



Masapo ma

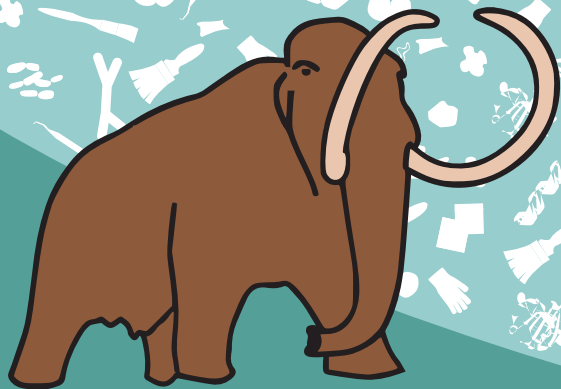
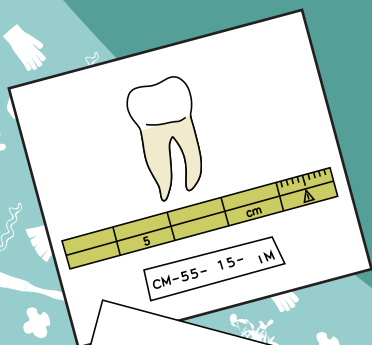
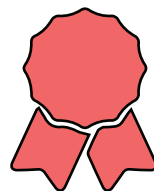
**ZEBI ZA**

**ARKEOLOJIA**

Buku eye ezali ya:

Kombo

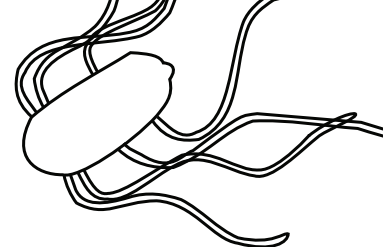
**Moyekoli o mambi  
matali arkeolojia**



Buku ya langi esalemi na

Eteyelo Max Planck mpo ya  
ntombwa ya mambi ma moto





Masapo ma

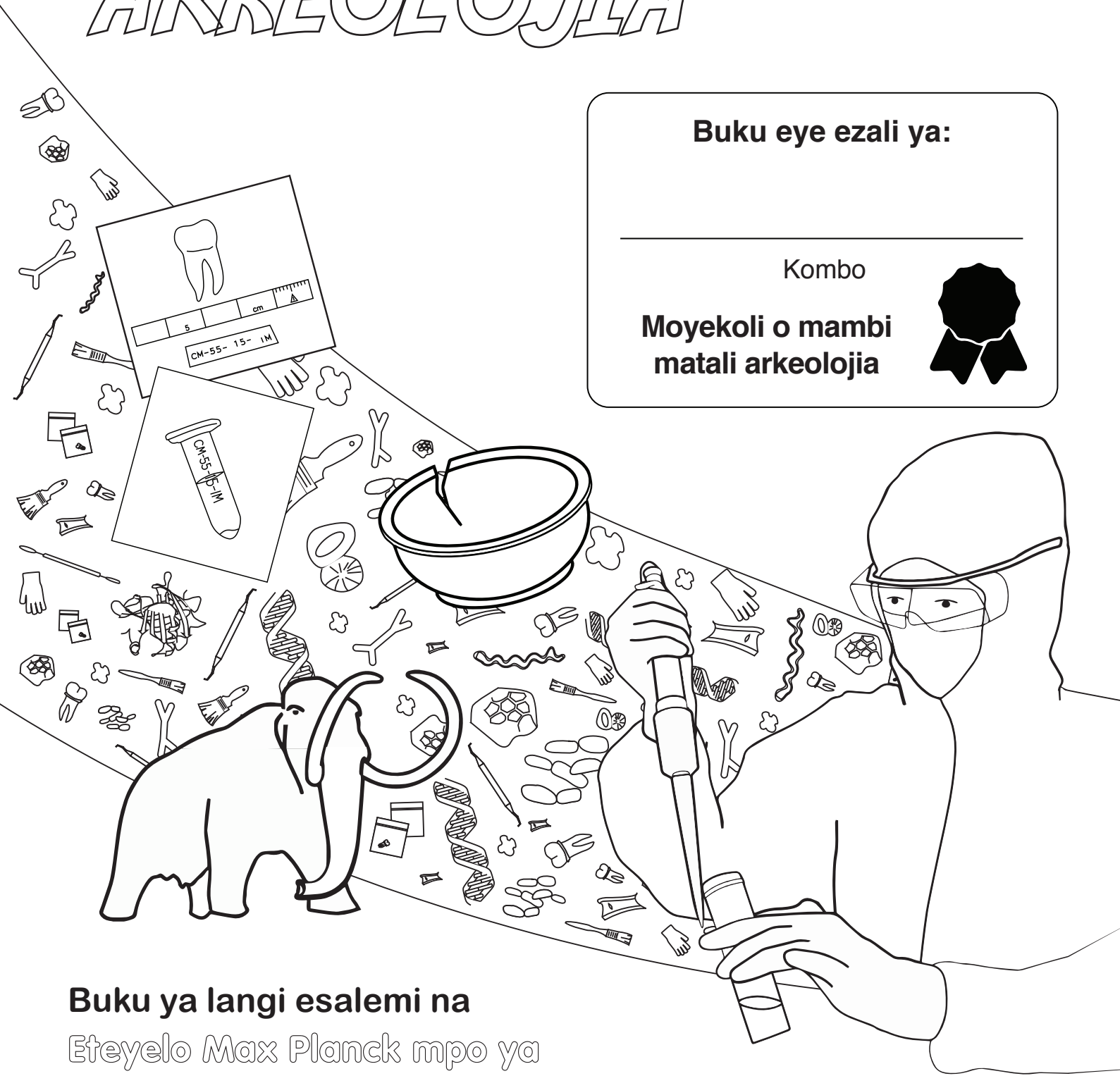
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**Moyekoli o mambi  
matali arkeolojia**



**Buku ya langi esalemi na**

Eteyelo Max Planck mpo ya  
ntombwa ya mambi ma moto



**Mokomi:** Eteyelo Max Planck eye ekoyekola bomoi bwa moto

**Mokomi mokozi:** Christina Warinner

**Mokomi mokitani:** Jessica Hendy

**Basungi:**

Zandra Fagernäs

Jessica Hendy

Allison Mann

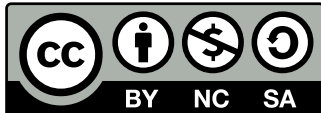
Åshild Vågane

Ke Wang

Christina Warinner

**Ebongolami na Lingala na:** Modeste Kandolo Simba mpe Nicolas Mombaya Liwila

Buku eye ya langi esalemaki mpo ya liteya likopesa ndakisa ya maye matali zebi.



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DOI: 10.17617/2.3524700

2023



## BISO NDE BANANI?

Balukiluki ba arkeolojia bazali bato baye basalelaka nzela ya zebi mpe ntoki esengeli poya boyekoli bomoi bwa bato babika kala.



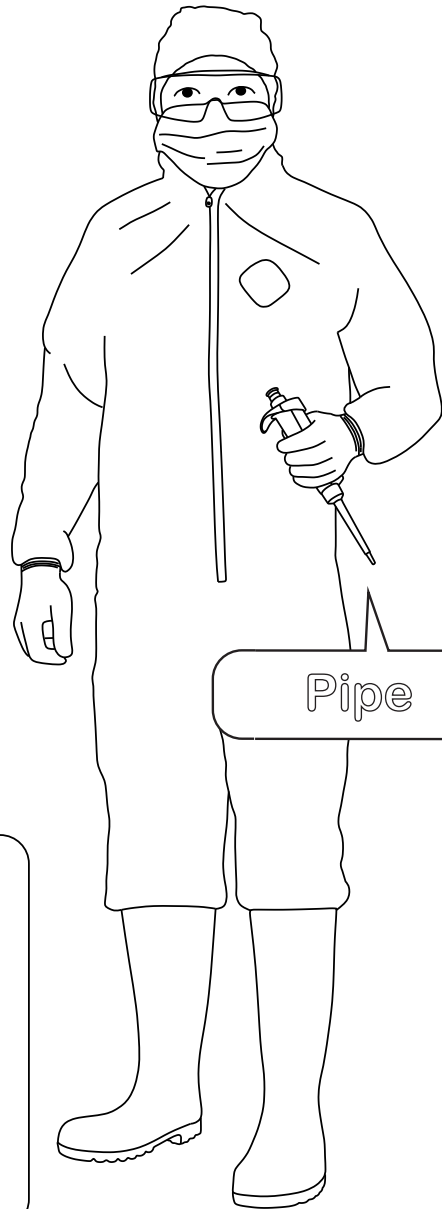
Mbeli ya kotonga na ndako

## Esika ya mosala...

Bato ba mayele basalaka mosala elongo na bato ba arkeolojia baye bameseni na mosala mona mpo ya kobimisa mpe kozwa ndambo ya bilembo biye bakoyekola sima o laboratoire mpo ya mosala mwango, esengeli: kopona yoko kunda, kolokota bosoto o nzungu ya kala, kolembetela mikuwa, ya kala o mabulu maye babwakaka bosoto to mpe koyengula mabele poya kozwa mitika mya nzete.

## O laboratoire...

Tango bazali koyekola ADN ya kala, bato ba mayele basengeli kosala mosala o kati ya eteni ya ndako pembe (ndako peto) mpe molato mwa mosala ndakisa: sapato, bagaa iye isengeli mpo ya kobatela ndambo ya bilembo bazwi na ntina te izwa bokono o nzela ya ADN ya sika te. Bato ba mayele (zebi) basalelaka biloko bya mosala mpe bisalelili ndenge na ndenge mpo ya koyekola ndambo ya bilembo bya kala.



Pipe



# MITIKA MYA KALA

Bato ba arkeolojia bakendeke mibembo o mokili mobimba mpo ya koyekola mambi ma bomoi bwa moto mpe mambi maye maleka kala. O bitando bisusu, esengeli kosalela boko bisaleli to mpe bolukiluki biye bisengeli ata ko soki bisaleli bisusu mpo ya bolukiluki bizali bizali. Ndakisa o Himalaya, bato ba arkeolojia basengeli bazwa ndingisa poya kotambola bipai na bipai o ngomba mpe basengeli na bisaleli mpo ya kobuta ngomba.

(Relief Government Ministry Department) TREKKING PERMIT

**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:

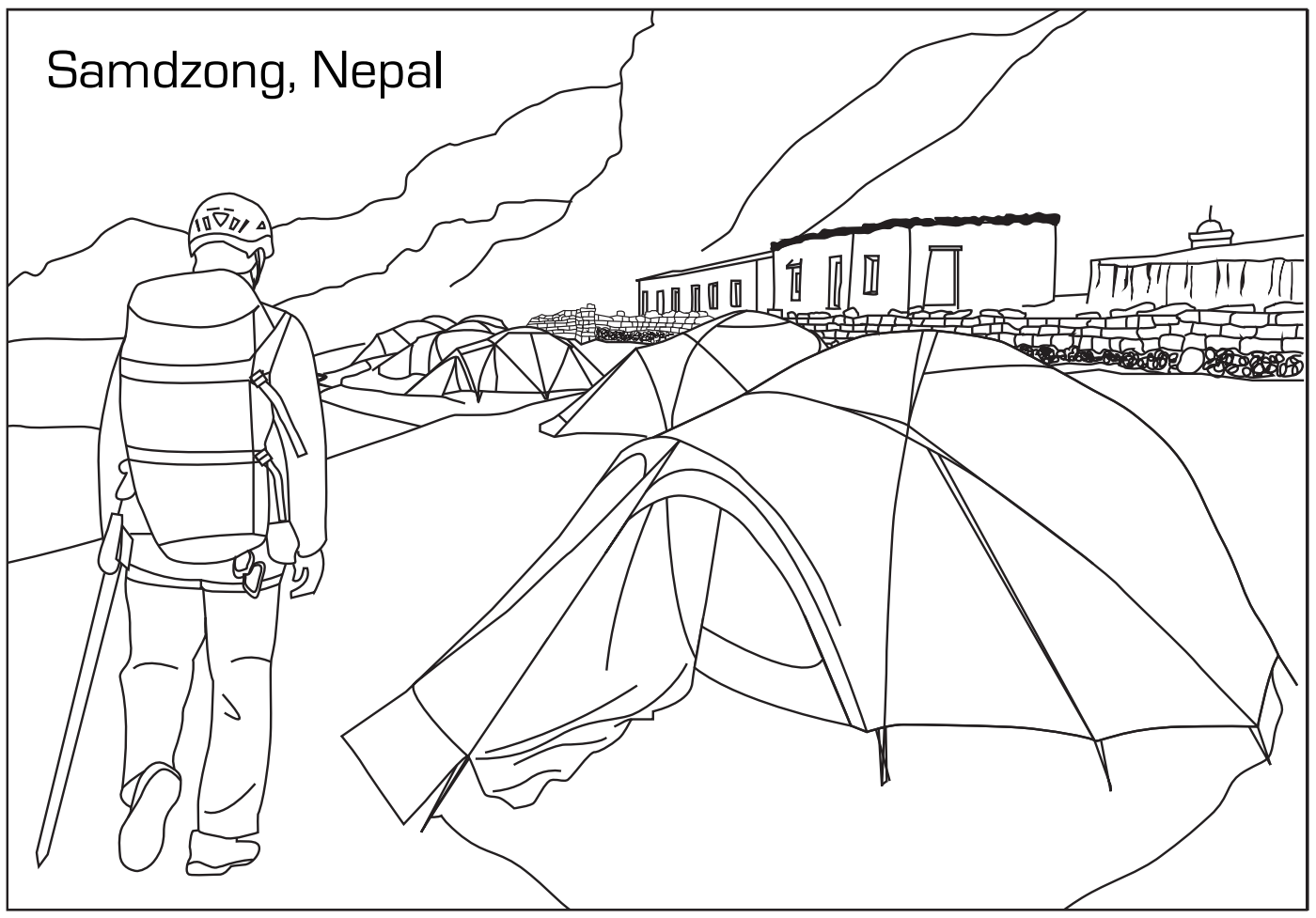
**NTNC-ACAMCA ENTRY FEE RECEIPT**  
 Ticket No. **0281630**  
 Date  
 Nationality  
 Authorized Signatory  
 Agency Name: **SHERPA SHAIKUN-LA**

Entry Permit Issuing Authority  
 Signature  
 Full Name:  
 Designation:

**TOURIST COPY**

gration Officer  
da No

## Samdzong, Nepal





## Palaki ya mino

Iyebani lisusu na kombo ya tartre ya mino, palaki ya mino ezali nde eteni se yoko ya nzoto eye ekotikalaka bomoi bwa yo mobimba. Ekangaka bilei mpe mikrobe, mpe ekoki mpe kosalelama poya kotonga lisusu nzoto mpe bilei bya moto.

## Mikuwa mpe mino

Mikuwa mpe mino mizalaka na bilembo bya ADN biye bikoki kosalelama mpo ya kokundola lolenge bato ba kala batambolaka, mpo ya kotonga lisusu bilembetelo bya bato ba kala. Ndakisa langi ya miso to langi ya suki to mpe bokokanisi bato bauti na libota lyoko. Mino ma bato bakufi o eleko bokono bozali ko ngala, ikoki mpe kozala na ADN ya bokono boye bango bazwaka.

## Mikuwa mya nyama

Mikuwa mya nyama mikoki kosalisa biso mpo ya kolimbola boniboni bato ba kala babandaki kolia mpe boniboni bazalaki kobomba biloko bya bango. Mikuwa mya nyama mizali mpe na litomba mpo ya kopima eleko o nzela ya karbone 14 mpe mpo ya kotonga lisusu bisika bya kala.

## Mitika mya mbeki

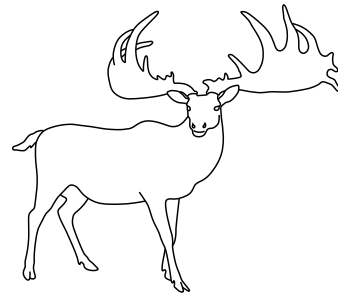
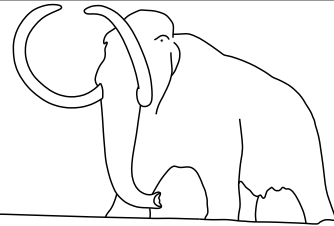
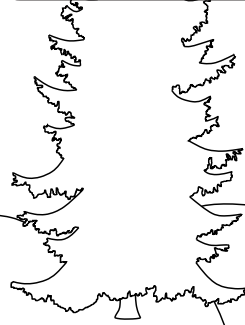
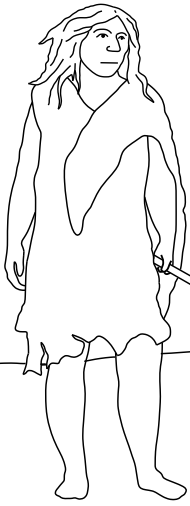
Mitika mya bilei mpe mitika misusu mizwami o mbeki mikoki kozala na proteine ya nyama to mpe ya milona mpe lisusu mitika mya mafuta ya bilei. Boyekoli mitika mina kala bokoki koyebisa biso elieli mpe elambeli ya bato ba kala.

## MAYE TOZALI KOYEKOLA

Balukiluki ba arkeolojia basalelaka nzela ya mayele mpe ntoki ya sika poya koyekola mambi maleka ma moto. Soki asaleli esaleli elamu ya mosala elembo ata ko eke (lokola mokuwa, lino to mpe sani) ekoki kolimbolela biso makambo mingi.

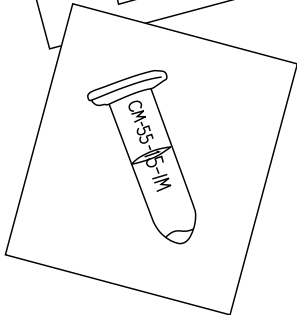
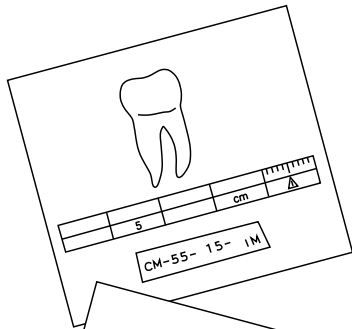
## OYEBAKI YANGO?

Bato ba Neandertal balimwi banso eleki mibu nkoto ntuku inei, kasi ADN ya bato ba Neandertal ezali komonana kino sika awa okati ya biteni bike bike bya selile ya nzoto ya bato ba sika baye bazali bai afrika te.



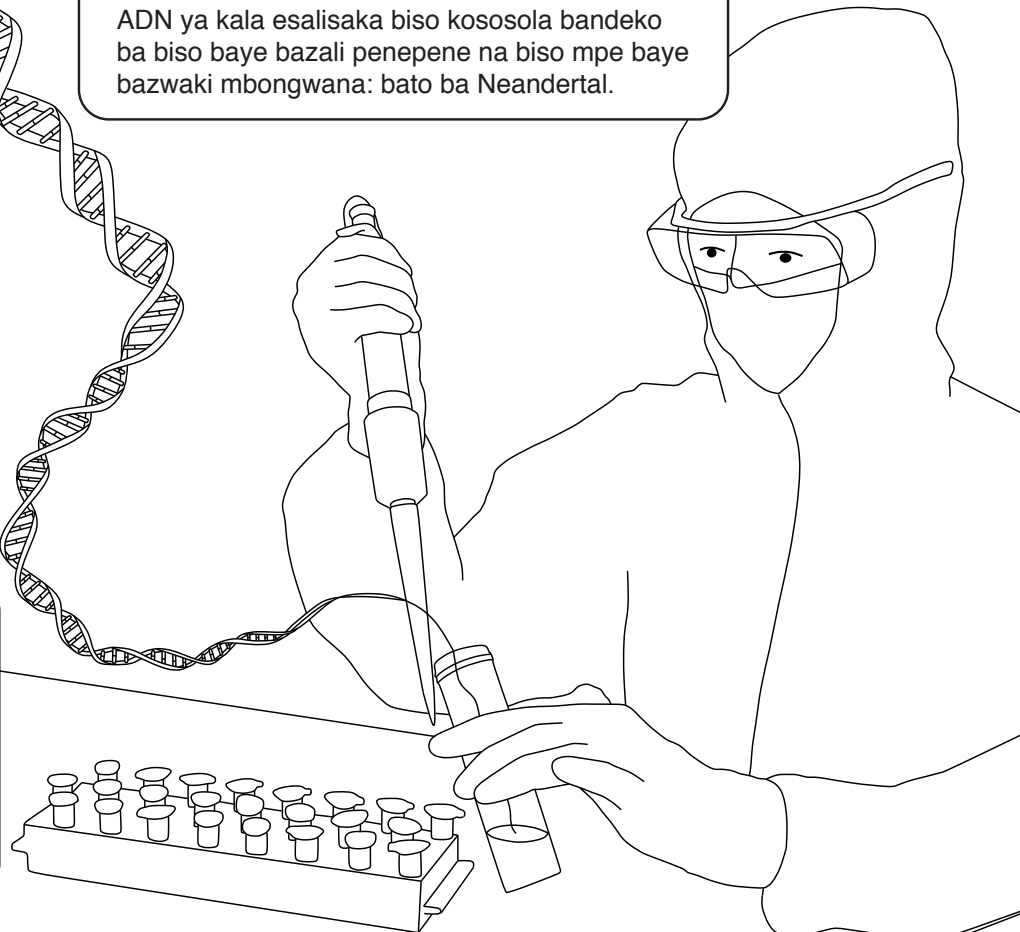
## EUTELO YA BATO

ADN ya kala esalisaka biso kososola bandeko ba biso baye bazali penepene na biso mpe baye bazwaki mbongwana: bato ba Neandertal.



## Mbongwana

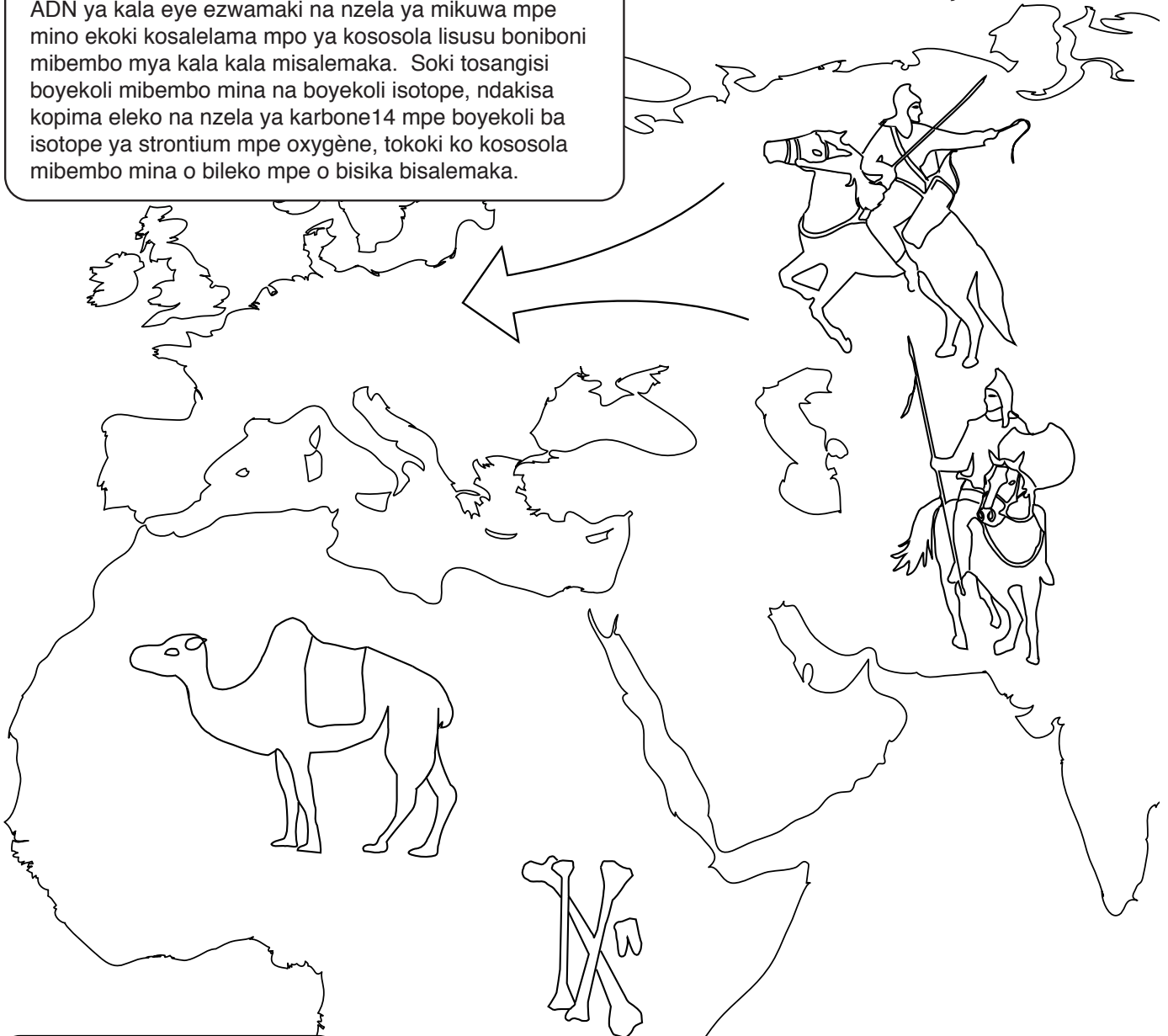
Na boyekolaka mino mpe mikuwa mya bato ba kala, tokoki koyeba lolenge nini bankoko ba biso babikaka mpe lolenge nini biso bato tokomi bikelamu biye tozali lelo.



# MIBEMBO MYA KALA

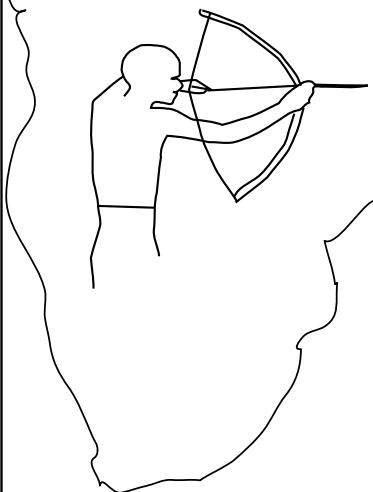
ADN ya kala eye ezwamaki na nzela ya mikuwa mpe mino ekoki kosalelamba mpo ya kososola lisusu boniboni mibembo mya kala kala misalemaka. Soki tosangisi boyekoli mibembo mina na boyekoli isotope, ndakisa kopima eleko na nzela ya karbone14 mpe boyekoli ba isotope ya strontium mpe oxygène, tokoki ko kososola mibembo mina o bileko mpe o bisika bisalemaka.

Scythes, Asia ya kati  
Age du Fer, mibu 700 liboso ya  
mbotama ya Yezu Kristu

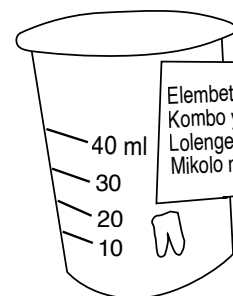


## OYEBAKI YANGO?

Radiokarbone, to mpe  $^{14}\text{C}$ ; ezali isotope ya karbone eye ekolemalema mpe yango ekomelama na milona o eleko ya photosynthèse. Nyama imemaka radiokarbone o kati ya biteni bya nzoto ya yango eleko izali kolia matiti. Radiokarbone ekitaka malembe malembe. Na bomekaka ndambo ya  $^{14}\text{C}$  o kati ya elembo yoko ya kala kala, ekoki kopesa makanisi poya koyeba o mobu kani ekelamu ezalaki na bomoi.



## Boyebi mibu o nzela ya karbone 14



Elembeteli ya elembo:  
Kombo ya moto wa mayele:  
Lolenge la elembo:  
Mikolo mya sanza:

Koyeba mibu o nzela ya karbone 14 ezali mbele mayele maye makoki kosalelamba poya koyebisa mibu mya milona mpe nyama eleki mibu nkoto ntuku inei (40 000 ans).

# ELIELI YA BANKOKO

Bato ba mayele (zebi) bakoki kosalela mikroskope mpo ya kozwa biteni bike bike bya bilei o kati ya sani ya kala mpe mino mya bato. Boyekoli mitika mike miye miyebisi biso bilei ba Mayas ba kala ba Mésoamerika bazalaki kolia eleki mibu nkoto ibale.

Copan, Honduras  
Eleko ya sika ya Maya,  
300 apr. J.-C.



Phytolithe ya masangu

Mokokoli mwa mbuma

Putulu ya fololo

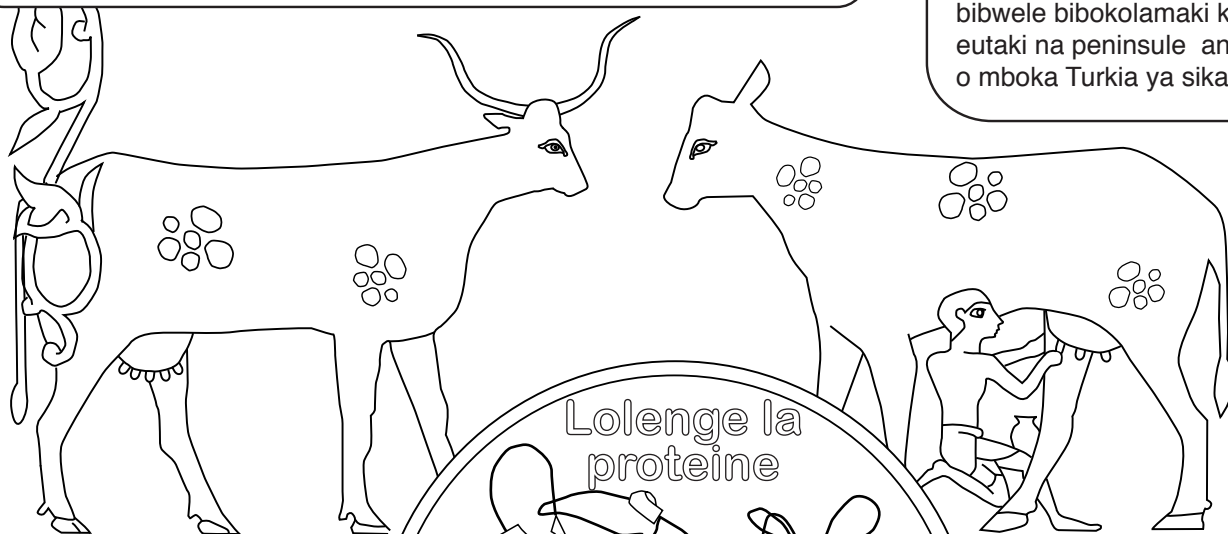
Amidon madesu

# KOBOKOLA

Mibu nkoto zomi mobimba bato bazalaki kolona milona mpe kobokola nyama na boponaka bilembeteli bya yango. Ngombe ezalaki nyama ya yambo kobokolama. Bato ba kala kala (bankoko) bazalaki kosalela nyama yango mpo ya komema mikumba, mpo ya nsuni ya yango, mabele mpe loposo.

## OYEBAKI YANGO?

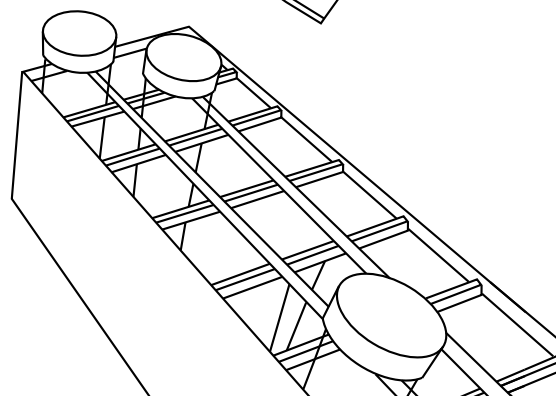
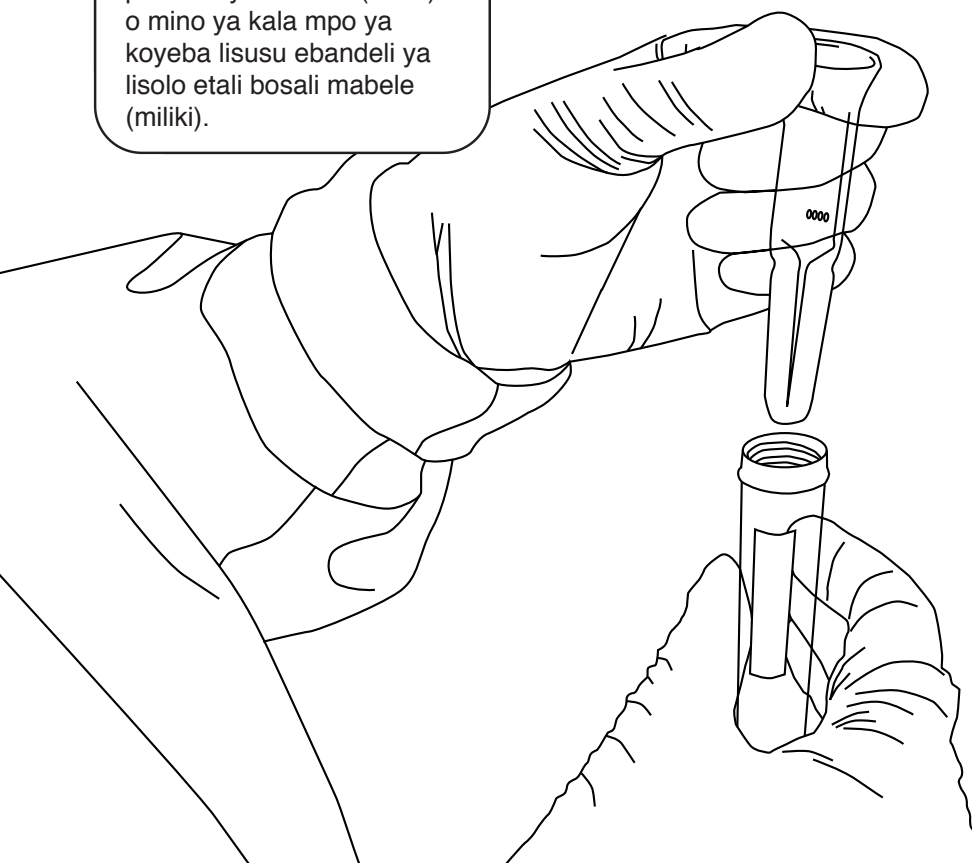
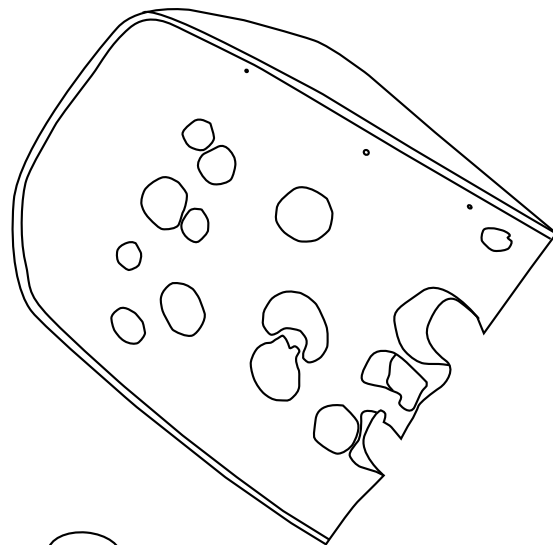
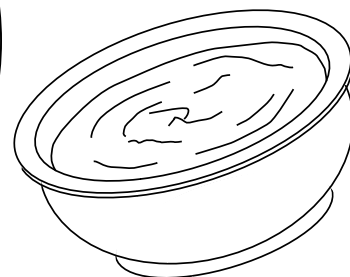
Ebwele ebokolamaki kolandana na nyama ibengami ngombe ya zamba lolenge yoko ya nyama ya zamba eulani na ngombe inene, lelo ilimwi. Elembo ya kala eye ekolakisa te bibwele bibokolamaki kala kala eutaki na peninsule anatolienne, o mboka Turkia ya sika.



Lolenge la  
proteine

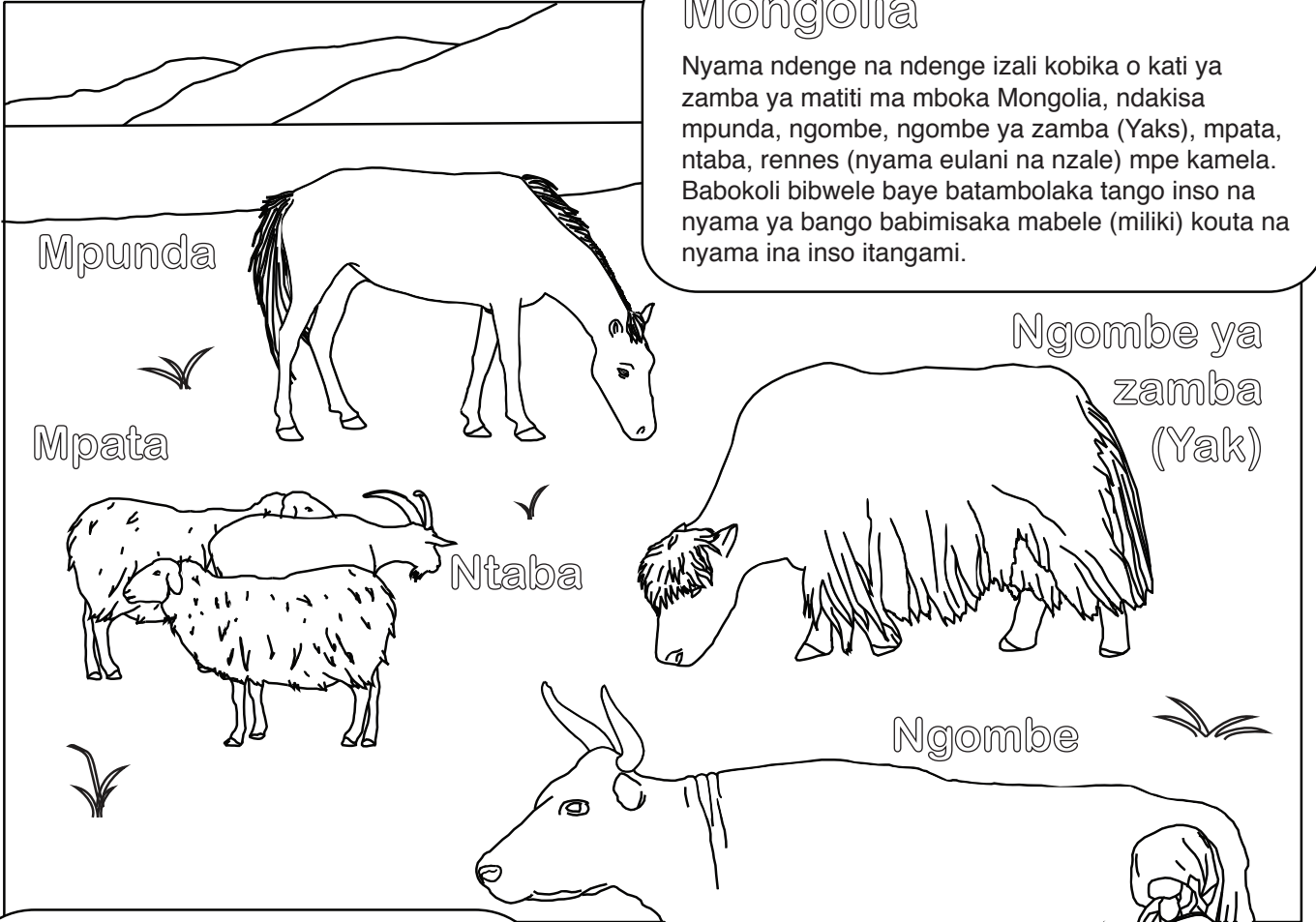
## Eutelo ya bosali mabele

Eutelo ya bosali mabele (miliki) eyebani penza penza te, kasi bato ba mayele basalelaka mayele maye mabengami spectrométrie yoko ebengami spectrométrie de masse poya kokukola ba proteine ya mabele (miliki) o mino ya kala mpo ya koyeba lisusu ebandeli ya lisolo etali bosali mabele (miliki).



# Mongolia

Nyama ndenge na ndenge izali kobika o kati ya zamba ya matiti ma mboka Mongolia, ndakisa mpunda, ngombe, ngombe ya zamba (Yaks), mpata, ntaba, rennes (nyama eulani na nzale) mpe kamela. Babokoli bibwele baye batambolaka tango inso na nyama ya bango babimisaka mabele (miliki) kouta na nyama ina inso itangami.



Mpunda

Mpata

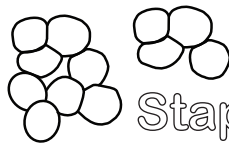
Ntaba

Ngombe ya zamba (Yak)

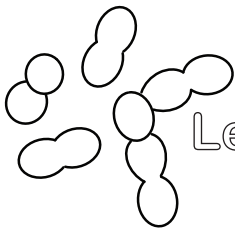
Ngombe

## BILOKO BIZALI NA MABELE (MILIKI)

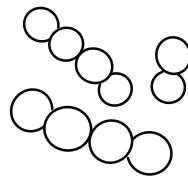
Biloko bizali na mabele (miliki) bizali yoko ya biloko bya litomba linene o kati ya bomoi o mboka Mongolia. Na nzela ya arkeolojia nde toyebi te lolenge lona la kobika eleki sikawa mibu penepene nkoto isato na nkama itano (3500 ans).



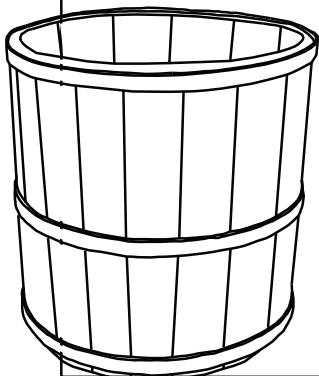
Staphylococcus



Leuconostoc

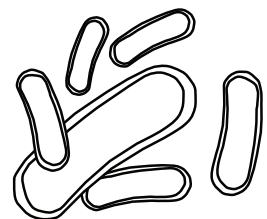


Lactococcus



## Nyama ya libumu

Mikrobe - mingi mingi penza ba bactéries mpe ba levure- izali na litomba linene mpo ya ko fulukisa mabele (miliki) ndenge na ndenge, ndakisa yaourt, beurre mpe fromage mpe lisusu biloko biyebani penza penza te ndakisa aaruul (mabele makaukisami na moi) mpe airag (masanga masalemi na mabele ma mpunda ya mwasi) kouta Mongolia.



Lactobacillus

am hilantia  
de de uone de cantate: qui tonim  
Aut Acidia

# MAKONO MA KALA

Mikuwa, mino mpe tartre ya mino ibombi nsango ya litomba mpo ya maye matali bokolongono bwa nzoto bwa bato ba kala (bankoko). Ndakisa ADN mpe proteine iye ibombami o tartre isungaka bato ba mayele mpo ya kososola mambi matali makono ma nsuni ya mino mpe boni boni mino ibebaka.

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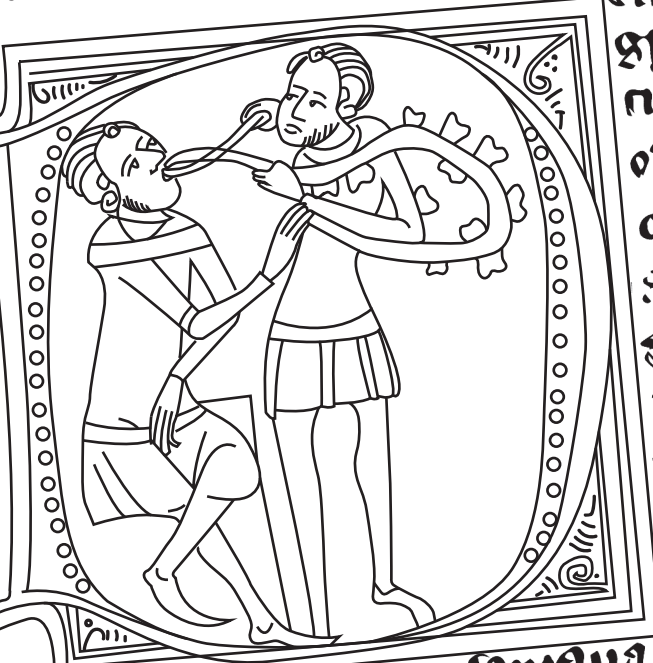
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### Omne Bonum

Omne Bonum ezali encyclopedie ya latino ya 14eme siacle likolo lya maye matali bomoi o mokili mwa Eropa eleko ya Moyen-Age iye ibombami o kati ya British Library. Izali na makoma maye makosakola maye matali mino mpe maye matali masalisi ma monganga maye makosalisa biso kososola bokolongono bwa nzoto mpe makono ma Moyen-Age.



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m

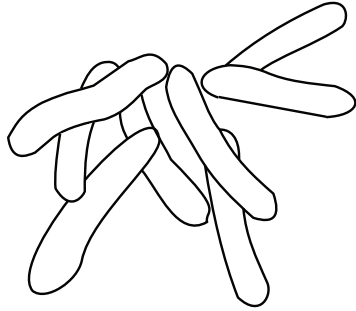
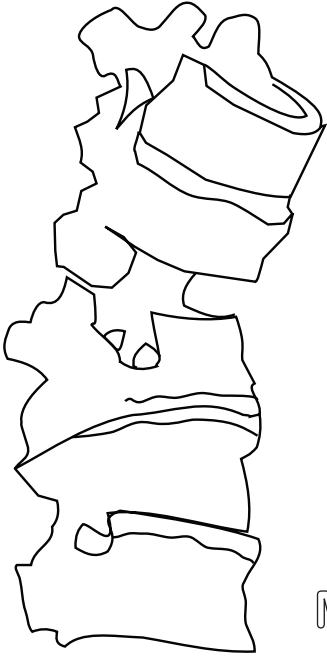


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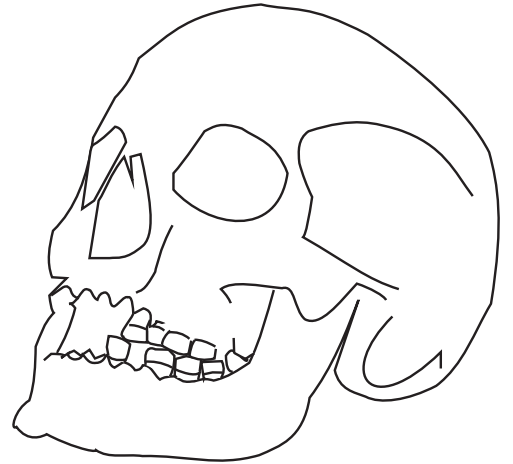
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a dulcora sup me

## KOSUKOSU YA LOHOMBE MPE MBALA

Kosukosu ya lohombe mpe mbala iutaka na ba bactéries iulani: *Mycobacterium tuberculosis* mpe *Mycobacterium leprae*. Bactéries ina ibale ikopesa bokono o mikuwa mpe bilembo bya ADN iye ikotikaka o skelete ya moto esalisaka bato ba mayele komanyola lisusu lisolo la makono mana ma kala.

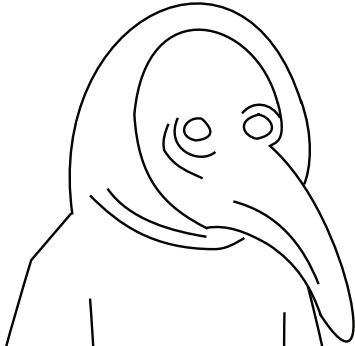


*Mycobacterium leprae*

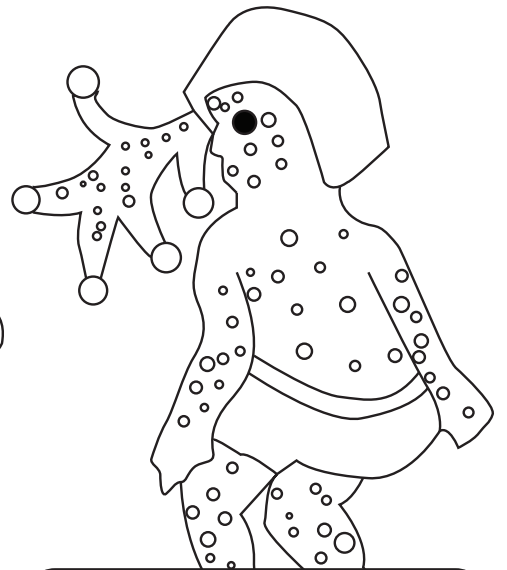
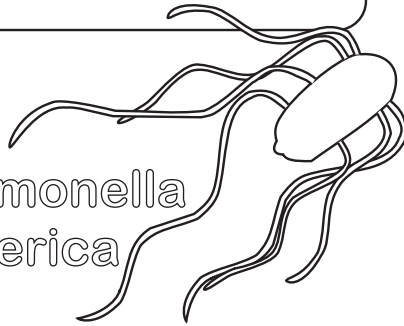


## COCOLIZTLI

Bokono boyebani te- bobengami na nkombo ya cocoliztli na ba Azteques- bobomi bato 60-90% o mboka Mexique o mibu kobanda 1545 kino 1550 apr. J. -C. Eleki ndambo ya mikolo, ADN ya bokono *Salmonella enterica* Paratyphi C emonanaki o mino ya bato baye babeli bokono bona.



*Salmonella enterica*



## Dokotolo Schnabel

Badokotolo baye basalisaka bato ba bokono o 17ème siècle bazalaka kolata minganza (masque) milandani na minoko mya ndeke poya komibatela na “mopepe mobe”.

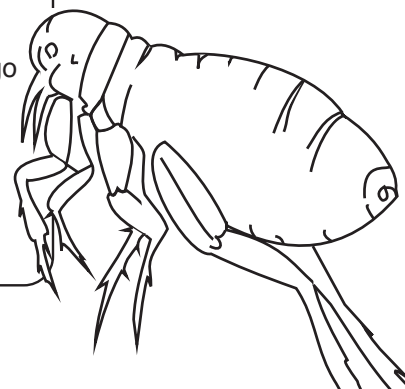


## Codex en Cruz

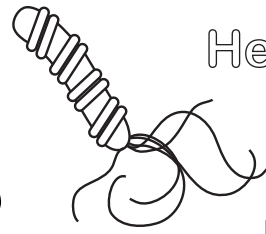
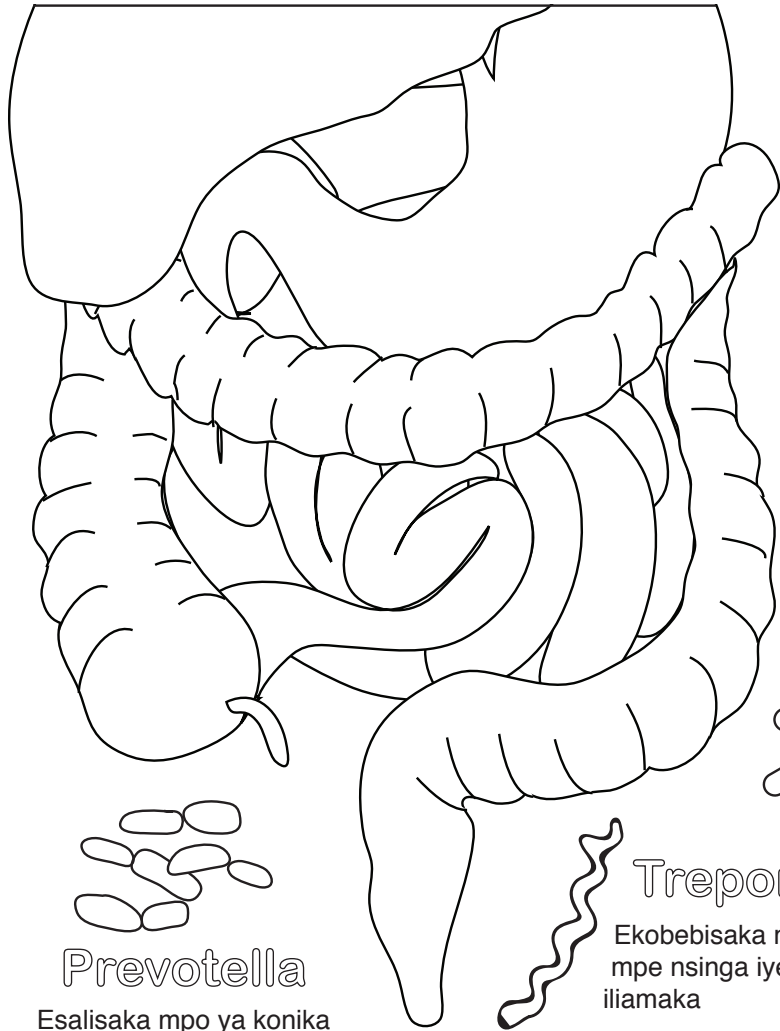
Buku eye ya azteque eye ekomami uto 16ème siècle elakisi na bilembani boni bokono bwa cocoliztli bokoyebana: fefele, loposo ya nzoto kobeba mpe kotanga makila mingi.

## PESTE (BOKONO BOBE)

Peste ezwamaka na nzela ya mikrobe ebengami *Yersinia pestis*. Yango ekopalanganaka na bopesaka bokono o nzela ya nyama nkeke iye ibikaka o loposo la mpanya. Bato baye baswami na nyama nkeke ina bakozwa bokono bobe (peste) boye bobimisaka makulu. Peste ezali bokono boye bobomaki bato ebele, bokono bwango bobengamaki “peste noire” (to mort noire) (1346-1353 apr. J.-C.) bobomaki bato penepene ndambo mobimba ya eleko ena o mokili mwa Eropa.







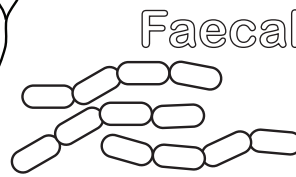
### Helicobacter pylori

Ebikaka o kati ya likundu mpe ekoki kobimisa likulu mpe kopesa bokono bwa kanser



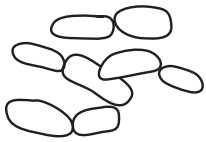
### Bifidobacterium

Esungaka bana mpo ya konika mabele maye bameli malamu



### Faecalibacterium

Ebimisaka bilei mpo ya ba selile ya misopo



### Prevotella

Esalisaka mpo ya konika malamu sima ya bolei matiti maye mazali na nsinga



### Treponema

Ekobebisaka matiti mpe nsinga iye iliamaka

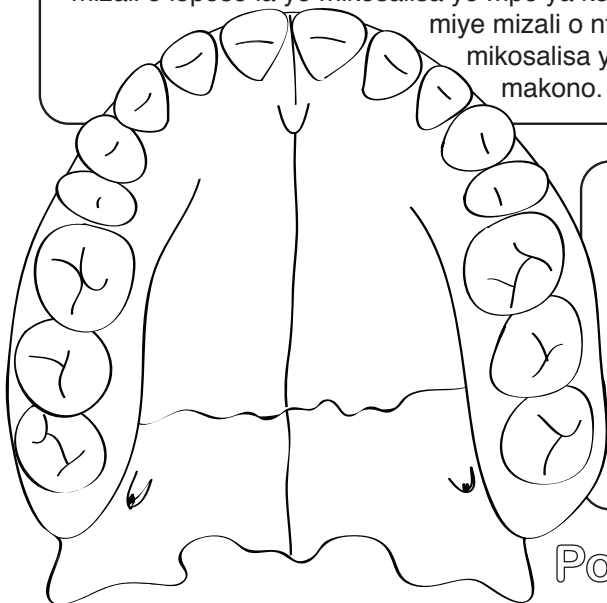


## MICROBIOME YA BANKOKO

Nzoto ya yo ebombi mikrobe **billiards** ebele ebele penza. Yango nde ebengami microbiome. Mikrobe iye ikobikaka o kati ya mosopo mwa yo ikosalisa yo mpo ya konika bilei mpe mpo ya kolendisa biteni bya nzoto biye bikobundisa makono mpo te mazwa yo te. Mikrobe miye mizali o loposo la yo mikosalisa yo mpo ya komipetola mpe mikrobe miye mizali o ntei ya monoko mwa yo mikosalisa yo mpo ya komibatela na makono.

### OYEBAKI YANGO?

Bato ba mayele bayekolaka calculs ya mino mpe nyei ya kala poya koyeba sikisiki microbiome ya bankoko mpe mpo ya kososola na bolamu ntina ya makono.



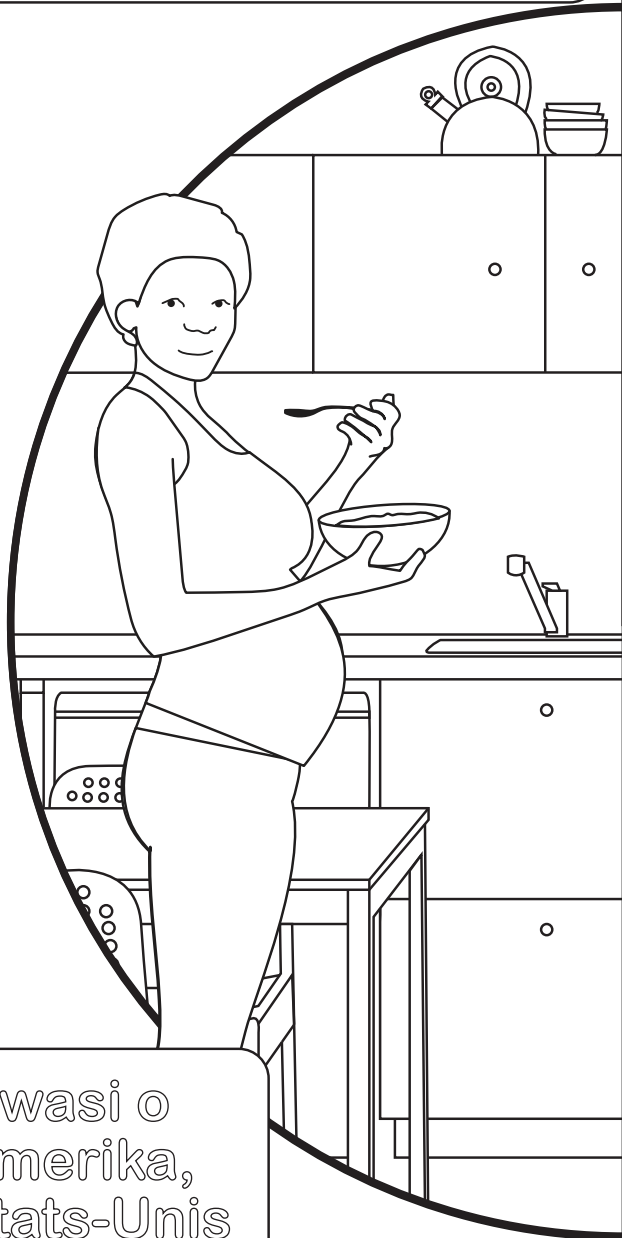
### Porphyromonas

## *BABOMI NYAMA MPE BABUKI MBUMA*

Babomi nyama mpe babuki mbuma baliaka bilei bya zamba mpe elieli ya bango ebongwanaka engebene na bileko bakobika.

Liboso penza te mambi ma bokati bilanga mabanda, eleki mibu penepene nkoto zomi, bato banso mokili bazalaka se babomi nyama mpe babuki mbuma.

Babomi nyama mpe babuki mbuma o mikolo miye bazali na microbiomes ya misopo ndenge na ndenge ikeseni na iye ya bato bakobika o mikolo mya ba industries.



Mwasi o  
Amerika,  
Etats-Unis



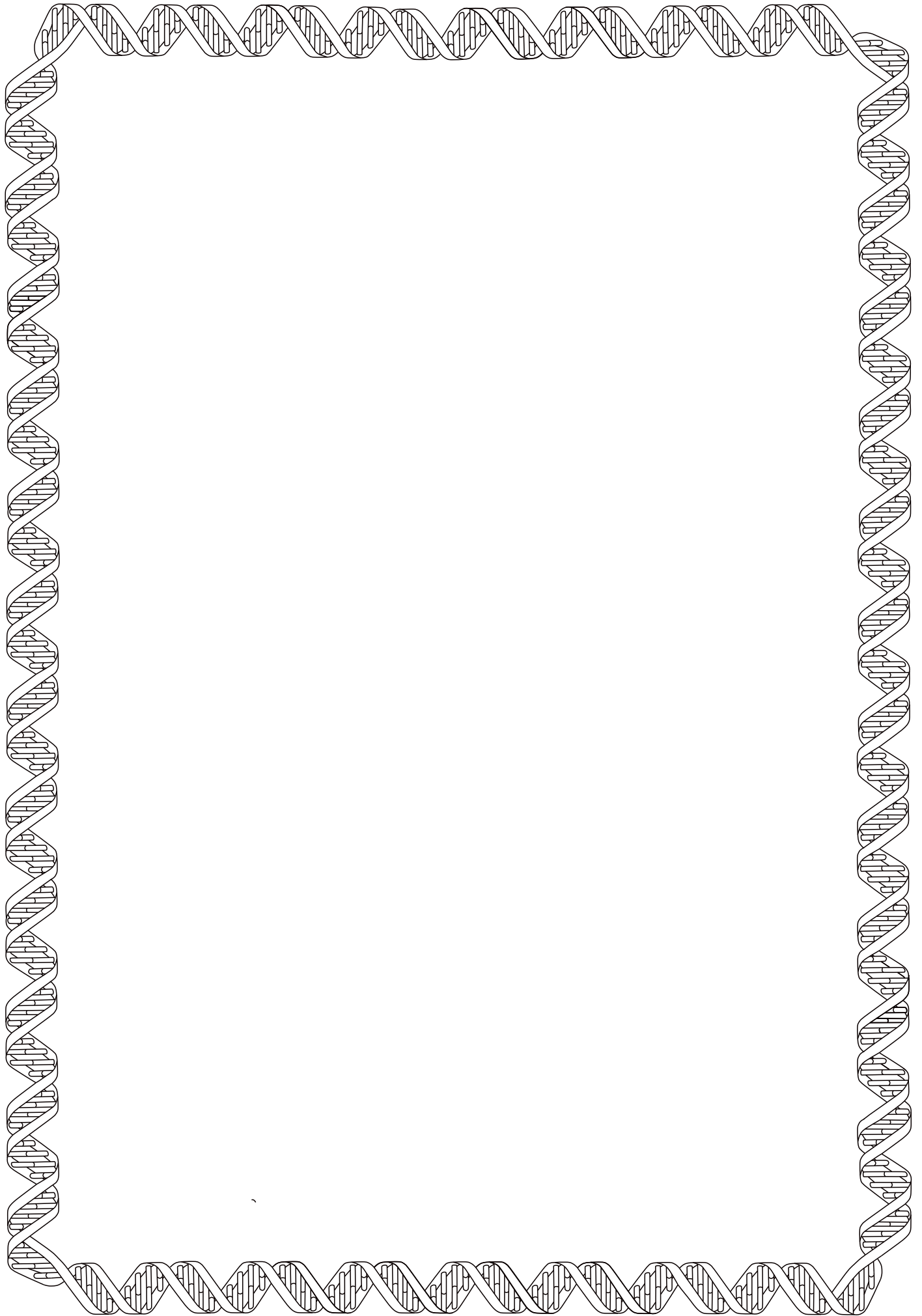
Mwasi mpe  
mwana hadza,  
Tanzania

## *BITUKA BIKOBIKA ELEKO YA BA INDUSTRIES*

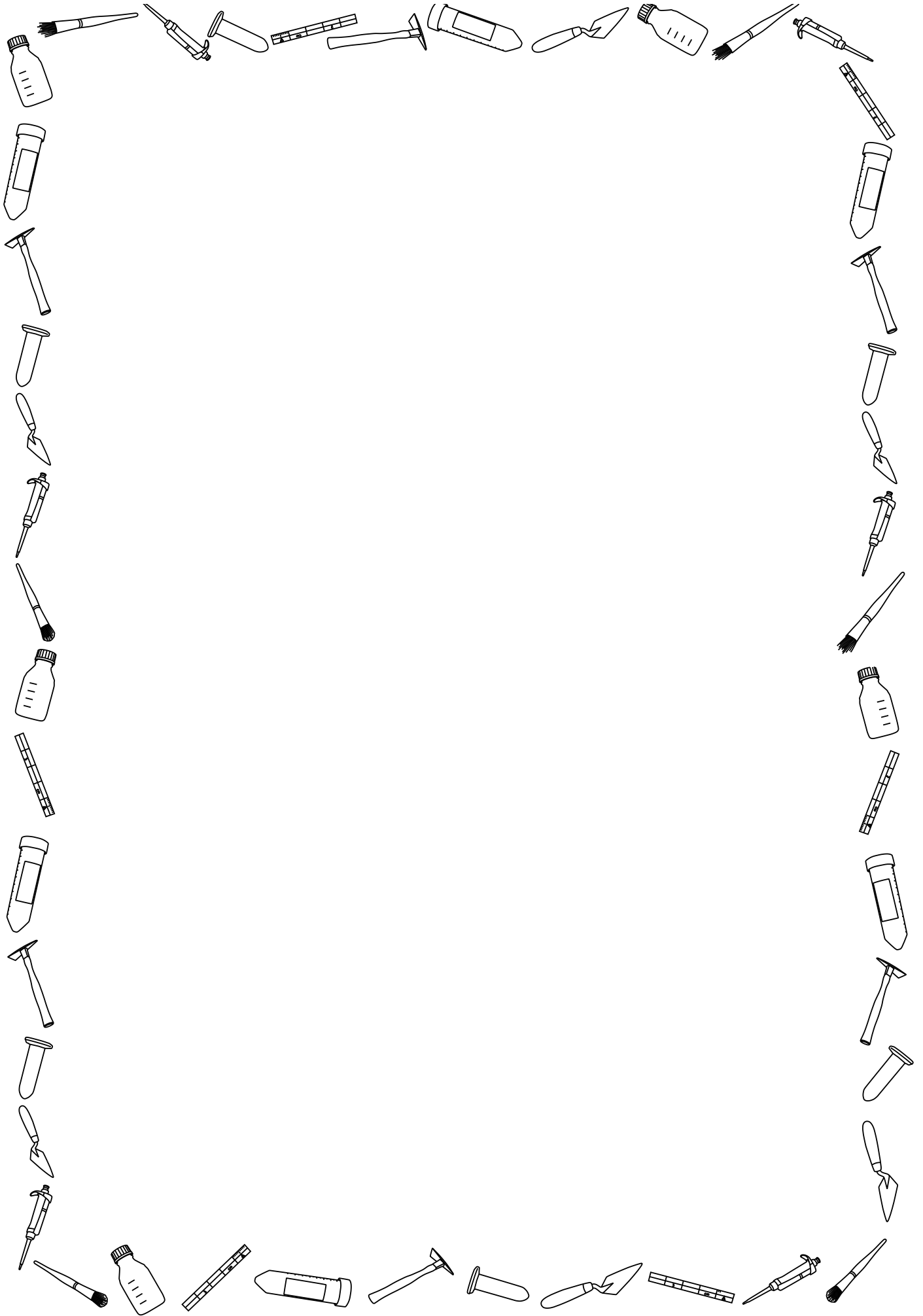
Bituka bya sika o eleko ya ba industries ikolia mingi mingi penza se mbuma ya misala mya bilanga mpe misala myango mikosalema se na mwa ndambo ya bato.

Bosaleli masini, lolenge la kobomba mpe kobatela biloko, yango nde izali mambi ma ntina mpo ya bobimisi bilei o eleko eye manso makosalema se na masini. Mpe bilei bikoki kosala mibembo misika penza yambo te iliama.

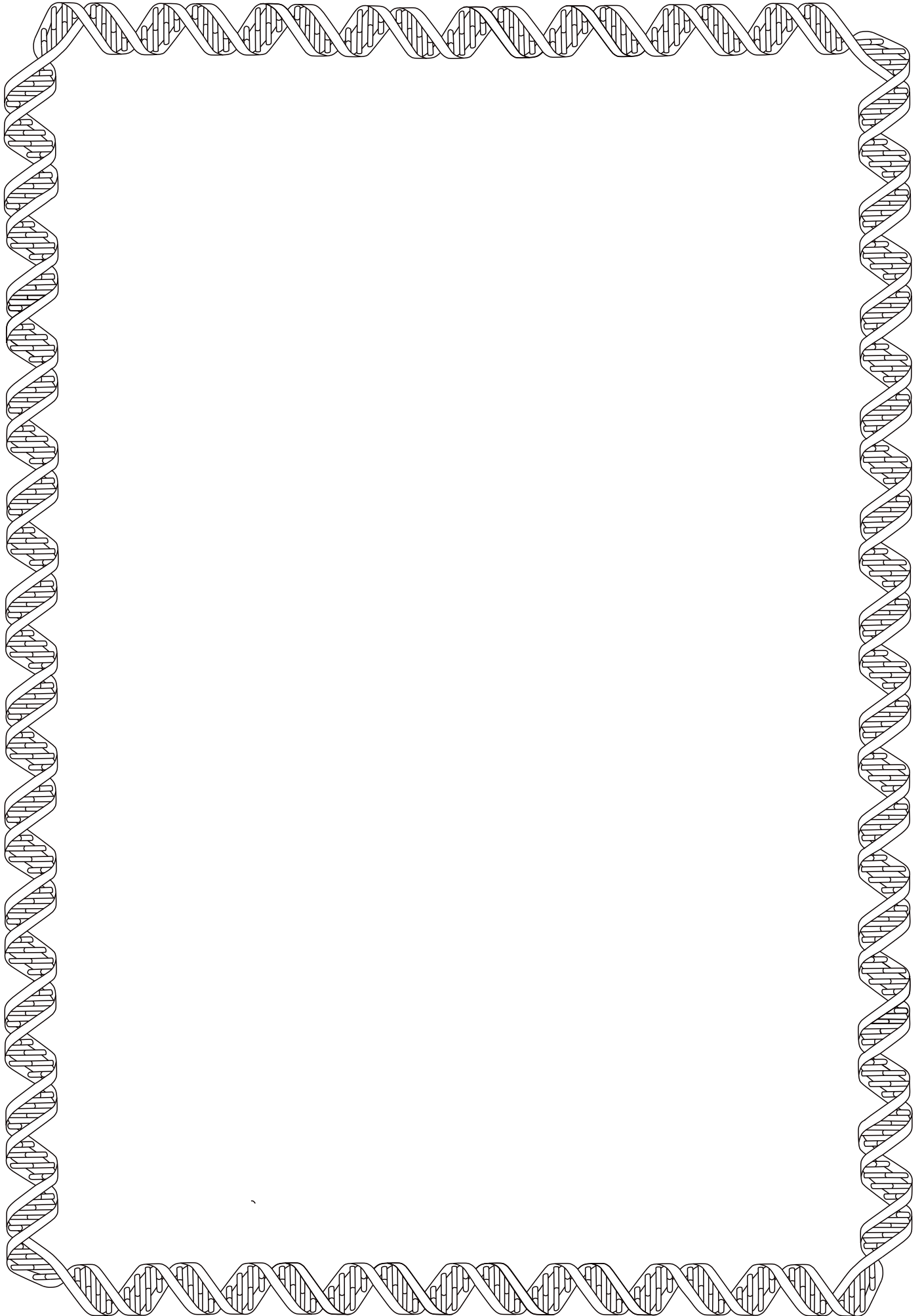
Bato baye bazali kobika o eleko eye ya ba industries bazali na microbiome ya mosopo eye ekobongwana penza penza te. Talaka ntina bakoki kozwa yoko makono ma kovimbavimba maye makobika te.





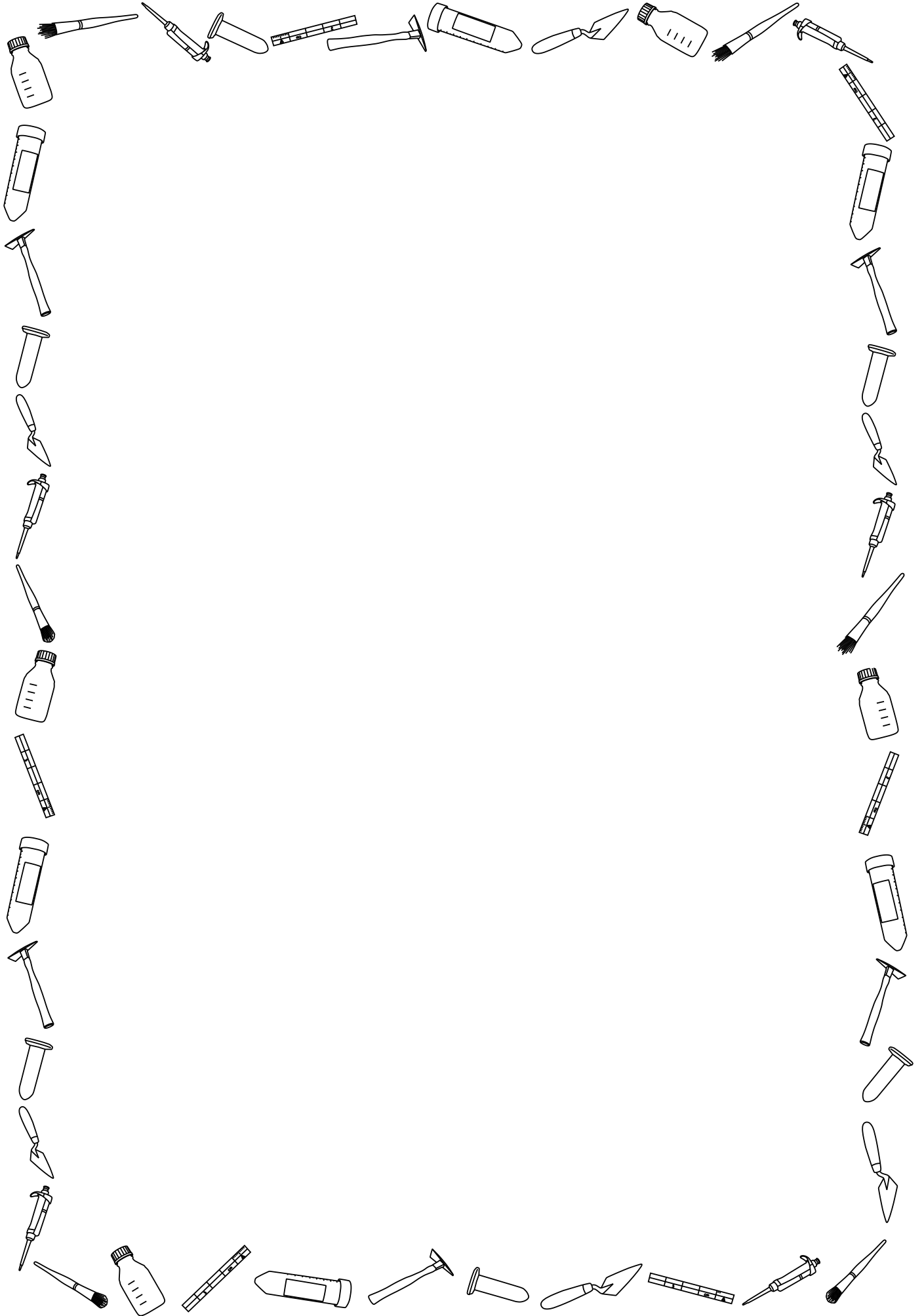




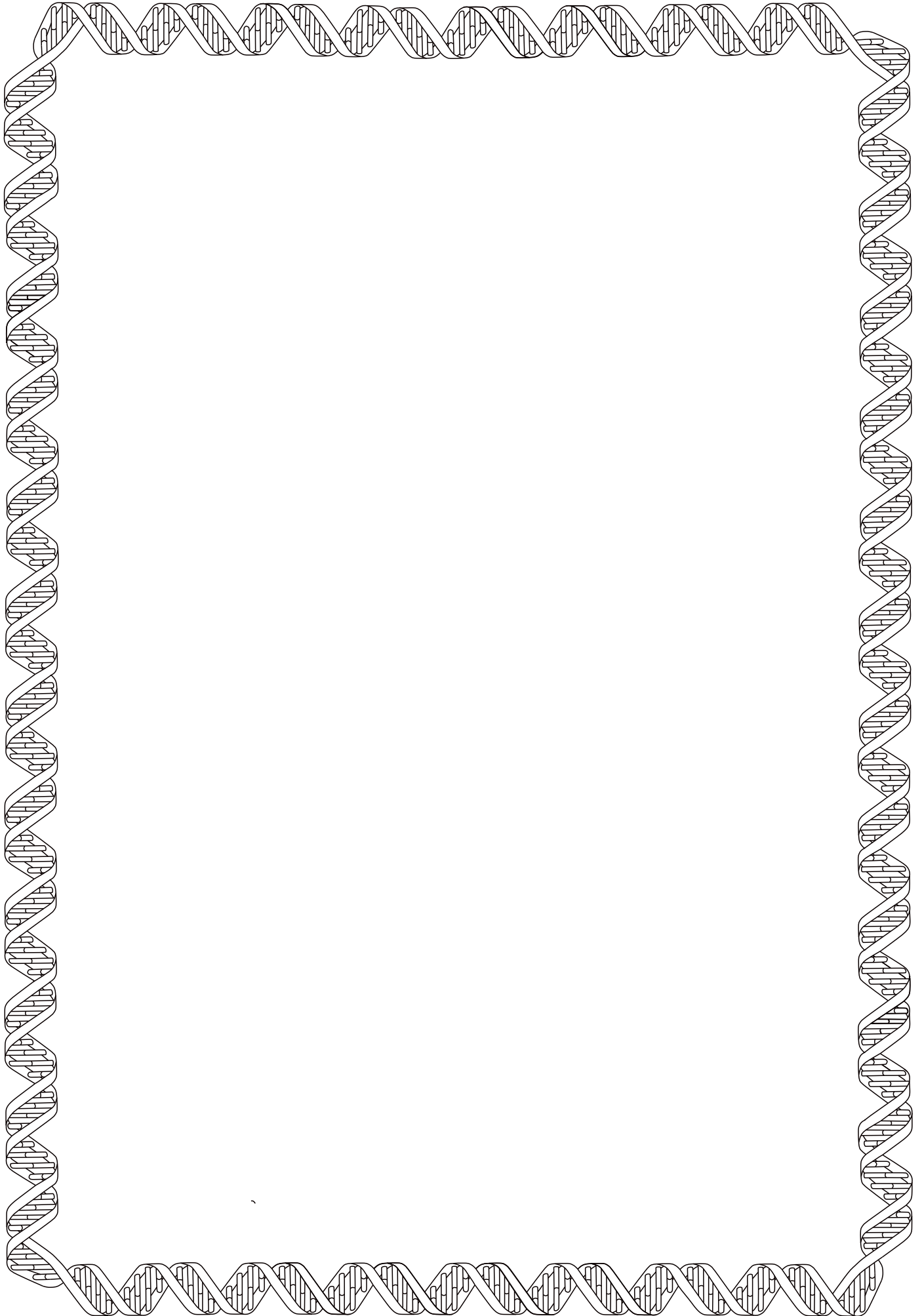






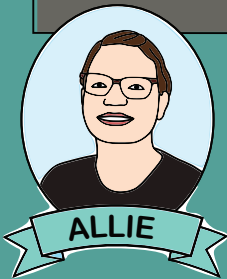




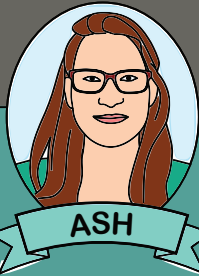




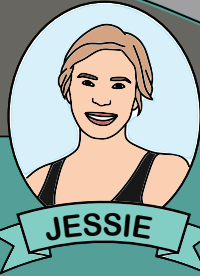
## Eteyelo Max Planck poya bokobi zebi za moto



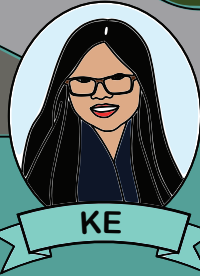
ALLIE



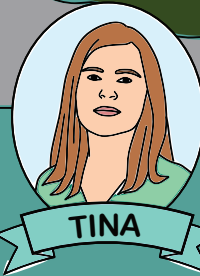
ASH



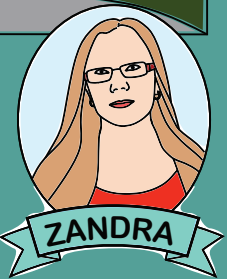
JESSIE



KE



TINA



ZANDRA

## Masapo o

# SIANSA YA ARKEOLOJIA

## Buku ya langi

Yekola lolenge nini bato ba arkeolojia mpe bato ba mayele basusu basalaka misala elongo pona kopesa biyano o mituna mitali bomoi bwa moto wa kalakala! Sala na biso elongo mpe **sosola biso malamu**, mpe **maye tozali koyekola uto ebandeli ya bomoi bwa bato** kino eleko **makono mabandaki o Moyen-Age**. Yekola mibembo mya bato ba kala mpe lolenge la boyekoli mibu o **nzela ya karbone 14**. Yekola boni boni bato ba mayele bakomanyola lisusu **elieli ya bato ba kala** na boyekolaka mitika mya milona o mikroskope. Kundola sekele ya bobokoli mpe zebi iye ibombami o **biloko bizali na mabele** (miliki). Manyola malamu **makono ma kala** mpe **makono maye mazwaka bato mingi na mbala yoko** mpe kundola **microbiome ya bato eye ezamaki epai ya bankoko**.

Esalemi na balukiluki ba Eteyelo Max Planck mpo ya Anthropologie évolutive.

Ebongolami na Lingala na Modeste Kandolo Simba mpe Nicolas Mombaya Liwila.



MODESTE



NICOLAS