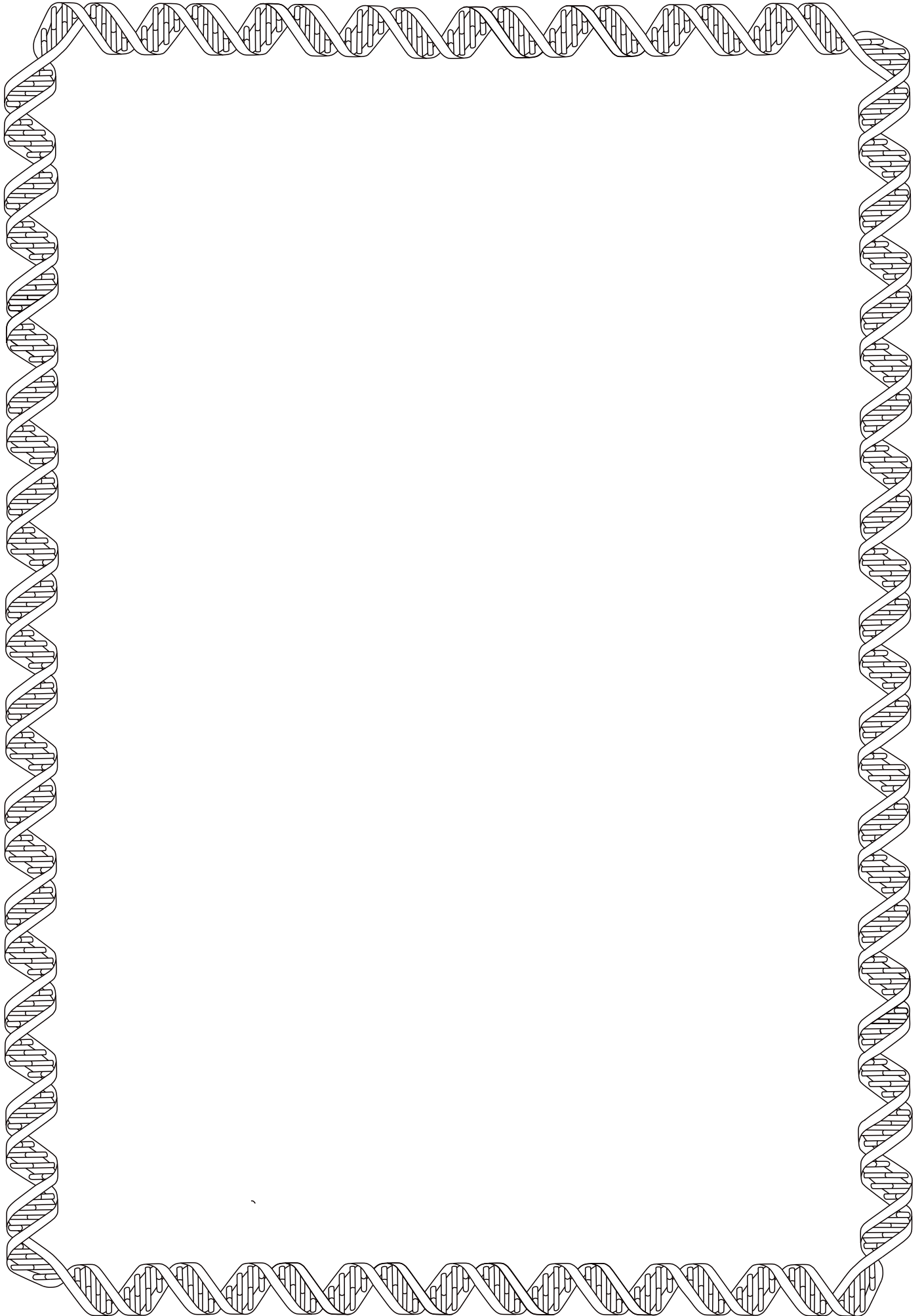
Batho mo merafeng e e tswelatseng gompiono ba na le mefuta e e sa farologanang ya dibokwana, se se ka ba tsenya mo kotsing e kgolo ya malwetse mangwe a sa foleng.



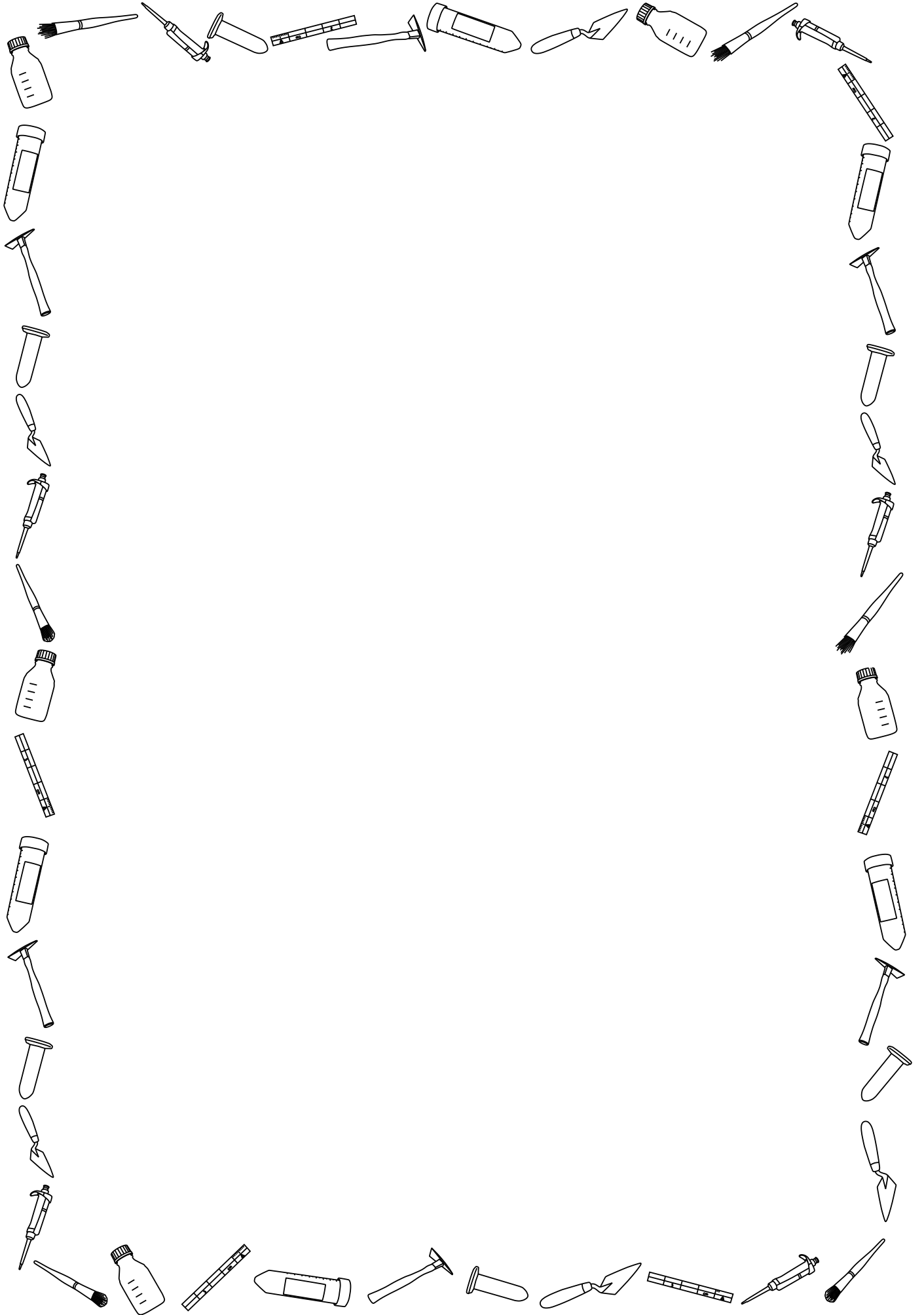




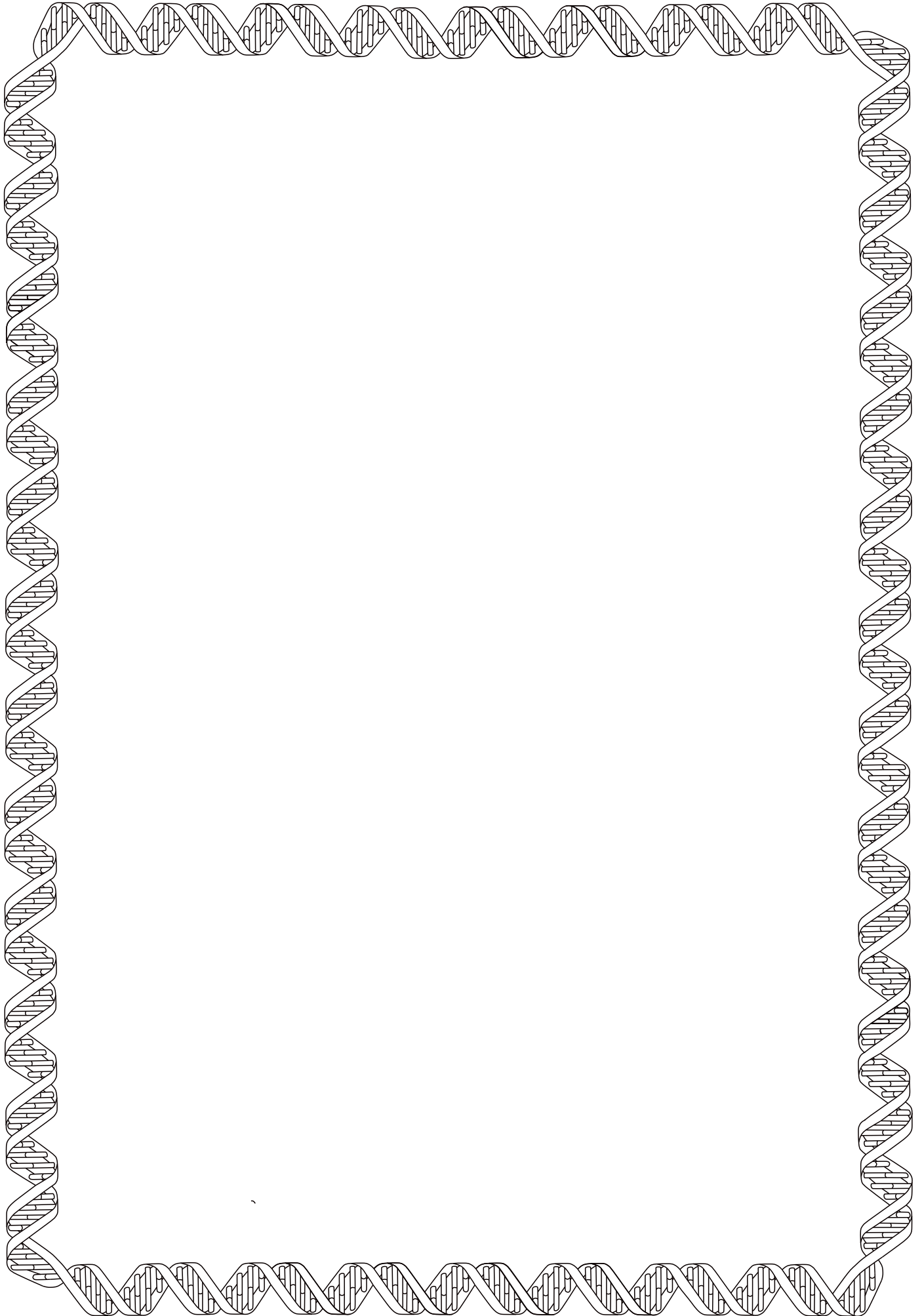






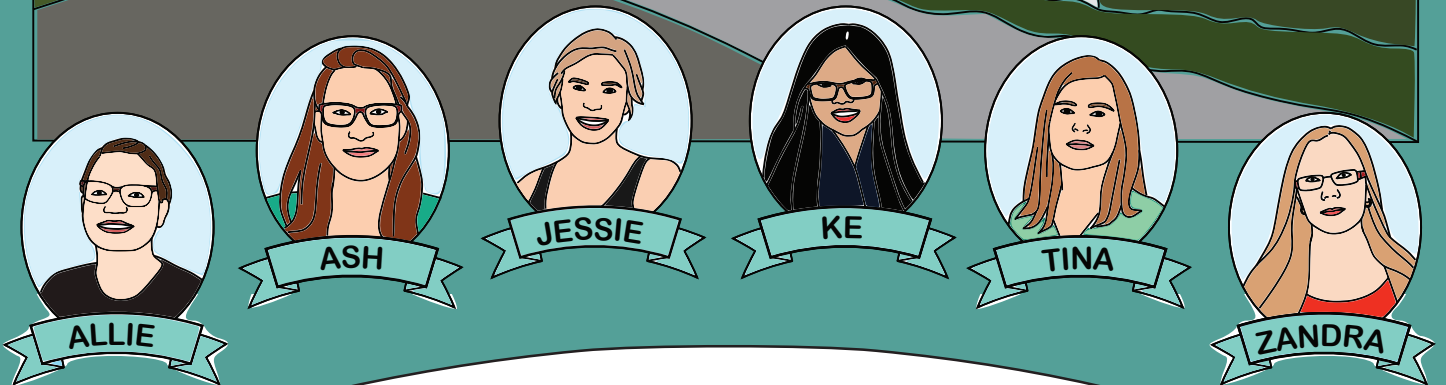








Setheo sa tlhabologo ya thutomotheo sa Max Planck



Maitemogelo mo

BOITSEANAPE JWA THUTAMAROPE

Buka ya metako ya mebala

Ithute gore badiri ba thutamarope le baitseanape ba dira mmogo go araba dipotso ka lemorago la motho! Ikopanye le rona jaaka re tlhalosa gore **re bomang** e bile **re ithuta eng**, go tswa **tshimologong ya batho** go fitlha **dingwageng tsa bogareng tsa kgogodi**. Ithute ka **diphudugo tsa bogologolo le mokgwa wa go lekanyetsa sekgala sa khabone**. Iponele ka mo o baitseanape ba agang sešwa **dijo tsa bogologolo** go tswa mo masaleding a dimela. Epolola dintlha tsa **go dira diphologolo e nne tsa selegae** le baitseanape jo bo mo dijong tsa **mašwi** bo ikaegileng mo go jo ne. Batlisisa ka **malwetse a bogologolo le maroborobo** le go ribolola **dibokwana tsa bagologolo**.

E tlhagisitswe ke baitseanape ba setheo sa tlhabologo ya thutomotheo sa Max Planck.

E fetoletswe mo puong ya Setswana ke Katlego Sejo, Vilicia Phungwako le Kgomotso Theledi.

