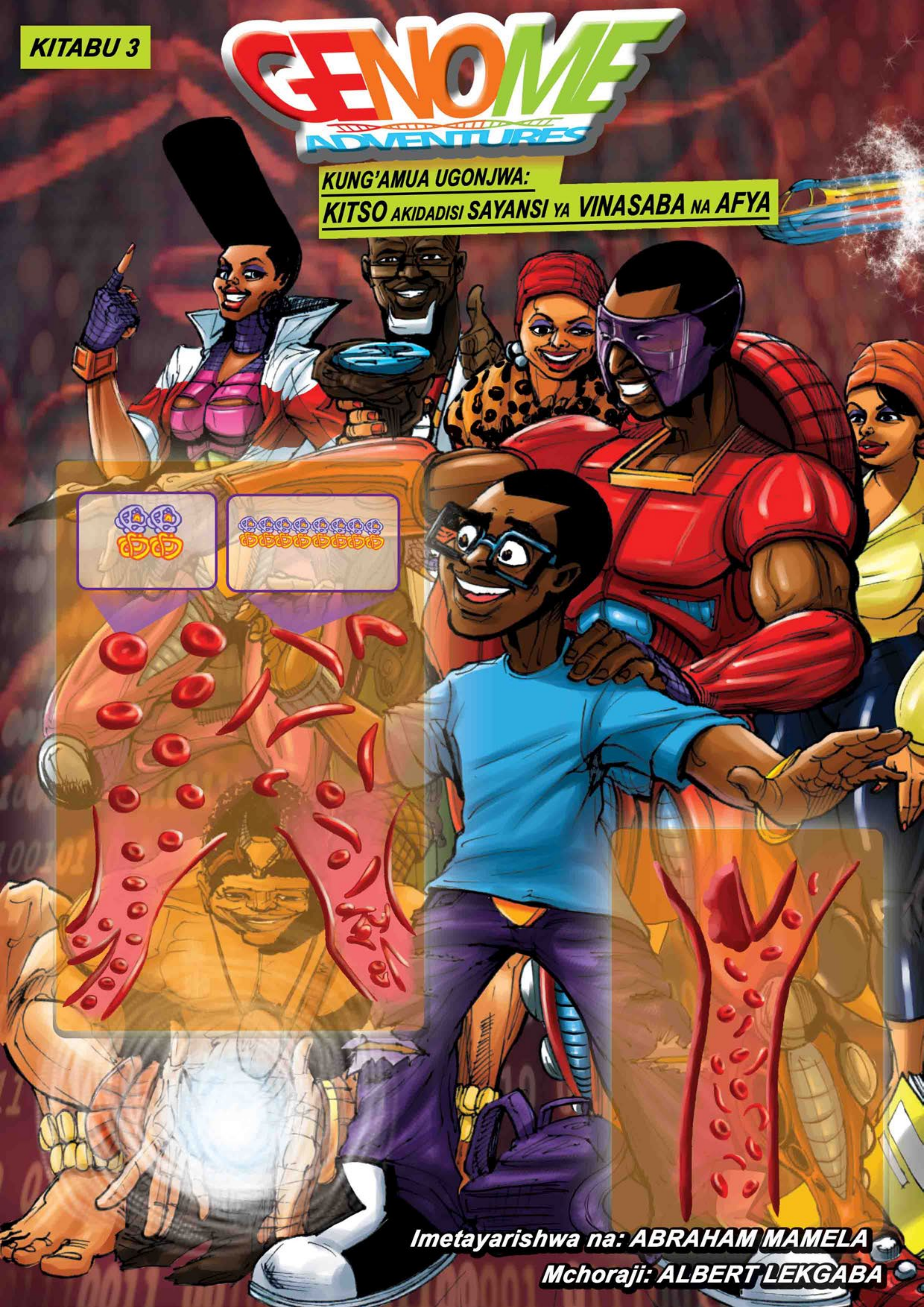
KITABU 3

GENOME ADVENTURES

KUNG'AMUA UGONJWA: KITSO AKIDADISI SAYANSI YA VINASABA NA AFYA



Imetayarishwa na: ABRAHAM MAMELA
Mchoraji: ALBERT LEKGABA

FOREWORD

The Ministry of Infrastructure, Science and Technology (MIST) has a mandate to provide and maintain building infrastructure, serve as a regulatory body for the use of nuclear technology and to coordinate Research, Science, Technology and Innovation. The key words science, research, technology and innovation define the core vision while consultation and collaboration with stakeholders are critical enablers of its mission. Broadly, MIST's stakeholders include artists and other players in the scientific arena.

The art industry plays a very crucial role in our society. Through art we can challenge our society's deepest assumptions, spark new ideas, inspire critical thought and vision and elicit new actions in society. Imaginations of future cities can come through the inspiration of artists. Through the use of cartoons and comics art can simplify and explain complex scientific concepts, demystify science and thus be a very powerful tool for communication. Therefore, we at MIST view art and artists as important collaborators and enablers of our vision and mission.

I am pleased to note that the Botswana-Baylor Children's Clinical Centre of Excellence (COE) is using art and comics to reach out, engage and educate the community on the complex topic of genes and how they relate to health and disease. In part fulfillment of the goals of the ongoing Collaborative African Genomics Network (CAfGEN) the COE has brought together a team of artists, cartoonists, scientists and journalists to develop a comic book series called Genome Adventures. Funded jointly by Wellcome Trust and the US National Institutes of Health, Genome Adventures is presented in four books. Those in the know will recall that in the first and second books, Kitso, the young hero of the series, with the assistance of several superheroes explored "Heredity and Genetics" and "Cracking the Code," respectively.

The current series of Genome Adventures consists of books three and four. In book three entitled "Decoding Disease" Kitso explores genes and health; and in the fourth entitled "Hope on the Horizon" he explores the intricacies of biomedical and genomics research. Through his amazing adventures Kitso travels the world, experiencing different cultures along the way as he learns about the link between health and genetics. As before, the books are presented in a pictorial and entertaining way using simple language and they can be enjoyed and understood by all. I understand the books will soon be translated into Setswana and several other African languages for greater reach. The Genome Adventures series clearly demonstrates that research and development offer great potential to solving societal problems; and further that even difficult scientific concepts can be communicated to all using comics. At MIST we salute all those involved in creating Genome Adventures. I wholeheartedly endorse this pioneering effort and urge those concerned to consider turning the books into a digie.

Nonofo E. Molefhi
Minister for Infrastructure,Science and Technology

KITSO

MULI MUTYA! NZE KASAJJA. MBEERA WANDEGEYA NE SSENGA. NJAGALA NNYO EBY'OKUVUMBULA! NNAZAALIBWA N'AKAWUKA AKALEETA MUKENENYA NAYE EKYO TEKINVUVUBA.

DR. MABOKO

NZE NKULIRA EKIBINJA EKIVUMBUZI KU BY'OBUTONDE BW'EBIRAMU (NAKAYONDO ABEERE NGA ABAGAMBA KI!) NNINA OBUSOBOZI OBUSAMAARZA OBUMPISA MU BISENGE NE MBUZAAWO SUKUUTA KANGE WANO ATE NENKADDIZAAWO ERI. SIKOMA AWO, MMANYA OMUNTU BY'ALOWOOZA!

KGOSIGADI

NDI MUKYALA ATEEMOTYAMOTYA ERA OMUKULEMBEZE WA BANTU BANGE OWA NNAMMADDALA, BA NNAYUGANDA. NNYINZA OKUBALABIKIRA NGA JJAJJAMMWE OWA BULIJJO, NAYE OMUGGO GWANGE GWENTAMBUZA GULINA AMAANYI AG'ENJAWULO AGAAVA MU BA JJAJJANGE! NGA NKOZESA AMAANYI GANO, NNYINZA OKULOGA ENKUBA, OKULAGIRIRA ENSOLO, N'OKUKOLA EBYEWUUYISA EBIRALA.

PHODISO

NZE PHILIPPA NAYE OYINZA OKUMPITA "SSENGA". BAABA BWE YAFA YANDEKERA OMWANA WE KASAJJA, ERA KASAJJA, MMWAGALA NGA BWE NJAGALA ABAANA BANGE ABALALA! TUBEERA FFENNA E WANDEGEYA, NGA WAKAVA OTI E KAMPALA TUYINZA N'OKUBEERA BALIRAANWA BO!

XGAO-TCGAI

NZE KWATA-MU NSAWO [OBA "KWATA" MU BUFUNZE]. NNENYUMIRIZA OKUBA OMUMBUTI- ABAMU ABANTU BANGE BABAYITA BA 'NNAKALANGA' OBA 'BUNNAKALANGA'. ERA NDI MUZIRA MU BAZIRA MU MAANYI G'OKUTAMBULIZA ABANTU MU BISEERA! ERINNYA LYANGE, NGA TOLIGENZE BUZIBA, LITEGEEZA 'OKULABA OKUSALA NG'AKAGIRITA', KUBANGA ENDABA YANGE NJOGI NGA AKAMBE AKOOGI ERA NSOBOLA N'OKULABA EBY'OMU MAASO!

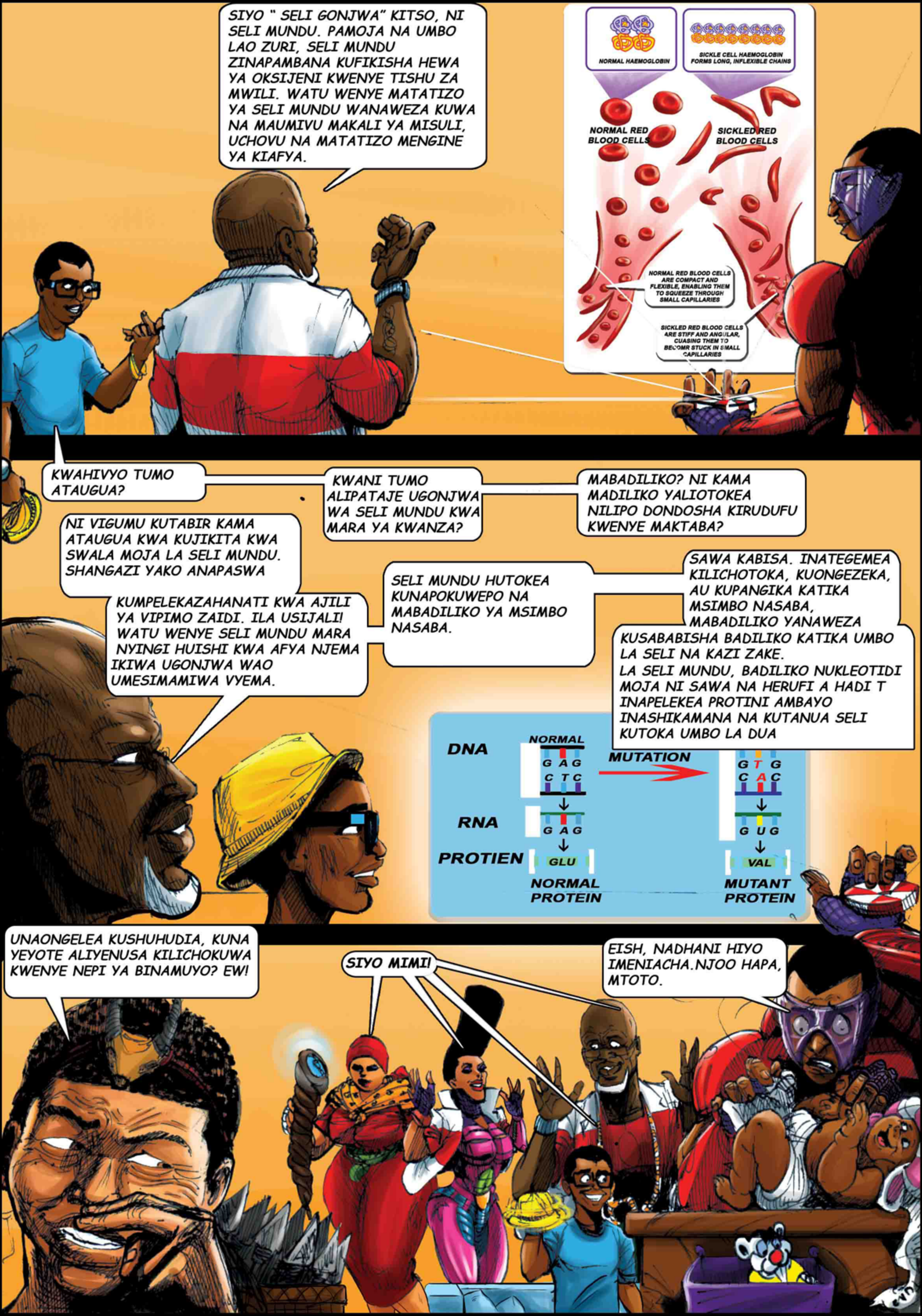
MARANYANE

MULI MUTYA! NGA ERINNYA LYANGE, MAKANIKA, BWE LIRI, NJAGALA EBY'EMIKONO. MWEKEBEJJE OMUBIRI GWANGE! EKITUNDU EKIMU KYUMA ATE EKRALA MUNTU. MU BWONGO NSAZA BUSAZA ERA NJAGALA OKUKOESA EBIKOZESEBWA EBYAKAFULUMA!

MMATLI

NZE NNANZIRI. NDI MUNOONYEREZA! NANGE NNINA AMAANYI AG'ENJAWULO AGASOBOLA OKUTONIYA EBINTU OKUBITUUSA KU BUNENE BW'EBIRABIBWA GAALBINDI EZIZIMBULUKUSA ZOKKA NG'OMWO MW'OTWALIDDE N'ABANTU! NJAGALA EBYEWUUNYO SSAAYANSI BY'ATUYAMBA OKUVUBULA ERA NNANDIYAGADDE OKULABA ABAWALA ABATO ABALALA MU UGANDA NGA BAFUUKA BA NNASSAAYANSI NGA NZE!

NIMEKUWA NA MSHITUKO, LAKINI SINA MUDA TENA!
WHOA, HIYO NI KAMA MAKAZI YA SELI INAONEKANA KAMA KISAHANI!
INAONEKANA KAMA SELI MUNDU!
HICHO NI NINI?
NI KITU TUNAPASWA KUKIONGELEA, LAKINI TUNAHITAJI KUKUNJUA MMATLI YAKO, NGOJA TUMLETE KITSO NYUMBANI.
HIYO SAFI. KITSO, TAYARI?
TAYARI.
LAKINI… KILIKUWA NINI HICHO "SELI GONJWA" NIMEKINAKILI MWISHO WA SAFARI?
ZOOOOOOP!

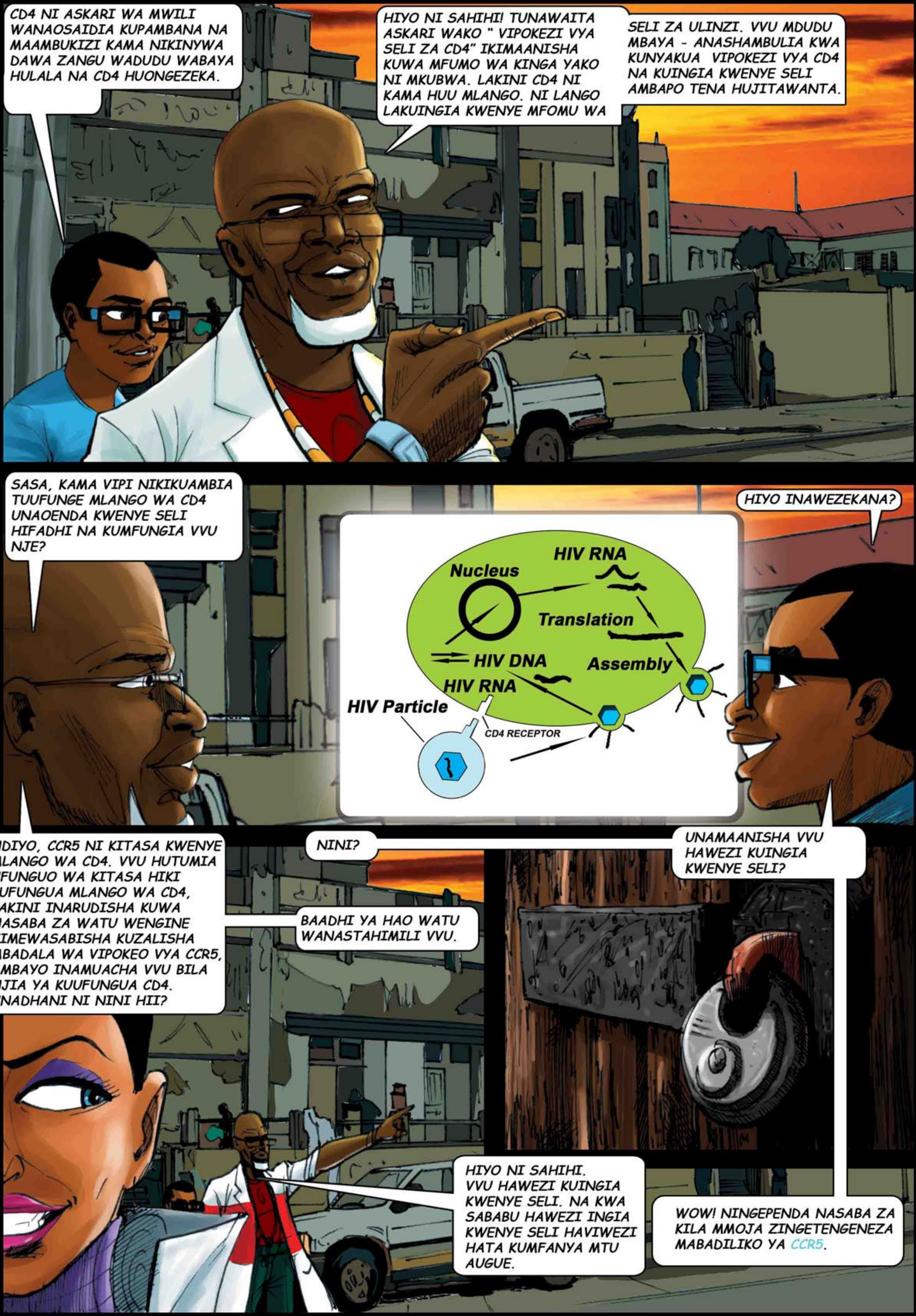

SIYO " SELI GONJWA" KITSO, NI SELI MUNDU. PAMOJA NA UMBO LAO ZURI, SELI MUNDU ZINAPAMBANA KUFIKISHA HEWA YA OKSIJENI KWENYE TISHU ZA MWILI. WATU WENYE MATATIZO YA SELI MUNDU WANAWEZA KUWA NA MAUMIVU MAKALI YA MISULI, UCHOVU NA MATATIZO MENGINE YA KIAFYA.
NORMAL HAEMOGLOBIN
SICKLE CELL HAEMOGLOBIN FORMS LONG, INFLEXIBLE CHAINS
NORMAL RED BLOOD CELLS
SICKLED RED BLOOD CELLS
NORMAL RED BLOOD CELLS ARE COMPACT AND FLEXIBLE, ENABLING THEM TO SQUEEZE THROUGH SMALL CAPILLARIES
SICKLED RED BLOOD CELLS ARE STIFF AND ANGULAR, CUASING THEM TO BECOMR STUCK IN SMALL CAPILLARIES
KWAHIVYO TUMO ATAUGUA?
KWANI TUMO ALIPATAJE UGONJWA WA SELI MUNDU KWA MARA YA KWANZA?
MABADILIKO? NI KAMA MADILIKO YALIOTOKEA NILIPO DONDOSHA KIRUDUFU KWENYE MAKTABA?
NI VIGUMU KUTABIR KAMA ATAUGUA KWA KUJIKITA KWA SWALA MOJA LA SELI MUNDU. SHANGAZI YAKO ANAPASWA
KUMPELEKAZAHANATI KWA AJILI YA VIPIMO ZAIDI. ILA USIJALI! WATU WENYE SELI MUNDU MARA NYINGI HUISHI KWA AFYA NJEMA IKIWA UGONJWA WAO UMESIMAMIWA VYEMA.
SELI MUNDU HUTOKEA KUNAPOKUWEPO NA MABADILIKO YA MSIMBO NASABA.
SAWA KABISA. INATEGEMEA KILICHOTOKA, KUONGEZEKA, AU KUPANGIKA KATIKA MSIMBO NASABA, MABADILIKO YANAWEZA
KUSABABISHA BADILIKO KATIKA UMBO LA SELI NA KAZI ZAKE. LA SELI MUNDU, BADILIKO NUKLEOTIDI MOJA NI SAWA NA HERUFI A HADI T INAPELEKEA PROTINI AMBAYO INASHIKAMANA NA KUTANUA SELI KUTOKA UMBO LA DUA
DNA
NORMAL
G A G
C T C
MUTATION
G T G
C A C
RNA
G A G
G U G
PROTIEN
GLU
VAL
NORMAL PROTEIN
MUTANT PROTEIN
UNAONGELEA KUSHUHUDIA, KUNA YEYOTE ALIYENUSA KILICHOKUWA KWENYE NEPI YA BINAMUYO? EW!
SIYO MIMI!
EISH, NADHANI HIYO IMENIACHA.NJOO HAPA, MTOTO.

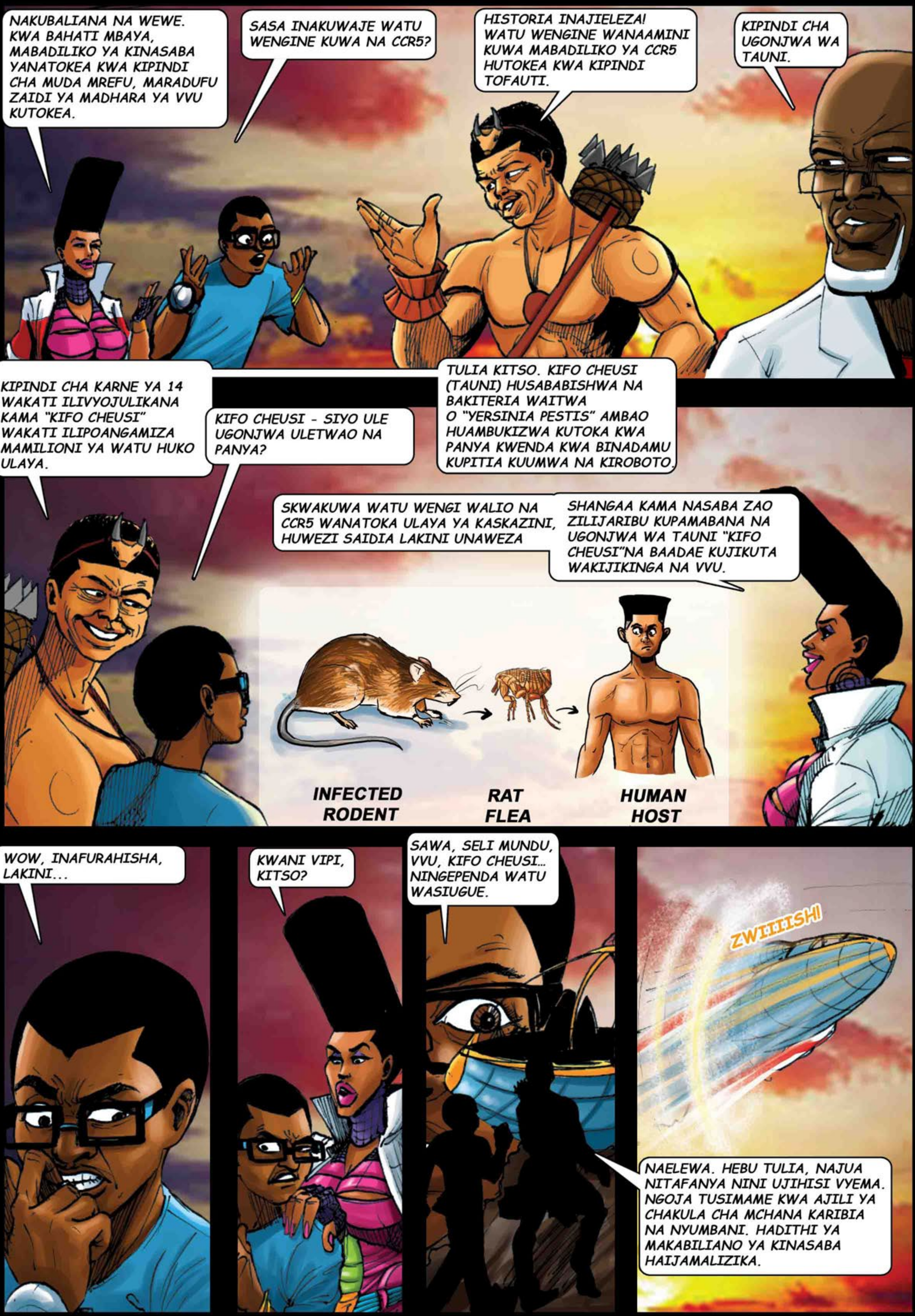
UNASEMA BINAMU YANGU ANA MAKOSA KWENYE MSIMBO NASABA WAKE?
MABADILIKO NI KUBADILIKA KWA MSIMBO NASABA. HATUYAITI "MAKOSA" KWAKUWA MABADILIKO MENGINI YANATUSAIDIA KUMUDU MAZINGIRA YETU.
NASIKIA KAMA TUNAINGIA HATUA NYINGINE YA SAFARI YETU!
KUTOKANA NA UTAFITI WANGU WA MAMBO YA KALE, MABABU WA BINAMU YAKO WANATOKA UKANDA WA AFRICA KWASASA UNAJULIKANA KAMA ANGOLA.
KWA HIVYO?
ZWOOOOSH!
HIVYO NI MUDA WA KUONA MABADILIKO YAKITOKEA, BWANA.
KILA MMOJA VUTA KAMBA.
VIPI KUHUSU TUMO?
ATAKUJA NASI. BAADA YA YOTE, HII NI HADITHI YAKE!

BEM-VENDA MLUANDA.
INI BEM-VIN-DO, SIYO VEN-DA. ACHA KUJIONYESHA KWA WATU VITU USIVYVO VIJUA.
HUH?
ALICHOJARIBU KUSEMA ILIKUWA KARIBU LUANDA, MJI MKUU WA ANGOLA.
EISH, INGEKUWA SAWA ISIPOKUWA KWA HAWA MBU WOTE!
HAPA, PULIZIA DAWA YA WADUDU.
ASANTE! KWAHIYO ...KWANINI TUPO HAPA TENA?
VYEMA KITSO, ANGOLA NI KATI YA NCHI ZENYE IDADI YA JUU YA UGONJWA WA SELI MUNDU DUNIANI. KILA MWAKA TAKRIBANI WATOTO 10,000 WANAZALIWA NA SELI
MUNDU, MADAKTARI NA MANESI WANAWAPIMA WATOTO MAPEMA ILI KUWAPATIA HUDUMA STAHIKI.
KWANINI UGONJWA WA SELI MUNDU NI MWINGI HAPA KULIKO BOTSWANA?

INATEGEMEA NASABA RITHI ULIZOZIPATA KUTOKA KWA MABABU ZAKO.
XT YUPO SAHIHI. SELI MUNDU NI UGONJWA RIDHI, HIVYO NI MARA CHACHE KUWEPO LAKINI PIA INAWEZEKANA. HUWA
INATOKEA MARA CHACHE KWA WATOTO AMBAO WAMERITHI NASABA KUTOKA KWA MAMA AU BABA.
UNAFFECTED "CARRIER" FATHER
UNAFFECTED "CARRIER" MOTHER
UNAFFECTED 1 IN 4 CHANCE
UNAFFECTED 2 IN 4 CHANCE
AFFECTED 1 IN 4 CHANCE
WAKATI MWINGINE KINACHO VUTIA ZAIDI NI JINSI HAYA MABADILIKO YANAVYO WEZA KUTOKEA KWA MARA YA KWANZA. KITSO UNAKUMBUKA NILIVYO WAHI KUTAJA KUWA MABADILIKO YANAWEZAKUTOKEA KAMA NJIA YA KUKABILIANA NA MAZINGIRA.
NDIYO. UNASEMA KUWA SELI MUNDU INAWEZA KUWA MSAADA?
SAWA, KURITHI NASABA MBILI ZA SELI MUNDU INAWEZA KUSABABISHA MATATIZO YA KITABIBU. LAKINI KWA WALE WALIORITHI NASABA KUTOKA KWA MZAZI MMOJA WANA KINGA YA KUUGUA.
MALARIA!
KWELI? NI UGONJWA GANI HUO?
MALARIA? KITU UNACHOPATA KUTOKA KWA MBU?

NI SAHIHI! SELI MUNDU HAZINA NAFASI KWA VIMELEA WA MALARIA KUINGIA NA KUJITAWANYA NDANI. KWAHIVYO HAZIWEZI KUMFANYA MTU AUGUWE.
NASABA ZINAWEZA KUWA SHUJAA KAMA ZIKIJIPANAGA VILIVYO.
AISEE! KWAHIVYO TUMO ANAWEZA STAHIMILI MALARIA? NINI NI UWIANO WA HIYO?
UKABILIANAJI WA NASABA UNATOKEA MARA KWA MARA ZAIDI YA JINSI UFIKIRIAVYO., KUPITIA MCHAKATO UITWAO UTEUZI ASILI. NASABA ZIKINGAZO WATU NA MAGONJWA ZINARIDHIWA KIZAZI HADI KIZAZI.
LABDA BAADAE, NASABA ZETU ZINAWEZA KUTUSAIDIA KUTIBU MAGONJWA TUSIYO YAWEZA KWA SASA.
HMMMM...LABDA NASABA ZANGU ZINAWEZ TUSAIDIA KUPAMBANA NA VVU.
TUNA KILA SABABU YA KUAMINI TAYARI ZINAWEZA!
NDIYO, KITSO, UNJAUA NI KWANINI CD4 ZAKO HUANGALIWA KILA BAADA YA MIEZI MICHACHE UKIENDA KLINIKI.
KWELI?
NDIYO...
UNAJUA CD4 NI NINI?


CD4 NI ASKARI WA MWILI WANAOSAIDIA KUPAMBANA NA MAAMBUKIZI KAMA NIKINYWA DAWA ZANGU WADUDU WABAYA HULALA NA CD4 HUONGEZEKA.
HIYO NI SAHIHI! TUNAWAITA ASKARI WAKO " VIPOKEZI VYA SELI ZA CD4" IKIMAANISHA KUWA MFUMO WA KINGA YAKO NI MKUBWA. LAKINI CD4 NI KAMA HUU MLANGO. NI LANGO LAKUINGIA KWENYE MFOMU WA
SELI ZA ULINZI. VVU MDUDU MBAYA - ANASHAMBULIA KWA KUNYAKUA VIPOKEZI VYA CD4 NA KUINGIA KWENYE SELI AMBAPO TENA HUJITAWANTA.
SASA, KAMA VIPI NIKIKUAMBIA TUUFUNGE MLANGO WA CD4 UNAOENDA KWENYE SELI HIFADHI NA KUMFUNGIA VVU NJE?
Nucleus
HIV RNA
Translation
HIV DNA
Assembly
HIV RNA
HIV Particle
CD4 RECEPTOR
HIYO INAWEZEKANA?
NDIYO, CCR5 NI KITASA KWENYE MLANGO WA CD4. VVU HUTUMIA UFUNGUO WA KITASA HIKI KUFUNGUA MLANGO WA CD4, LAKINI INARUDISHA KUWA NASABA ZA WATU WENGINE ZIMEWASABISHA KUZALISHA MBADALA WA VIPOKEO VYA CCR5, AMBAYO INAMUACHA VVU BILA NJIA YA KUUFUNGUA CD4. UNADHANI NI NINI HII?
NINI?
UNAMAANISHA VVU HAWEZI KUINGIA KWENYE SELI?
BAADHI YA HAO WATU WANASTAHIMILI VVU.
HIYO NI SAHIHI. VVU HAWEZI KUINGIA KWENYE SELI. NA KWA SABABU HAWEZI INGIA KWENYE SELI HAVIWEZI HATA KUMFANYA MTU AUGUE.
WOW! NINGEPENDA NASABA ZA KILA MMOJA ZINGETENGENEZA MABADILIKO YA CCR5.


NAKUBALIANA NA WEWE. KWA BAHATI MBAYA, MABADILIKO YA KINASABA YANATOKEA KWA KIPINDI CHA MUDA MREFU, MARADUFU ZAIDI YA MADHARA YA VVU KUTOKEA.
SASA INAKUWAJE WATU WENGINE KUWA NA CCR5?
HISTORIA INAJIELEZA! WATU WENGINE WANAAMINI KUWA MABADILIKO YA CCR5 HUTOKEA KWA KIPINDI TOFAUTI.
KIPINDI CHA UGONJWA WA TAUNI.
KIPINDI CHA KARNE YA 14 WAKATI ILIVYOJULIKANA KAMA "KIFO CHEUSI" WAKATI ILIPOANGAMIZA MAMILIONI YA WATU HUKO ULAYA.
KIFO CHEUSI - SIYO ULE UGONJWA ULETWAO NA PANYA?
TULIA KITSO. KIFO CHEUSI (TAUNI) HUSABABISHWA NA BAKITERIA WAITWA O "YERSINIA PESTIS" AMBAO HUAMBUKIZWA KUTOKA KWA PANYA KWENDA KWA BINADAMU KUPITIA KUUMWA NA KIROBOTO.
SKWAKUWA WATU WENGI WALIO NA CCR5 WANATOKA ULAYA YA KASKAZINI, HUWEZI SAIDIA LAKINI UNAWEZA
SHANGAA KAMA NASABA ZAO ZILIJARIBU KUPAMABANA NA UGONJWA WA TAUNI "KIFO CHEUSI"NA BAADAE KUJIKUTA WAKIJIKINGA NA VVU.
INFECTED RODENT
RAT FLEA
HUMAN HOST
WOW, INAFURAHISHA, LAKINI...
KWANI VIPI, KITSO?
SAWA, SELI MUNDU, VVU, KIFO CHEUSI... NINGEPENDA WATU WASIUGUE.
ZWIIIISH!
NAELEWA. HEBU TULIA, NAJUA NITAFANYA NINI UJIHISI VYEMA. NGOJA TUSIMAME KWA AJILI YA CHAKULA CHA MCHANA KARIBIA NA NYUMBANI. HADITHI YA MAKABILIANO YA KINASABA HAIJAMALIZIKA.

KARIBU WILAYA YA GHANZI YA KALAHARI.
CHUKUA ANDAZI!
KAMA SELI MUNDU ILIVYO SAMBAA ANGOLA. KIFUA KIKUU (KK) KIMEATHIRI WAKAAZI WA GHANZI KWA KIWANGO CHA JUU.
HIYO INAWEZAJE KUNIFANYA NIJIHISI VYEMA?
SAWA, KUNA TAARIFA NJEMA HATA KATIKATI YA UGONJWA. WAKATI UJAO NI TAJIRI WA UWEZEKANO.
WANASAYANSI WANJIFUNZA KUWA HATA KK KINAWEZA KUWA NA NASABA ZINAZO WEZA KULETA MATIBABU YAKE.
INAONEKANA KAMA KITSO ANAWEZA KUNUFAIKA KWA MTIZAMO TU.
WHOA!!!
KWA BAADAYE TUTAPATA UJUZI ZAIDI HUSUSANI JUU YA SAYANSI YA NASABA. WATU WATAWEZA KUYAKABILI MAGONJWA IPASAVYO KAMA VILE KK, VVU NA SELI MUNDU.
WILAYA YA GHANZI ITAKUWA ENEO LENYE AFYA NJEMA.
UPO SAHIHI, XT. HII INANIFANYA KUJIHISI VYEMA ZAIDI. NALIONA TUMAINI! NINGEPENDA KAMA ISINGEKUWA KIANGAZI SASA….
NAWEZA KUMALIZA HILO! KWANZA INATAKIWA TWENDE KWENYE MKUTANO WA "KGOTLA".

NINGEPENDA PIA KUPATA KIBUYU CHA MAJI.
NINAVYO BAADHI HAPA!
GIVE US HEAVY SHOWERS, OPEN UP THE HEAVENS AND POUR OUT THE RAINDROPS; GOOD RAIN, THAT IS VERY GENTLE, NOT LIKE SPEARS; A WASHING OF THE EARTH; A FEMALE, HEAVY RAIN IN THIS TIME!
TUPATIE MVUA KUBWA,FUNGUA MBINNGU NA UTUMWAGIA MVUA:MVUA NZURIILIYO LAINI NA SI KAMA MIKUKI: KISAFISHACHO DUNIA; MWANAMKE, MVUA NZITO WAKATI HUU.
INAPENDEZA!
TUKIENDELEA KUWA WALINZI WEMA WA MAZINGIRA NA RASILIMALI, BAADAYE INAWEZEKANA NA ITAPENDEZA.
MAMA!!!
SAWA. TUMO ANAKUWA MZITO SASA. NADHANI NI WAKATI WA KWENDA NYUMBANI SASA.
NADHANI UPO SAHIHI. KGOSIGADI.
KWAHIYO…. NILINI BAADAYE ITAKUWA HAPA? NATAKIWA KUSUBIRIA TIBA IGUNDULIWE?

BAADAYE IPO KARIBU ZAIDI UDHANIAVYO!
CHAMSINGI, UNAWEZA KUTUSAIDIA KUFIKIA PALE.
KWELI? LAKINI MIMI BADO NI MTOTO.
KUMBUKA NI KWANINI TULIIANZA HII SAFARI YA KUDHUBUTU? KWA KUJIUNGA NA TAFITI ZA VVU/KK ZA KGALAGADI, AMBAYO NI JENOME- SHIRKISHO PANA LA KITAFITI.
JE--NINI?
JENOME- SHIRIKISHO PANA LA UTAFITI - NIPALE UNAPOJARIBU KUTAFUTA NASBA ZINAZOBAINI NI KWANINI WATU TOFAUTI WANAPATWA NA MAGONJWA MBALIMALI KITOFAUTI.
KWA KUJIUNGA NA UTAFITI WA VVU/KK WA KGALAGADI UTATULETA HATUA MOJA KARIBU KWA MANAFANIKIO YA AFYA YA BADAYE. LABDA TUNAWEZA KUBAINI NI KWANINI VVU NA KK HUTOKEA NA KUENEA. LABDA TUNAWEZA PATA VITASA VYA MILANGO - KAMA CCR5 NA KUZUIA USAMBAAJI WAO.
UNAFIKIRIA NINI KITSO? UNAHISI JE JUU YA HAYA YOTE?
UPO TAYARI KUJIUNGA NA UTAFITI, ILI KWENDA NASI KUIFIKA BAADAE?
NA LABDA KWA KUFANYA HIVYO UKAIBADILI HISTORIA?
NAFIKIRI NILISHAAMUA.

FAHARASA

ISTILAHI ZA KISAYANSI

UTHIBITISHO HIARI - NI UKUBALI ANAOUTOA MTU ASIYE NA UHALALI KISHERIA KUTOA RIDHAA.

UTHIBITISHO MPANA HIARI - NI MSHIRIKI KATIKA UTAFITI WA MASWALA YA KIDAKITARI ANAPOTOA RIDHAA YA KUTUMIA DAMU YAKE KWA TAFITI ZA BAADAE.

MASHINEPEWA - NI KIFAA CHA MAABARA KINACHOTUMIKA MAHUSUSI KATIKA KUTENGANISHA VIMIMINIKA VILIVYO KATIKA UJAZO TOFAUTI, KWA KUZUNGUSHA SAMPULI ZA VIMIMINIKA KWA KASI.

RIDHAA - NI UKUBALI WA MTU ANAYETAMBULIKA KISHERIA KAMA ANAWZA KUJITEGEMEA KIMAAMUZI.

UFUATANISHAJI WA VINASABA - NI UTARATIBU WA KUBAAINI MFATANO WA NYUKLEOTIDI KATIKA UTANDO WA VINASABA.

FLUROMETA - KIFAA KINACHOTUMIKA KUPIMA KIWANGO CHA MIONZI ILI KUBAINI MKUSANYIKO KATIKA DUTU.

MUADHIRIKA WA MUDA MREFU - NI MTU ALIYEAMBUKIZWA VVU NA KUCHUKUA KIPINDI KIREFU KUONYESHA KUWA ANA UKIMWI BAADA YA ISHARA ZA KWANZA KUTOKEA.

WAFLEBOTOMIA - HAWA NI WATU MAALUMU WALIOFUNDISHWA NAMNA YA KUCHUKUA DAMU KUTOKA KWA WAGONJWA KWA AJILI YA KUCHANGIA DAMU, KUMUONGEZEA MTU DAMU AU KWA AJILI YA MAJARIBIO.

MUADHIRIKA WA HARAKA - MUADHIRKA WA VVU ANAYECHUKUA KIPINDI KIFUPI KUADHIRIKA NA UKIMWI HASA BAADA YA ISHARA ZA KWANZA.

VITENDANISHI - VIAMBATA AU VIUNGO VYA ZIADA VINAVYOONGEZWA KWENYE DAMU ILI KUVUNJAVUNJA KIINI DAMU NA KUTENDANGANISHA VINASABA.

STETOSIKOPU- KIFAA CHA UDAKTARI KITUMIKACHO KAITIKA KUSIKILIZA SAUTI NDANI YA MWILI WA BINADAMU KAMA VILE MAPIGO YA MOYO.

MLIPUKO WA SIKU ZA NYUMA: KITSO AKICHUNGUZA URITHI NA MAUMBILE
IMECHAPWA KATIKA JAMUHURI YA BOTSWANA NA KITUO CHA UBORA WA TIBA ZA WATOTO
TOLEO LA 1.0, KUCHAPISHWA MARA YA KWANZA 2015
HAKIMILIKI KWA KITUO CHA UBORA WA TIBA ZA WATOTO BAYLOR BOTSWANA
2015

SHUKRANI

WABUNIFU NA WAUNDAJI WA MRADI: ABRAHAM MAMELA, ALBERT LEKGABA NA EDWARD PETTITT,

WANDISHI WA MSWADA: STEPHEN ALEXANDER MANNING, NATASHA MORAKA, JONATHAN STRYSKO, TIERRA HOLMES, PATRICK BRINGARDNER, AAMIRAH MUSSA, TSWELELOPELE MASUTLHA, NIKA SOON-SHIONG, ZACK BONZELL

MHARIRI WA KITABIBU/KISAYANSI: MASEGO TSIMAKO-JOHNSTONE, SEBALD VERKUIJL

WASIDIZI MRADI: THATO REGONAMANYE, TAPIWA KANGWA

WAHARIRI VIJANA: ANNAH KETLAARENG

BODI YA USHAURI WA JAMII CAFGEN: (BOTSWANA MUSLIM ASSOCIATION); CINDY KELEMI (BONELA); NONTOMBI KRAAI (INTERNATIONAL LINKS); IRENE KWAPE (BOCAIP); PHENYO MAHUMA (BCC); ALICE MOGWE (DITSHWANELO); KGORELETSO MOLOSIWA (BONEPWA+); ONKEMETSE MONTSHEKI (CHILDLINE BOTSWANA); JOB MORRIS (SAN YOUTH NETWORK); KAGO MOTEKETELA (YOUTH MEMBER); BUYANI ZONGWANI (MISA); TIDIMALO DENNIS (BOPHA: BOTSWANA PUBLIC HEALTH ASSOCIATION)

MUONGOZO MKAKATI ULITOLEWA NA: GABRIEL ANABWANI, S.W. MPOLOKA, MOGOMOTSI MATSHABA, OLEKANTSE MOLATLHEGI, KEOFENTSE MATHUBA, MADUKE KULA, ABHILASH SATHYAMOORTHI, LEANO PHETOGO, CLINS MMUNYANE, NICHOLAS MURIITHI, KENNEDY SICHONE, KOKETSO MAPLANKA, PINKIE GOBUAMANG, AND LETOYA CYNTHIA BALEBETSE

IMETAFASIRIWA KATIKA LUGHA YA KISWAHILI NA: NGOGO MANG'ENYI
IMETAFARISIWA KATIKA LUGHA YA KIINENGEZI NA: SHARIFA KALOKOLA

ONYO

KWAKUWA TUMEFANYA JITIHADA ZA KUHAKIKI UKWELI WA KISAYANSI WA YALIYOMO KWENYE KITABU HIKI, TAARIFA ZILIZOMO HUMU HAZIMAANISHI KUWA MBADALA WA USHAURI WA KITABIBU. MADHARANI WAMERUHUSIWA KISHERIA, WAANDISHI NA WACHAPISHAJI WA KITABU HIKI PAMOJA NA MAWAKALA WAO, HAWATAHUSIKA, KUKUBALI AU KUWAJIBIKA NA MAJERAHA, UPOTEVU AU UHARIBIFU WOWOTE UTA

HAKI ZOTE ZIMEHIFADHIWA

HAKUNA SEHEMU YA CHAPISHO HILI INAWEZA KUTOLEWA TENA , KUHIFADHIWA KATIKA MFUMO RETRIEVAL, AU KUSAMBAZWA KWA NAMNA YOYOTE AU KWA NJIA YOYOTE , UMEME, MITAMBO , FOTOKOPI , KUREKODI, AU VINGINEVYO, BILA IDHINI YA WACHAPISHAJI.

CAfGEN H3

GENOME ADVENTURES

GENOME ADVENURES, NI MPANGO WA UBUNIFU WA COLLABORATIVE AFRICAN NETWORK (CAFGEN) KWA AJILI YA KUSHIRIKISHA JAMII UNAOFADHILIWA NA WELLCOME TRUST . CAFGEN NI MWANACHAMA WA HUMAN HERIDITY AND HEALTH AFRICA CONSORTIUM (H3AFRICA). INARATIBIWA NA KITUO CHA AFYA CHA BOTSWANA-BAYLOR CHIDREN'S CLINAL CENTER OF EXCELLENCE (COE).
GENOMO ADVENTURES INATUMIA WARSHA ZA KUJENGA UWEZO, KATUNI ZA KUELIMISHA NA MITANDAO YA KIJAMII KUSHIRIKISHA WADAU NA WAJAMII, WAANDISHI WA HABARI NA JAMII KWA UJUMLA- HUSUSANI VIJANA - KATIKA KUELEWA ELIMU YA JINOMU (GENOMICS) NA UTAFITI WA MATIBABU.

MFULULIZO WA VITABU VYETU VYA GENOME ADVENTURES COMIC VINALENGA KUELIMISHA WASOMAJI JUU YA HISTORIA YA URITHI NA ELIMU YA JENI (GENETICS), MUUNDO NA KAZI YA VINASABA (DNA) NA JENI , UHUSIANO KATI YA ELIMU YA JINOMU NA AFYA, NA MCHAKATO KWA AJILI YA KUJIANDIKISHA KATIKA UTAFITI WA MATIBABU AU ELIMU YA JINOMU UTAFITI, IKIWA NI PAMOJA NA MASUALA YA KIMAADILI YANAYOHUSU RIDHAA HABARI, KUSAFIRISHA SAMPULI NA KUHIFADHI, NA USHIRIKI WA JAMII.

KWA TAARIFA ZAIDI, TAFADHARI TEMBELEA MITANDAO YETU YA KIJAMII:

- *GENOMEADVENTURES.WEEBLY.COM*
- *FACEBOOK.COM/GENOMEADVENTURES*
- *TWITTER.COM/GENOMEADVENTURE*
- *PINTEREST.COM/GENOMEADVENTURE*

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