Vipengele vya Astrobiolojia
Elements of Astrobiology

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Malengo

Objectives

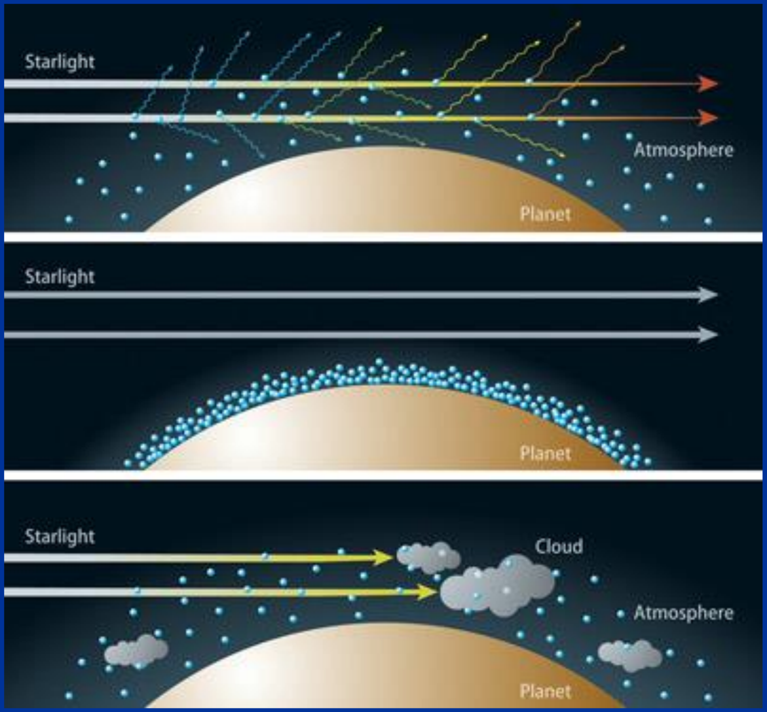
- Kuelewa elementi zilizo katika jedwali radidi (periodic table) zinatokanaje
- Understand where the different elements of the periodic table arise.
- Kuelewa mahitaji ya uwezeshwaji wa uhai
- Understand the habitability conditions necessary for the development of life.
- Kumudu miongozo ya namna ya kutambua kuwepo kwa uhai nje ya Dunia
- Manage the minimum guidelines of life outside the earth.

Uundaji wa mifumo ya sayari

Formation of planetary systems

Nyota inapoundika mada itakayounda mfumo wa sayari inakuwa Jirani na nyota

During the formation of a star its planetary system is also constituted with the remains of material close to the star.



Spektroskopi inatumika kufahamu yaliyomo ndani ya nyota na inatumika pia kufahamu angahewa za sayarinje zinaundwa na mada zipi

Spectroscopy is used to know the composition of the star and is also used to know the atmosphere of the exoplanets.

Zoezi 1: Uundaji wa mfumo wa sayari kutoka gesi na vumbi

Activity 1: Formation of the planetary system from gas and dust

Kundi linagawanywa kuwa vikundi viwili: Wasichana (gesi) na wavulana (vumbi) k.m. (Kama idadi zimetofautiana sana basi kundi la gesi liwe ni kundi lenye watu wengi kwa vile mfumo wa sayari unapoundika, masi ya gesi ni mara 100 zaidi ya masi ya vumbi).

The group is divided into two: girls (gas) and boys (dust) e.g.

(If there is a substantial difference in the number of participants from one group and another, it is recommended that the group representing the gas be the largest, since, in a planetary system in formation, the mass of the gas is 100 times the mass of the dust).

Wshiriki wanafanya vitendo jinsi wanavyosikiliza maelezo, kwa mfano:

As the participants listen to the story, they make dynamic actions of what they hear, for example:

Zoezi 1: Uundaji wa mfumo wa sayari kutoka gesi na vumbi

Activity 1: Formation of the planetary system from gas and dust

Maelezo ya simulizi: **Text of the story:**	**Washiriki wanachotenda** **Participants performance:**
Mwanzo kulikuwa na wingu la gesi nyingi na vumbi kidogo There was once a cloud of a lot of gas and a little less dust.	Wote wanachanganyika katika wingu. Washiriki wengi wanawakilisha gesi. Ndani ya wingu washiriki wote wanashikana mikono shagalabagala na kuunda kama wavu All are mixed in a cloud. There are more participants representing gas. In the cloud, all participants hold hands randomly, forming as a network.
Halafu gesi ikakusanyika katikati ya wingu na vumbi ikwawa pembezoni. **Then the gas began to gather in the center of the cloud and around it the dust.**	Wanaanza kutengana. Washiriki wa gesi wanakusanyika katikati ya wingu na wale wa vumbi wanaendelea kushikana minkono pembezoni. They begin to separate. Participants representing gas accumulate in the center and those representing dust hold hands around the centre.

Zoezi 1: Uundaji wa mfumo wa sayari kutoka gesi na vumbi

Activity 1: Formation of the planetary system from gas and dust

Maelezo ya simulizi: Text of the story:	Washiriki wanachotenda Participants performance:
Kukawa na miendo mingi, gesi ikavutwa na gesi na vumbi kuvutwa na vumbi. There was a lot of movement, gas particles attracted gas and dust particles attracted dust.	Zikaanza kuzunguka, kutembea, kugongana, kutikisika na kuruka. Mengine yakarushwa nje kutokana na miendo ya nguvu na wengine wanawaokoa, kushika na kumbatiana wa aina yao (gesi kwa gesi na vumbi kwa vumbi) They begin to rotate, move, crash, vibrate, jump. Some shoot out as a result of so much movement and others "rescue", catch, hug those particles by identification (gas with gas and dust with dust).
Katikati kitovu kizanuru (“opaque”) kikaundwa na kuzungukwa na shani (“disk”) ya vumbi na gesi In the center a dense opaque core formed surrounded by a disk of dust and gas.	Wale katikati (gesi) wanakusanyika na wale wa vumbi wanashikwa mikono. Ufafanuzi: Gesi yote haipo katikati, kuna gesi inayoelea nje ya duara Those in the center (gas) accumulate and around them participants who represent dust in a kind of circle are taken by the hand. Clarification: not all gas is in the center, there is remote gas outside the circle.

Zoezi 1: Uundaji wa mfumo wa sayari kutoka gesi na vumbi

Activity 1: Formation of the planetary system from gas and dust

Maelezo ya simulizi: Text of the story:	Washiriki wanachotenda Participants performance:
Kitovu hiki ndio hatimaye kitaunda Jua aur nyota mama ya mfumo wa sayarinje This nucleus is the one that would finally give rise to the Sun or the parent star of an extrasolar system.	Jua au sayari mama inaanza kung'aa kwa hiyo miale lazima ya rushwe nje kila upande Ufafanuzi: Jua au sayari mama ikianza tu kung'aa gesi inayoelea nje inaanza kutoweka. The Sun or the parent star begins to shine so that its rays must shoot outwards in all directions. Clarification: The moment the sun or the parent star begins to shine the "loose" gas begins to move away.
Baadhi ya sayari ndogo zikaundwa na chembe za vumbi zilizoendelea kukuwa, zikawa mawe na mawe makubwa hadi sayari mawe zikaundika. Some small planets were formed by the union of increasingly larger and larger dust grains, then rocks and so on until terrestrial planets are made.	Washiriki wanaowakilisha vumbi inayounda sayari mawe wanakusanyika. Ufafanuzi: Siyo vumbi yote inabaki kwenye sayari mawe, vumbi kidogo inabaki katika maeneo ya mbali kabisa. The participants representing the dust that forms the terrestrial planets begin to group together. Clarification: not all dust stays on terrestrial planets, there must be some dust in the farthest regions.

Zoezi 1: Uundaji wa mfumo wa sayari kutoka gesi na vumbi

Activity 1: Formation of the planetary system from gas and dust

Maelezo ya simulizi: Text of the story:	**Washiriki wanachotenda** Participants performance:
Sayari jitu zikaundwa mbali na joto la Jua au sayari mama ambapo gesi inaweza kujikusanya bila kizuizi The giant planets formed away from the heat of the Sun or the central star where the gas could gather without hinderance.	Sayari zilizobaki, yaani sayari jitu ziaanza kuundika: gesi nyingi na vumbi kiasi. Ufafanuzi: Kupungua kwa halijoto kwa sababu ya kuwa mbali na Jua au nyota mama ndio sababu ya tofauti kubwa kati ya sayari mawe za ndani na sayari jitu za mbali. The rest, the giant planets, begin to come together: a lot of gas and some dust. Clarification: The decrease in temperature due to the greater distance from the Sun or the mother star was the cause of the main differences between the inner rocky planets and the other giants.

Shughuli 2: Wigo wa utoaji

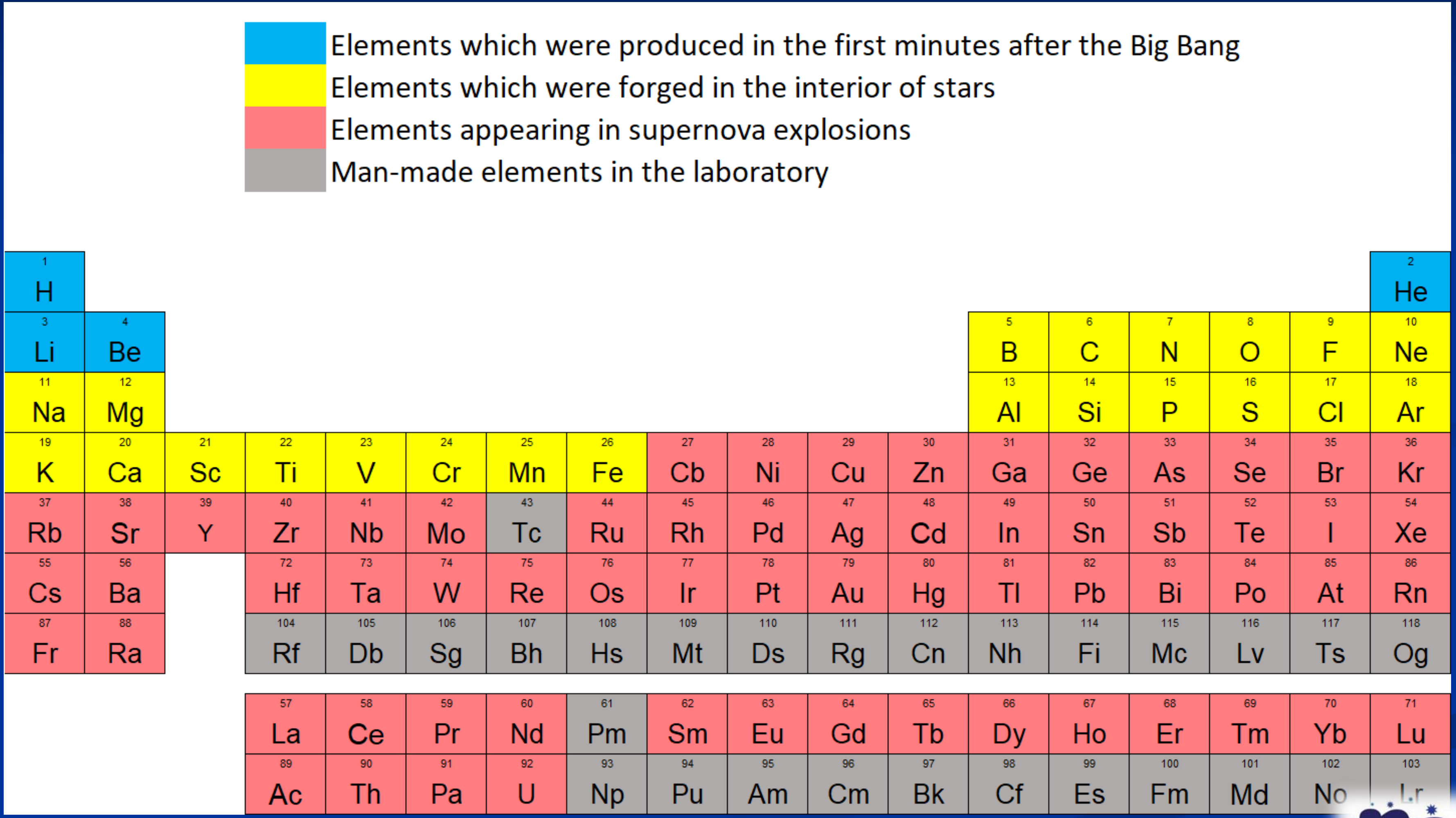
Activity 2: Emission spectrum

Spectroscopy huturuhusu kujua habari fulani juu ya muundo wa kemikali wa exoplanets na angahewa zao. Tunaweza kuibua taswira ya wigo wa balbu na DVD (tunaona mistari ya gesi iliyomo ndani)

Spectroscopy allows us to know some information about the chemical composition of exoplanets and their atmospheres. We can visualize the spectrum of a light bulb with a DVD (we see the lines of the gases it contains inside)

Kimia ya kutokana na mageuko ya nyota

Chemical aspects of stellar evolution



Zoezi 3: Mpangilio wa Jedwali Radidi

Activity 3: Periodic Table Classification

Weka kila aina katika mifuko yake (bluu, manjano na nyekundu)

Place in each basket (blue, yellow and red) each object

Pete: (Ring**):** **Dhahabu (**Gold**) Au**	**Kipande cha kuchimibia iliyozungushiwa (**Drill bit coated with**):** **Titanium (**Titanium**) Ti**	**Gesi ndani ya puto zinazoelea (**Gas inside a child's balloon**):** **Heli (**Helium**) He**	**Sugulio ya sufuria (**Pan scourers**):** **Nikeli (**Nickel**) Ni**
Simu ya kiganjani/betri za saa (Mobile/button battery**):** **Lithi (**Lithium**) Li**	**Plagi za gari (**Car spark plugs**):** **Platini (**Platinum**) Pt**	**Waya za umeme (**Electric copper wire**):** **Shaba (**Copper**) Cu**	**Mmumunyo wa Iodini** (Iodine solution**):** **Iodini (**Iodine**) I**
Chupa ya maji (Water bottle**) H_2O:** **Hidrojeni (**Hydrogen**) H**	**Sufuria ya zamani (**Old Cooking Pan**):** **Alumini (**Aluminum**) Al**	**Pensili nyeusi ya kinywe** (Black Pencil Lead Graphite**):** **Mkaa (**Charcoal**):** **Kaboni (**Carbon**)) C**	**Salfa ya mbolea (**Sulfur for agriculture**):** **Salfa (**Sulfur**) S**
Kopo la soda (Can of soft drink**):** **Alumini (**Aluminum**) Al**	**Saa ya mkononi (**Wrist watch**):** **Titaniam (**Titanium**)Ti**	**Medali (**Medal**):** **Fedha (**Silver**) Ag**	**Bomba ya metali (**Metal pipe**):** **Risasi (**Lead**) Pb**
Kichongeo cha penseli cha Zinki (Zinc pencil sharpener**):** **Zinki (**Zinc**) Zn**	**Msumari ulioshika kutu** (Rusty Old Nail**):** **Chuma (**Iron**) Fe**	**Kipimajoto (**Thermometer**):** **Galium (**Gallium**) Ga**	**Kiberiti (**Matchbox**):** **Fosforasi (**Phosphorus**) P**

Elementi zilizoundika katika dakida za mwanzo za Mlipuko Kuu (bluu)

Elements generated in the first minutes after the Big Bang (blue)

Elementi zilizofuliwa sehemu za ndani ya nyota (manjano)

Elements forged inside the stars (yellow)

Elementi zinatoundwa katika milipuko ya novakuu (nyekundu)

Elements that appear in supernova explosions (red)

Zoezi 3: Mpangilio wa Jedwali Radidi

Activity 3: Periodic Table Classification

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Elementi zilizoundika katika dakida za mwanzo za Mlipuko Kuu (bluu)

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Elements that appear in supernova explosions (red)

Zoezi 4: Watoto wa nyota

Activity 4: Children of the stars

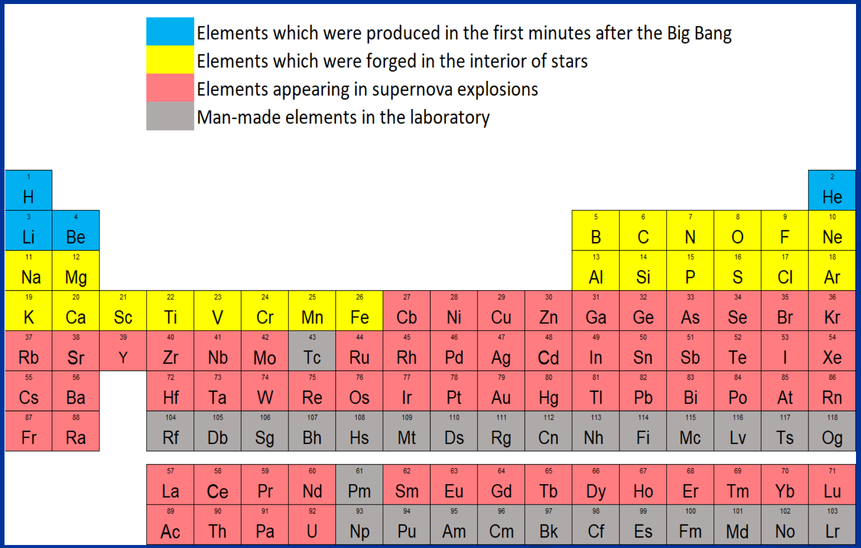
Mwili wa binadamu umeundwa kwa:

Composition of the human body:

Elementi tele: (Abundant elements): **oxijeni** (oxygen), **kaboni** (carbon), **haidrojeni** (hydrogen), **nitrojeni** (nitrogen), **kalisi** (calcium), **fosforasi** (phosphorus), **potasiamu** (potassium), **salfa** (sulfur), **chuma** (iron), **sodiamu** (sodium), **klorini** (chlorine), **and magnesi** (magnesium).

Elementi za dalili (Trace elements): **florini** (fluorine), **zinki** (zinc), **shaba** (copper), **silikoni** (silicon), **vanadiuim** (vanadium), **manganizi** (manganese), **iodini** (iodine), **nikeli** (nickel), **molibdinamu** (molybdenum), **kromi** (chromium) **na and kobalti** (cobalt)

Elementi muhimu (Essential elements): **lithi** (lithium), **kadimiamu** (cadmium), **arseniki** (arsenic) **na stani** (tin).



Elementi tele ZOTE (ila Haidrojeni) zimeundwa ndani ya nyota

All abundant elements (except H) have been produced within the **stars.**

Sisi kweli ni Watoto wa nyota !!!!

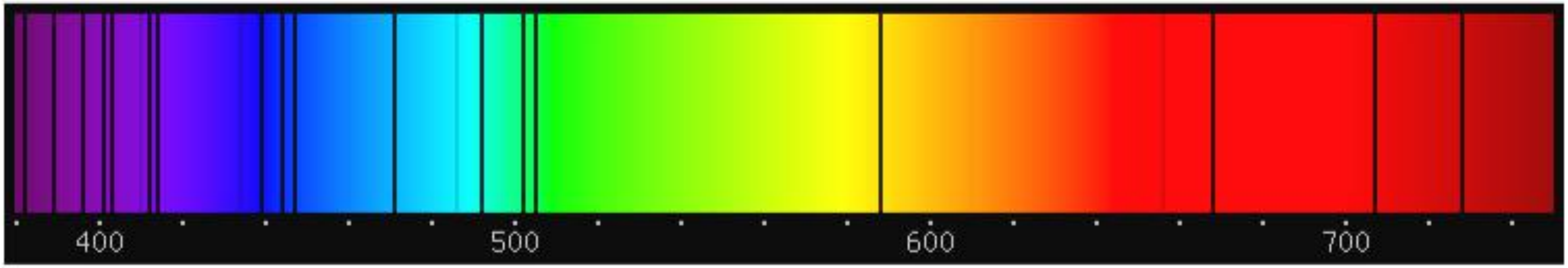
We are children of the stars !!!!

Jua siyo nyota ya hatua ya mwanzo

The Sun is not a star of first generation

Nyota za hatua ya mwanzo ziliishi kwa haraka, zikafa katika ujana na hazipo tena sasa hivi. Mistari ya Hadrojeni, Heli na labda Lithi huonekana katika mwanga wake

The first generation stars lived fast, died young and have not survived to this day. Only with Hydrogen, Helium and perhaps Lithium lines are visible.



Taswirangi ya nyota ya hatua ya mwanzo (Kwa muono wa mchoraji)

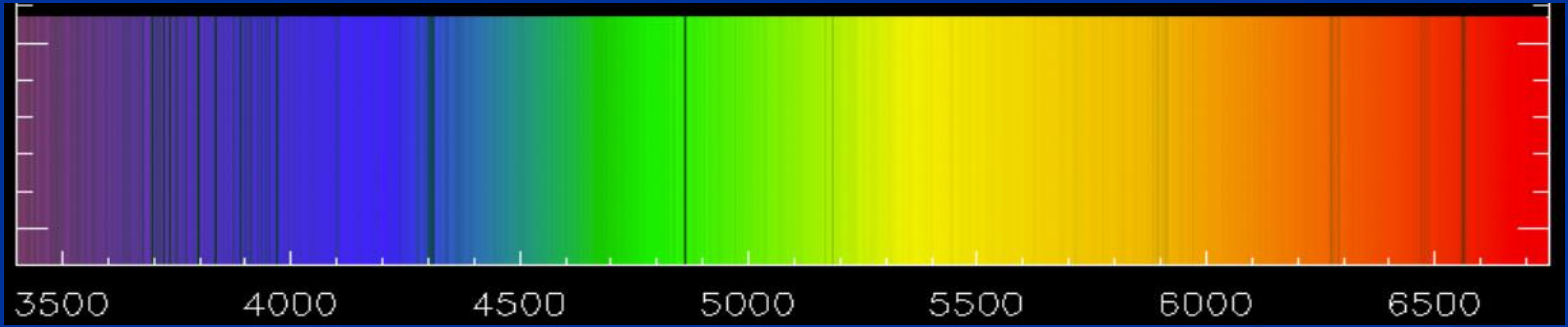
First Generation Spectrum (Artist's impression).

Jua siyo nyota ya hatua ya mwanzo

The Sun is not a star of first generation

Nyota zenye elementi tete inamaanisha wingu la mwanzo lilianzia mabaki ya milipuko ya novakuu

The stars with more elaborate elements means that their initial cloud started from the remains of a supernova explosion.



Taswirangi ya nytoa ya hatua ya pili

Zenye mistari ya Haidrojeni na Kaboni

Second Generation Spectrum.

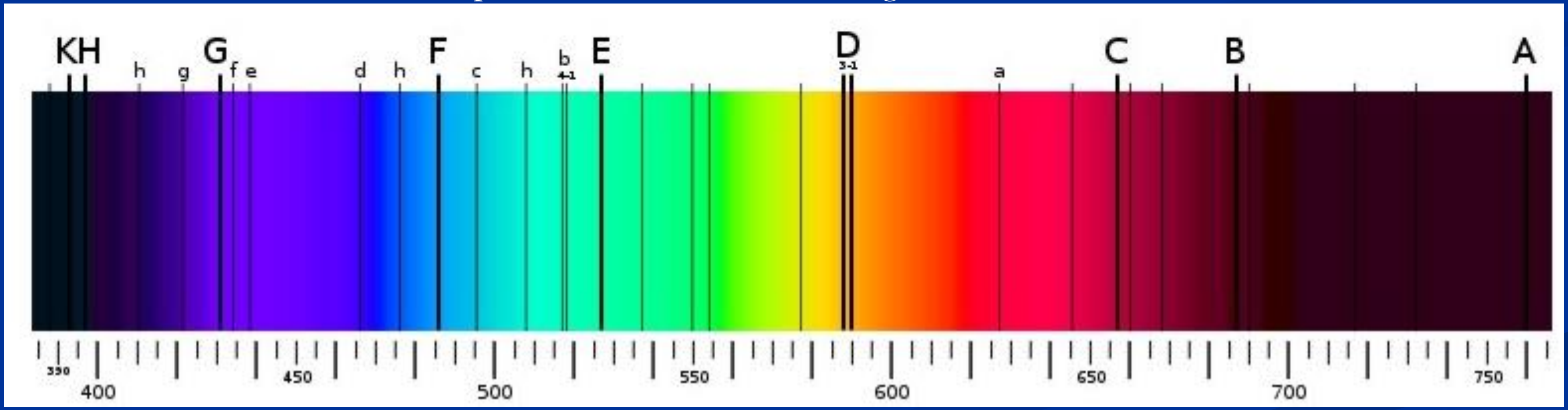
SMSS J031300.36-670839.3 with Hydrogen and Carbon lines

Jua siyo nyota ya hatua ya mwanzo

The Sun is not a star of first generation

Katika mfumo wa Jua elementi nyingi zinatambuliwa zilizotokana na milipuko za novakuu. Kwa hiyo Jua liliundwa kutoka wingu la mwanzo lililotokana na milipuko miwili ya novakuu, yaani Jua ni nyota ya hatua ya tatu.

In the solar system many elements that arose after a supernova explosion are detected. Therefore the Sun was possibly formed from an initial cloud that corresponded to the remains of at least two supernova explosions, that is, it is a third-generation star.



Taswirangi ya Jua. Ina mistari mingi ya spectra

Spectrum of the Sun. With various spectral lines

Shughuli 5: Mistari ya Fraunhofer ya Jua

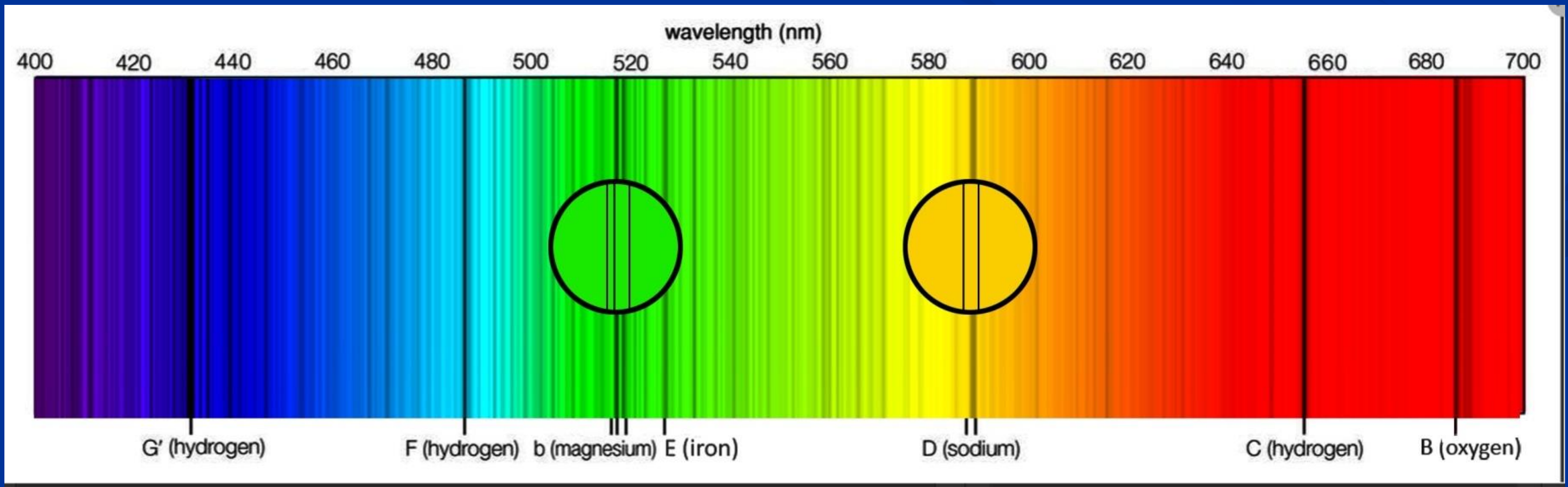
Activity 5: Fraunhofer lines of the Sun

Wigo wa Jua ni endelevu, wenye mistari meusi inayoitwa mistari ya Fraunhofer, ambayo inalingana na vipengele vya kemikali vilivyomo katika angahewa yake.

Wanaweza kuonekana kwa jicho uchi katika kuakisi mwanga wa jua kwenye DVD. Mistari mingi ya Fe inazingatiwa, Mg triplet (katika kijani), Na doublet (katika njano)

The Sun's spectrum is continuous, with dark lines called Fraunhofer lines, which correspond to the chemical elements contained in its atmosphere.

They can be seen with the naked eye in the reflection of sunlight on a DVD. Many Fe lines are observed, the Mg triplet (in green), the Na doublet (in yellow)



Shughuli 5: Mistari ya Fraunhofer ya Jua

Activity 5: Fraunhofer lines of the Sun

Ili kuona mistari ya Fraunhofer, inabidi ukabiliane na Jua, ukiwa na DVD mlalo, kuleta uso wako takriban sm 5 kutoka kwenye DVD, ukiweka jicho lako juu kidogo ya shimo la kati la DVD.

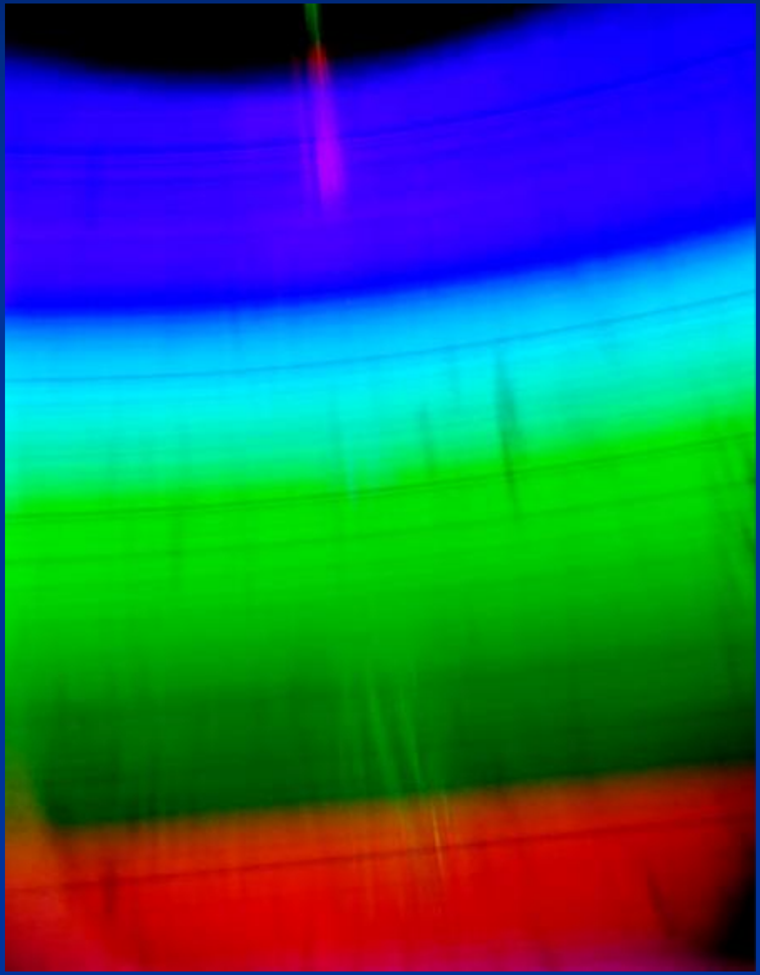
To see the Fraunhofer lines, you have to face the Sun, with the DVD horizontal, bring your face about 5 cm from the DVD, placing your eye just above the central hole of the DVD.

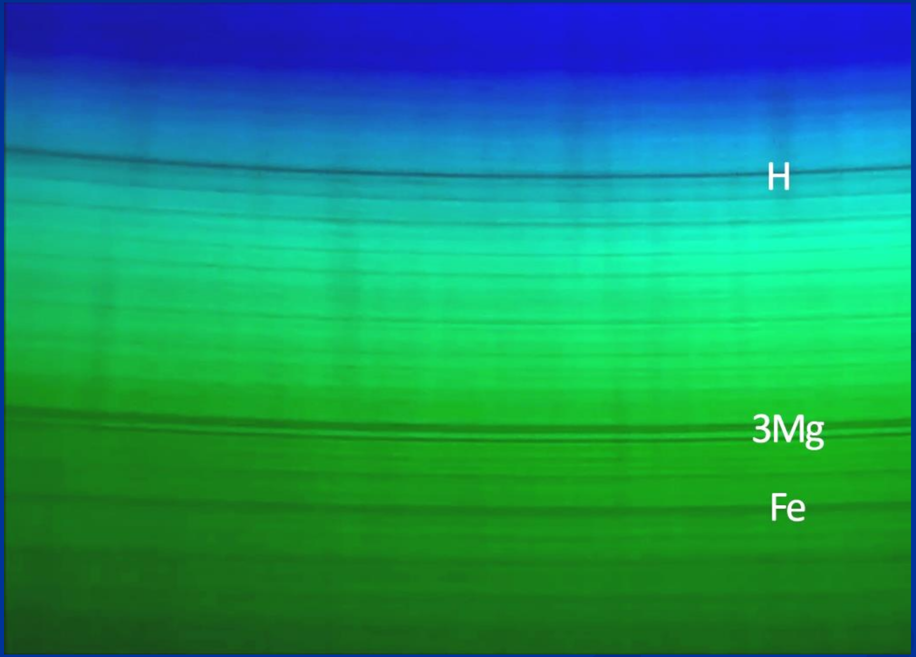
Katika nafasi hiyo, unatazama rangi za uakisi wa Jua karibu na ukingo wa DVD karibu na mwili wako.

In that position, you look at the colors of the reflection of the Sun near the edge of the DVD next to your body.

Shughuli 5: Mistari ya Fraunhofer ya Jua

Activity 5: Fraunhofer lines of the Sun





Kanda ya Kuweza Kuwepo Uhai

Zone of Habitability

Kanda ambayo kunaweza kuwepo uhai in eneo lakuzunguka Jua ambapo miale ya mnunurisho unaomulika sakafu ya sayari mawe inawezesha kuwepo kwa maji uoevu

Zone of habitability is the region around a star in which the flow of radiation onto the surface of a rocky planet would allow the presence of liquid water

(uhai unahitaji kaboni yanategemea kuwepo kwa maji uoevu)

(carbon-based life is assumed the presence of liquid water).

Kawaida magimba yenye masi kati ya nusu (0.5) na kumi (10) ya masi ya Dunia (M_e) na angahewa yenye kanieneo ya 6.1 mba, inayolingana na halijoto ya 273.16 K (ambapo maji ya hali ya mango, uoevu, na gesi zinaweza kuwepo kwa pamoja)

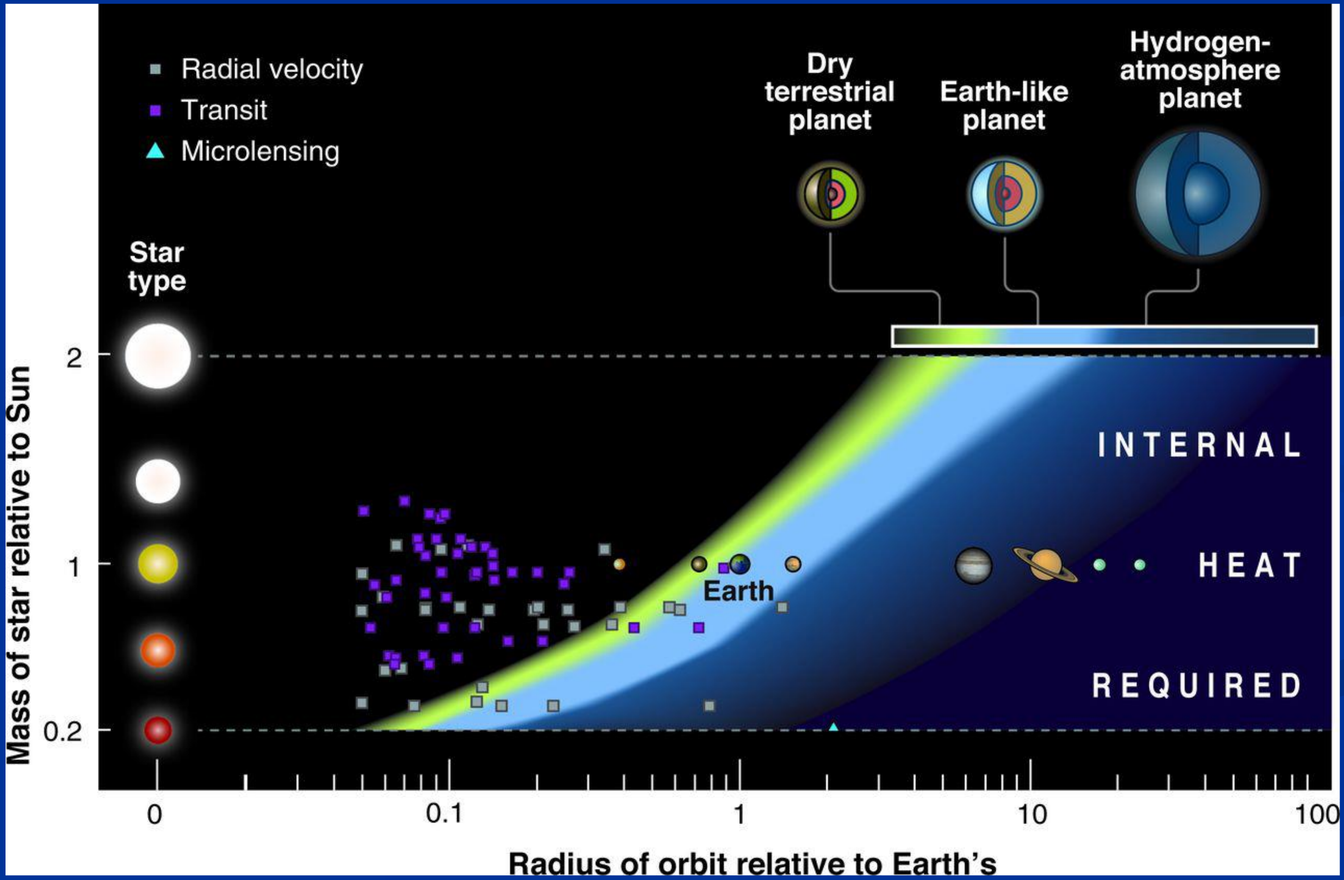
It usually occurs in bodies of mass between **0.5 and 10 Me** and an atmospheric pressure greater than 6.1 mbar, corresponding to the triple point of water at a temperature of 273.16 K (when water coexists in the form of ice, liquid and steam).

Kanda ya Kuweza Kuwepo uhai

Zone of Habitability

Kanda ambayo kunaweza kuwepo uhai linaendana na masi ya nyota. Masi inapozidi, halijoto na mng'ao unaongezeka kwa hiyo kanda linazidi kuwa mbali

The zone of habitability **depends on the mass of the star**. If the mass is greater then its temperature and brightness increase and consequently the zone of habitability is increasingly distant.

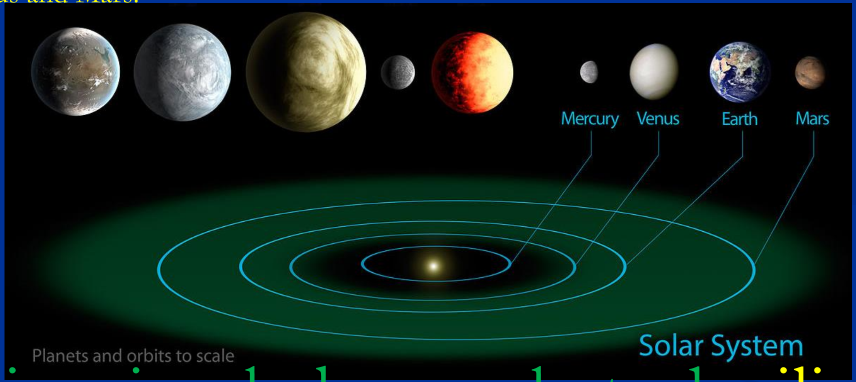


Masharti mengine ya kuwepo kwa uhai

Other conditions for Habitability

Umbali kutoka Jua ni sharti muhimu kwa uwezekano wa kuwa na uhai, ila hiyo haitoshi kwa sayari kuwa na uhai. Mfano: Zuhura na Mirihi ni tofauti kabisa na Dunia

The **orbital distance** of the planet that places it in the zone of habitable is a necessary condition, but not enough for a planet to embrace life.Example: Venus and Mars.



Masi ya sayari lazima iwe kubwa ya kutosha ili gravity iweze kushika anagahewa. Hii ndiyo sababu kuu ya Mirhi kutowesa kuishika sasa hivi, kwa vile imepoteza karibu angahew yake yote pamoja na maji katika uso wake ambapo ilikuwa tofauti katika miaka bilioni yake ya kwanza.

The **mass of the planet must be large enough** so that its gravity is able to retain the atmosphere.It is the main reason why Mars is not habitable at present, since it lost most of its atmosphere and all surface water, which it had in its first billion years.

Zoezi 6: Maji kwenye Mirihi?

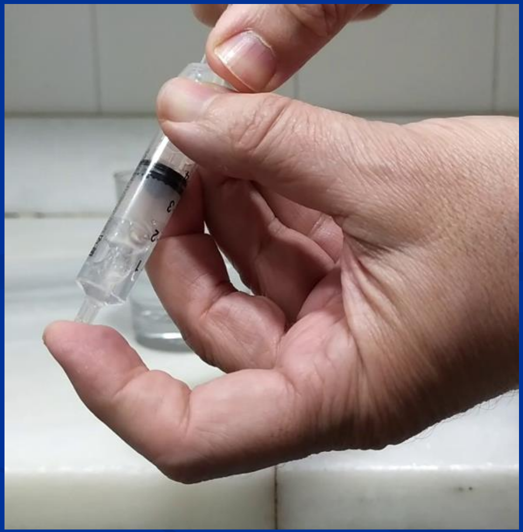
Activity 6: Liquid water on Mars?

Angahewa ya Mirihi ni hafifu (asilimia 0.7% ya Duaniani). Ingawa kanieneo ni ndogo sana, kuna mawingu kutokana na maji kwenye ncha za sayari. Mirihi haina maji oevu

On Mars the atmospheric pressure is weak (0.7% of the Earth's one). Despite this low pressure, the water form clouds at the planet's poles. But why Mats has no liquid water on its surface?

Tunaweka maji moto karibu na kuchemka ndani ya sirinji

We put inside the syringe hot water close to boiling



Tukivuta mvutio wa sirinji kanieneo ndani ya sirinji inapungua na maji yanaanza kuchemka na kugeuka mvuke na baadaye yanaisha. Kuiga hali ya kanieneo ya Mirihi tutahitaji sirinji yenye bomba ndefu kiasi cha kuvuta kivutio kwa kiasi cha mita 9m.

If we pull the plunger the inside pressure lowers and the water begins to boil, becomes steam and gradually disappears. To simulate the Martian pressure we should have a very long syringe and to pull the plunger up to 9 m.

Shughuli 7: Athari ya chafu

Activity 7: Greenhouse effect

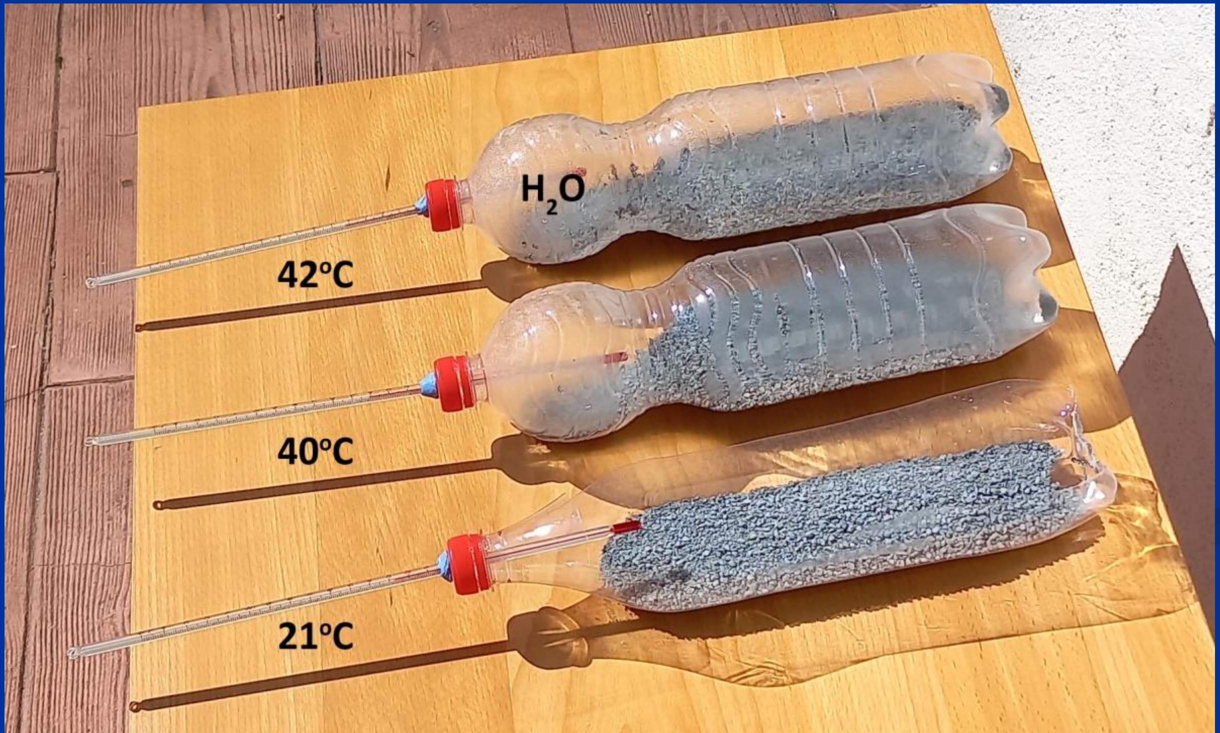
Tunaweka ardhi ya giza ndani ya chupa 2 za plastiki tupu, na katika kata ya tatu kwa urefu wa nusu. Tuliingiza thermometer kwenye kizuizi cha kila chupa. Chupa iliyokatwa inaiga sayari bila mawingu, chupa nzima ya kwanza inaiga sayari na mawingu, na katika ya mwisho, tunaweka matone machache ya maji ndani yake, kuiga anga na mvuke wa maji.

We put dark earth inside 2 empty plastic bottles, and in a third cut lengthwise in half. We inserted a thermometer into the stopper of each bottle. The cut bottle simulates the planet without clouds, the first whole bottle simulates the planet with clouds, and in the last one, we put a few drops of water inside it, to simulate an atmosphere with water vapor.

Shughuli 7: Athari ya chafu
Activity 7: Greenhouse effect

Tunaweka chupa kwenye jua na kupima joto ndani kila dakika 5. Tunaandika vipimo ili kuamua jinsi athari ya chafu huathiri.

We put the bottles in the sun and measure the temperature inside every 5 minutes. We write down the measurements to determine how the greenhouse effect influences.

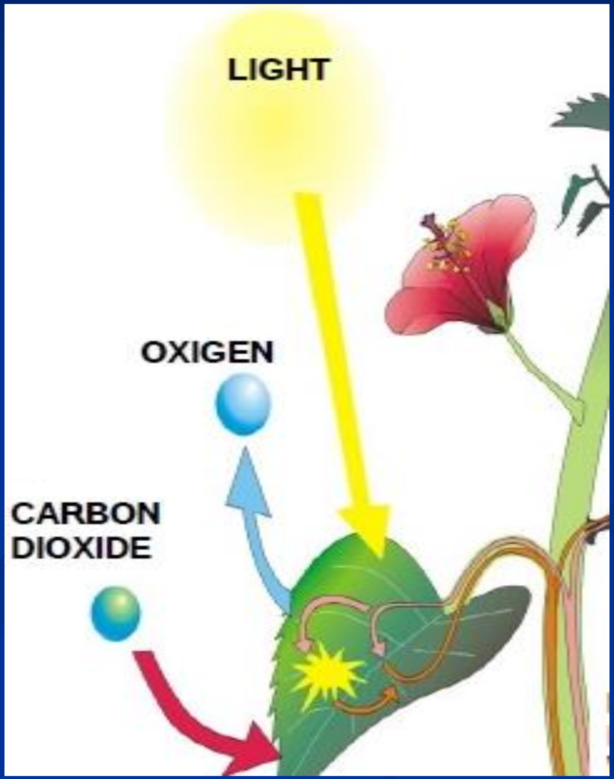


Usanisinuru: Kutengeneza Oksijeni

Photosynthesis: Oxygen production

Usanisinuru ni mchakato amabao mimea na bakteria fulani zinatumia kutengeneza glukosi, wanga na oksijeni kutokana na gesi makaa na maji

Photosynthesis is the process by which plants and some bacteria use sunlight to produce glucose, carbohydrates and oxygen from carbon dioxide and water.



Molekuli ziitwazo rangi za usanisinuru hugeuza nishati mwanga kuwa nishati kimia.

Molecules called photosynthetic pigments convert light energy into chemical energy.

Usanisinuru: kwa nini majani ni kijani?

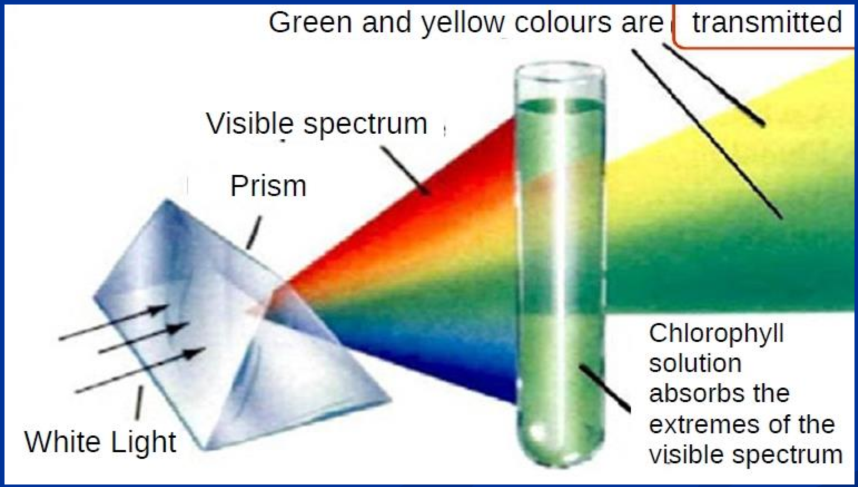
Photosynthesis: why the leaves are green?

Mwanga unaonyonwa unaweza kutumiwa na mimea kwa mmenyuko wa kemikali, wakati kwa masafa ya mwanga unaoakisiwa yatabaini macho yataona rangi gani

The light that is absorbed can be used by the plant in different chemical reactions, while the reflected wavelengths of the light determine the color of the pigment that will appear to the eye.

Mojawapo ya makundi ya rangi za usanisinuru yanaitwa chanikiwiti ("chlorophyll") ambayo kawaida ina aina mbili ya kunyonya katika taswirangi onekani, moja katika eneo la bluu (400-500 nm) na nyingine katika sehemu nyekundu (600-700 nm).

One of the groups of photosynthetic pigments are chlorophylls that typically have two types of absorption in the visible spectrum, one in the blue region (400-500 nm), and another in the red zone (600-700 nm).



Hata hivyo zinaakisi katika eneo la katikati ya taswirangi, ambayo ni ya rangi kijani

However they reflect the middle part of the spectrum, which corresponds to the green color (500-600 nm).

Usanisinuru: Kutengeneza Oksijeni

Photosynthesis: Oxygen production

Rangi za usanisinuru zinamulikwa na zinahamisha elektroni zinazosisimuliwa na mwanga . Maji yanachanga elektroni zinazoruka kutoka molekuli moja kwenda nyingine na kusababisha kutengenezwa oksijeni kwa kumegua molekuli za maji. Hii ni hatua ya mng'ao ya usanisinuru.

The pigments are illuminated and transfer their electrons that are excited by the light. Water is a donor of electrons that jump from one molecule to another and **the end result is the production of oxygen when the water molecules break down.** This is the luminous phase of photosynthesis.

Katika hatua ya giza, wanga na sukari zinatengenezwa. Mwanga hautakiwi kuunda hizi.

In the dark phase carbohydrates or sugars are produced. Light is not necessary for that part.

Zoezi 8: Kutengeneza oksijeni kwa usanisinuru

Activity 8: Oxygen production by photosynthesis

Tumia chupa mbili za kioo jangavu na weka plastiki za bluu na nyekundu upande wa mwisho wa chupa

Use two transparent glass jars and place blue and red cellophane paper at the end of the jar.

Zoezi 8: Kutengeneza oksijeni kwa usanisinuru

Activity 8: Oxygen production by photosynthesis

Kwa kutumia panchi ya kutoboa matundu katika karatasi, kata diki 10 za jani (mchicha au jani laini bila kukata sehemu ya mishipa)

With the help of a punch, cut discs of uniform sheets (spinach or chard avoiding veins). Put 10 discs in each jar.

Zoezi 8: Kutengeneza oksijeni kwa usanisinuru

Activity 8: Oxygen production by photosynthesis

Tengeneza mmumunyo wa “bicarbonate” 2 g/1 lita ya maji. Weka 20 ml ya hii katika kila chupa.

Prepare a solution of sodium bicarbonate of 2 g / 1 litre of water. Place 20 ml of it in each bottle.

Lowesha diski za jani kwa mmumunyo wa “bicarbonate”. Weka diski ndani ya sirinji ya 10ml na nyonya mmumunyo wa “bicarbonate” hadi diski zielee

Impregnate the leaf discs with the bicarbonate solution. Place the discs in a 10 ml disposable syringe and draw in the bicarbonate solution until the discs are suspended.

Zoezi 8: Kutengeneza oksijeni kwa usanisinuru

Activity 8: Oxygen production by photosynthesis

Toa kiasi unachoweza cha hewa iliyoinigia na diski zikbakia zinaelea ndani ya “bicarbonate”.

Remove as much as possible the air that has entered, leaving only discs suspended in bicarbonate.

Ziba mwisho wa sirinji kwa kidole na nyonya kwa nguvu kujaribu kutengeneza ombwe, ili nafasi za ndani ya mada ya jani zinajazwa na mmumunyo wa “bicarbonate” ambayo itakuwa ni chanzo cha kaboni, karibu na sehemu za kutokea usanisinuru ndani ya jani

Seal the end of the syringe with a finger and suck tightly, trying to make the vacuum, so in the internal spaces of the plant tissue air is replaced by bicarbonate solution that will be an available carbon source, close to the photosynthetic structures of the leaf.

Zoezi 8: Kutengeneza oksijeni kwa usanisinuru

Activity 8: Oxygen production by photosynthesis

Weka diski za jani ndani ya kila chupa. Funika kila chupa na plastiki nyekundu na ya bluu.

Place the leaf discs in each jar. Cover each of the jars with red and blue cellophane paper.

Weka taa moja (siyo chini ya 70W) juu ya kila chupa (ikifunikwa na karatasi). Taa zote mbili ziwe umbali mmoja kutoka chupa.

Place an individual light bulb (not less than 70W) over each jar (with the paper covering it). Both lights at the same distance.

Vizuri kutumia taa za sola maana zingine hupata joto

Better LED because others emit energy as heat.

Zoezi 8: Kutengeneza oksijeni kwa usanisinuru

Activity 8: Oxygen production by photosynthesis

Unapowasha taa na anza kupima muda wa diski kuanza kuelea

When turning on the light start recording the time for the discs to float.

Hii ni njia isiyo ya moja kwa moja ya kupima kasi ya usanisinuru.

It is an indirect measure of the rate of photosynthesis.

Zoezi 8: Kutengeneza oksijeni kwa usanisinuru

Activity 8: Oxygen production by photosynthesis

Subiri dakika 5 na diski zitaanza kupanda (kutegemeana na nguvu ya taa na umbali wake)

Wait about 5 minutes and the discs begin to rise (depending on the powers of the lights and their distance).

Zoezi 8: Kutengeneza oksijeni kwa usanisinuru

Activity 8: Oxygen production by photosynthesis

Diski za jani zinaanza kuelea kwa vile zinatoa oksijeni kwa mapovu, ambayo hueleesha diski

The discs begin to float as they release oxygen in the form of bubbles, which help in floating.

Muda unakuwa tofauti, kutegemeana na rangi ya mwanga: kasi inakuwa kubwa kwa mwanga wa bluu (ambayo ni mwanga wenye nishati kubwa katika mnunurisho wa spektra ya umemesmaku ["electromagnetic spectrum"])

Times are different, depending on the color of light: it is faster for blue light (it is the high energy component of electromagnetic radiation, it is the most efficient in the process)

Zoezi 9: Uhai katika hali ya kukithiri mno

Activity 9: Life in extreme conditions

Hamira (uyoga) hugeuza sukari (glukosi) kuwa "ethyl alcohol" au "ethanol" na gesi ya makaa.

Yeasts (fungi) transform sugar (glucose) into ethyl alcohol or ethanol and carbon dioxide.

Uchachu ni mchakato wenye ufanisi mdogo kinishati, na kupumua inagharimu kiasi kidogo ya nishati na ni njia ya karibuni kwa muono wa mageuzi viumbe

Fermentation is a low energy efficiency process, while breathing is much more cost-effective and more recent from an evolutionary point of view.

Zoezi 9: Uhai katika hali ya kukithiri mno

Activity 9: Life in extreme conditions

Kukiwepo gesi ya makaa inaonesha kuwa kumetokea uchachu na hivyo tumepima **uwezekano wa kuwa na uhai**

If the presence of carbon dioxide is observed we will know that there has been fermentation and therefore the possibility of life has been tested.

Katika hali zote za majaribio yetu tunaanzia sampuli ambayo ina maji.

In all cases of our experiment we start from a sample in which water is present.

Zoezi 9: Uhai katika hali ya kukithiri mno

Activity 9: Life in extreme conditions

We will use:

1 tablespoon of yeast (to make bread). It is a live microorganism easy to get,

1 glass of warm water (just over half a glass between 22º and 27º C),

1 tablespoon of sugar that microorganisms can consume.

The same procedure in the control experiment and the other experiments developed under extreme conditions.

Zoezi 9: Uhai katika hali ya kukithiri mno

Activity 9: Life in extreme conditions

Jaribio dhibiti:

Control experiment:

Ndani ya glasi, yeyusha hamira na sukari kwenye maji vuguvugu.

In a glass, dissolve the yeast and the sugar in warm water.

Mchanganyiko huu unawekwa haraka kwenye mfuko wa plastiki ambayo haitaruhusu hewa kupita ndani, hewa yote ikiwa kwanza imeondolewa na mfuko kufungwa kwa makini

The mixture obtained is quickly placed in an airtight plastic bag, removing all the air inside and closing it.

Ni muhimu kutoacha kabisa hewa ndani ya mfuko.

It is important not to leave any air inside the bag.

Zoezi 9: Uhai katika hali ya kukithiri mno

Activity 9: Life in extreme conditions

Jaribio dhibiti:

Control experiment:

Baada ya dakika 15-20 utaona gesi makaa ikibubuka ndani ya mfuko uliotanuka

After 15-20 minutes you see the carbon dioxide bubbles in the swollen bag

Kuwepo mapovu ya gesi makaa inaonesha kuwa viumbe vidibuni vipo hai.

The presence of carbon dioxide bubbles shows that microorganisms are alive.

Zoezi 9: Uhai katika hali ya kukithiri mno

Activity 9: Life in extreme conditions

Taratibu ya kufuata katika "sayari alkalini" (k.m. Neptuni au mwezi Titan katika sayari ya Zohali):

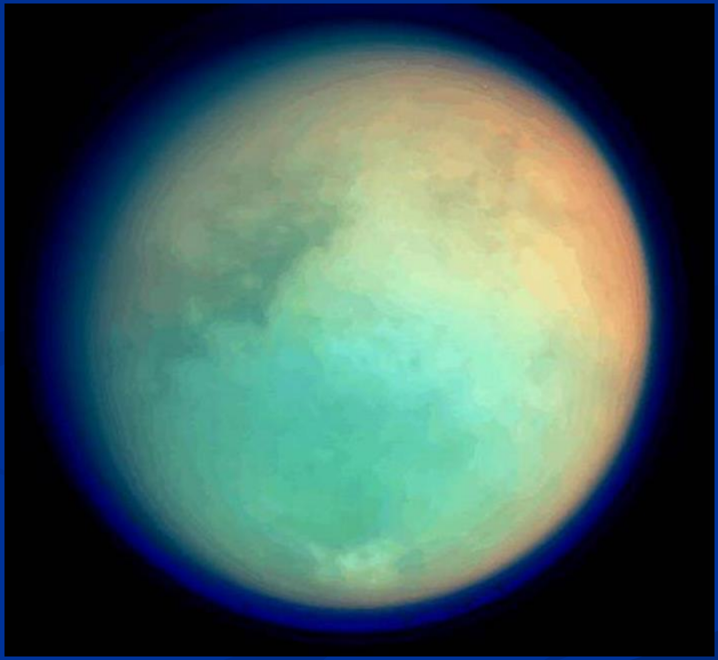
Rudia jaribio na sodiamu bikaboneti au amonia.

Skeli ya Ph za alkalini:

Sodiamu bikaboneti (soda ya kuoka): Ph 8.4

Ammonia ya nyumbani: Ph 11

Procedure on an "alkaline planet"
(e.g. Neptune or Titan both with ammonia):
Repeat the experiment with sodium bicarbonate or ammonia
Ph alkaline scales:
Sodium Bicarbonate or Baking soda: Ph 8.4
Homemade Ammonia: Ph 11



Titan, Credit NASA

Kama kuna mapovu kuna uhai

If there are bubbles there is life

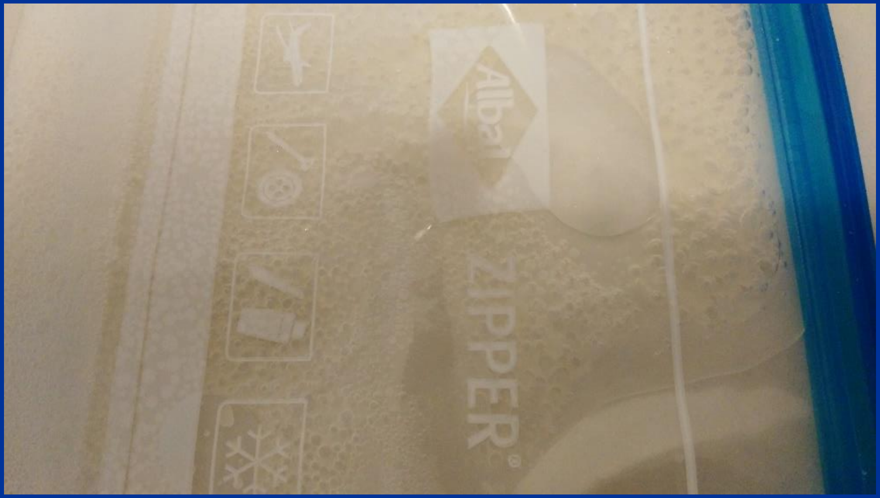
Zoezi 9: Uhai katika hali ya kukithiri mno

Activity 9: Life in extreme conditions

Taratibu katika “sayari chumvi” (k.m. Mirihi au mwezi Ganyamede wa sayari Mshtarii)

Rudia jaribio kwa kuyeusha kloridi ya sodiamu (chumvi ya kawaida)

Procedure on a “saline planet”
eg Mars or Ganymede).
Repeat the experiment dissolving sodium chloride (common salt) in the water.



Ganimede, Credit NASA

Kama kuna mapovu kuna uhai

If there are bubbles there is life

Zoezi 9: Uhai katika hali ya kukithiri mno

Activity 9: Life in extreme conditions

Taratibu katika “sayari asidi” (k.m. Zuhura ina mvua ya asidi ya salfuria)

Rudia jaribio kwa kumumunyia siki au juisi ya ndimu ndani ya maji)

Skeli ya Ph za asidi:

Siki: Ph 2.9

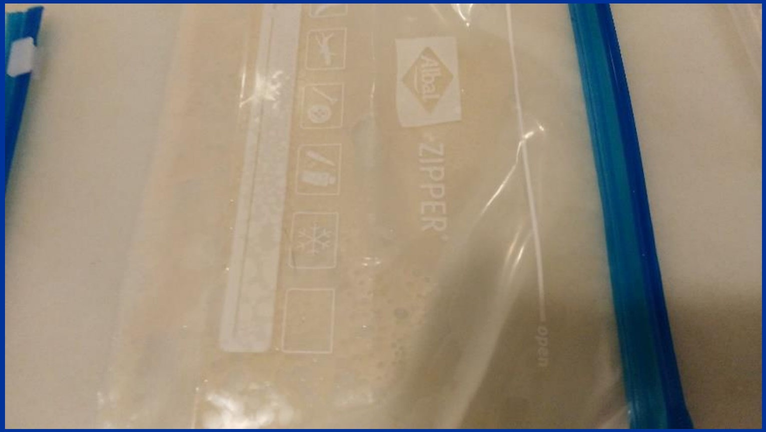
Juisi ya ndimu: Ph 2.3

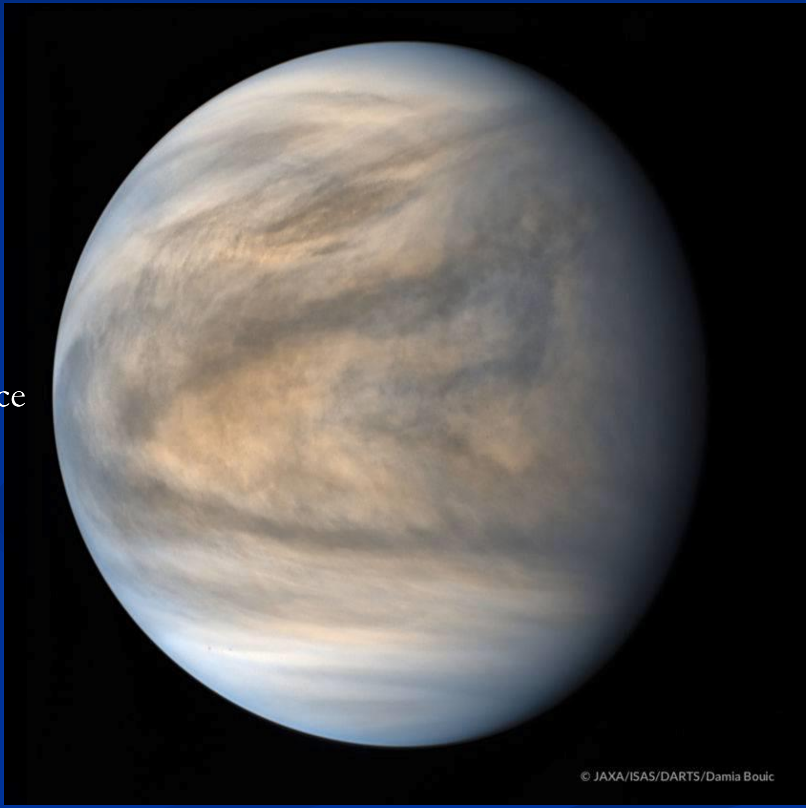
Procedure on an “acid planet”
(eg Venus that has sulfuric rainfall**):** Repeat dissolving vinegar or lemon juice in the cultivation water.

Ph Acid scales:

Vinegar: Ph 2.9

Lemon juice: Ph 2.3.





Venus, Credit NASA

Kama kuna mapovu kuna uhai

If there are bubbles there is life

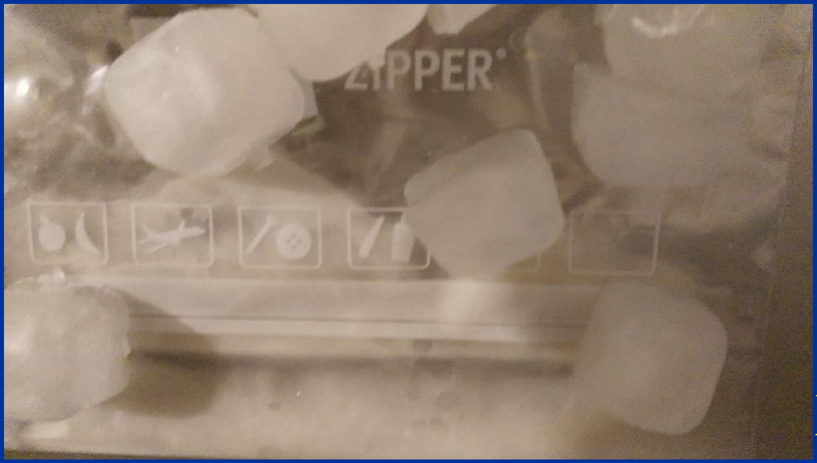
Zoezi 9: Uhai katika hali ya kukithiri mno

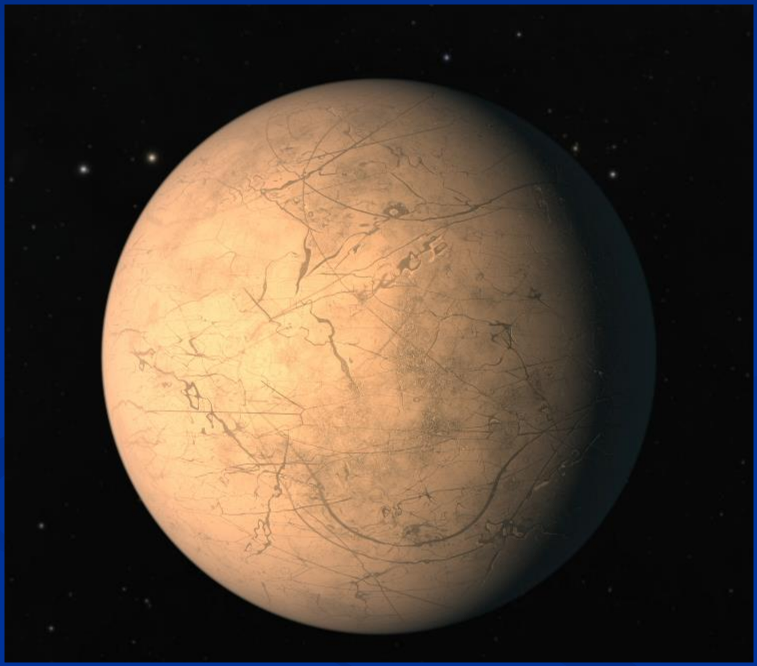
Activity 9: Life in extreme conditions

Taratibu katika “sayari barafu” (k.m. Mwezi wa Mshtarii Europa au syarinje Trapist-1 h)

Weka mfuko katika debe iliyojazwa barafu au tumia jokovu la barafu

Procedure on an “icy planet”
(eg Europa or Trapist-1 h)
Place the bag in a container full of ice or use a freezer





Trappist 1h Artist’s impression

Kama hakuna mapovu hakuna uhai

If there are no bubbles there is no life

Zoezi 9: Uhai katika hali ya kukithiri mno

Activity 9: Life in extreme conditions

Taratibu katika "sayari yenye urujuanimno" (k.m. Mirihi)

Fanya jaribio wakati mfuko ukiwa chini ya mwanga wa urujuanimno

Procedure on a "planet with UV" (eg Mars)

Perform experiment but with the bag under UV light

Marte, Credit iStock

Kama hakuna mapovu hakuna uhai

If there are no bubbles there is no life

Zoezi 10: Kutafuta Dunia ya pili

Activity 10: Looking for a second Earth

Dunia ni sayari pekee inayofahamika kuwa na uhai. Hebu tutafute sayarinje iliyo na hali yakulingana. Lakini je vipengele vipi ni muhimu?

- ❑ Kipenyo na masi ya sayarinje
- ❑ Kanda ya kuweza kuwa na uhai
- ❑ Masi ya nyota mama

Earth is the only known planet with life. Let's look for an exoplanet with similar conditions. But what parameters are important?

- ❑ Radius and Mass of exoplanet
- ❑ Habitable zone
- ❑ Mass of the Host Star

Kipenya na Masi (sayarinje)

Radius and Mass (exoplanet)

Kipenyo na masi ya sayari lazima zizingatiwe kuweza kutathmini density ya kutosha

The radius and mass of the planet must be considered to assess an adequate density.

Kwa kutumia vigezo vya mradi wa Kepler:

Using the Kepler Mission criteria:

- Sayari saizi za Dunia lazima ziwe na nusukipenyo chini ya mara 2 ya nusukipenyo ya Dunia R<2Re
- Mara 10 ya masi ya Dunia inachukuliwa kama kiwango cha juu kwa sayari kubwa M<10Me
- Earth-sized planets must have a radius of less than 2 Earth radii. R<2Re
- 10 Earth masses are considered an upper limit for super-terrestrial planets M<10Me

Kanda ya kuweza kuwepo uhai

Habitability Zone

Nyota zilizo katika Mfuatano Mkuu zina uhusiano wa moja kwa moja kati ya mng'ao na halijoto zake. Halijoto ya nyota ikiwa kubwa, mng'ao wake nao unkuwa mkubwa na kanda ya uhai unakuwa mbali zaidi

The main sequence stars have a direct correlation between brightness and temperature. The hotter the surface temperature is, the brighter the star is and the further away is the habitable zone.

Aina ya Spektra Spectral Type	Halijoto K Temperature K	Kanda ya Uhai AU Habitability Zone AU
O6V	41 000	450-900
B5V	15 400	20-40
A5V	8 200	2.6-5.2
F5V	6 400	1.3-2.5
G5V	5 800	0.7-1.4
K5V	4 400	0.3-0.5
M5V	3 200	0.07-0.15

Masi ya Nota Mama

Host Star Mass

Mageuko nyota na urefu wa maisha yake yanategemea masi yake. Nishati ambayo nyota inaweza kupata kutoka myeyungano wa haidrojeni inaendana na masi yake. Na muda wa nyota kubake ndani ya Mfuatano Mkuu (t*)unapatikana kwa kugawanya masi yake (M*) kwa mng'ao wake (L*) kulingana na masi ya Jua (Ms) na mng'ao wa Jua (Ls) inavyoonekana katika mlinganyo huu:

The evolution and life of a star depends on its mass. The energy that a star can obtain from hydrogen fusion is proportional to its mass. And **the main sequence time is obtained by dividing it by the luminosity of the star.** Using the Sun as a reference, the life of a star in the main sequence is

$$t*/ts = (M*/Ms)/(L*/Ls)$$

Kwa nyota zilizo katika Mufatano Mkuu, mng'ao unalingana na masi kwa ulingano $L \alpha M^{3.5}$

For the main sequence, the luminosity is proportional to the mass according to $L \alpha M^{3.5}$

$$t*/ts = (M*/Ms)/(M*^{3.5}/Ms^{3.5}) = (M*/Ms)^{-2.5}$$

$$t*/ts = (Ms/M*)^{2.5}$$

Masi ya Nota Mama

Host Star Mass

Kwa vile urefu wa maisha ya jua (ts) ni miaka **$ts=10^{10}$**

Tunapata urefu wa maisha ya nyota kuwa miaka:

As the life of the Sun $ts=10^{10}$ years, the lifespan of a star is:

.

$$t* \sim 10^{10} \cdot (Ms/M*)^{2.5} \text{ years}$$

Tukokotoa kiwango cha juu ya masi ya nyota ili iweze **muda wa kuwepo katika Mfuatano Mkuu uwe zaidi ya miaka 3×10^9 ili ipate muda wa kuwa na mageuko.**

Let's calculate the upper limit for the mass of the star so that the residence time in the main sequence is at least 3×10^9 years to give time for life to evolve.

$$M* = (10^{-10} \times t)^{-0.4} Ms$$

.

$$M* = (10^{-10} \times 3\,000\,000\,000)^{-0.4} Ms$$

$$\mathbf{M* =< 1.6\ Ms}$$

Kutafuta Dunia ya pili

Looking for a second Earth

Jina la Sayarinje Exoplanet Name	**Masi kwa masi ya Dunia** Mass in masses of Earth	**Nusukipenyo kwa ile ya Dunia** Radius in Earth radii	**Umbali w nyota kwa AU** Distance to star in AU	**Masi ya Nyota kwa masi ya Jua** Star Mass in masses of the Sun	**Aina ya Spektra ya Nyota/halijoto ya uso wake** Star Spectral Type/surface temperature
Beta Pic b	4100	18.5	11.8	1.73	A6V
HD 209458 b	219.00	15.10	0.05	1.10	G0V
HR8799 b	2226	14.20	68.0	1.56	A5V
Kepler-452 b	unknown	1.59	1.05	1.04	G2V
Kepler-78 b	1.69	1.20	0.01	0.81	G
Luyten b	2.19	unknown	0.09	0.29	M3.5V
Tau Cet c	3.11	unknown	0.20	0.78	G8.5V
TOI 163 b	387	16.34	0.06	1.43	F
Trappist-1 b	0.86	1.09	0.01	0.08	M8
TW Hya d (yet unconfirmed)	4	unknown	24	0.7	K8V
HD 10613 b	12.60	2.39	0.09	1.07	F5V
Kepler-138c	1.97	1.20	0.09	0.57	M1V
Kepler-62f	2.80	1.41	0.72	0.69	K2V
Proxima Centauri b	1.30	1.10	0.05	0.12	M5V
HD 10613 b	12.60	2.39	0.09	1.07	F5V

Kutafuta Dunia ya pili

Looking for a second Earth

Jina la Sayarinje Exoplanet Name	Masi kwa masi ya Dunia Mass in masses of Earth	Nusukipenyo kwa ile ya Dunia Radius in Earth radii	Umbali w nyota kwa AU Distance to star in AU	Masi ya Nyota kwa masi ya Jua Star Mass in masses of the Sun	Aina ya Spektra ya Nyota/halijoto ya uso wake Star Spectral Type/surface temperature
Beta Pic b	~~4100~~	~~18.5~~	~~11.8~~	~~1.73~~	A6V
HD 209458 b	~~219.00~~	~~15.10~~	~~0.05~~	1.10	G0V
HR8799 b	~~2226~~	~~14.20~~	~~68.0~~	1.56	A5V
Kepler-452 b	**unknown**	**1.59**	**1.05**	**1.04**	**G2V**
Kepler-78 b	1.69	1.20	~~0.01~~	0.81	G
Luyten b	**2.19**	**unknown**	**0.09**	**0.29**	**M3.5V**
Tau Cet c	3.11	unknown	~~0.20~~	0.78	G8.5V
TOI 163 b	~~387~~	~~16.34~~	~~0.06~~	1.43	F
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HD 10613 b	~~12.60~~	~~2.39~~	~~0.09~~	1.07	F5V
Kepler-138c	**1.97**	**1.20**	**0.09**	**0.57**	**M1V**
Kepler-62f	2.80	1.41	~~0.72~~	0.69	K2V
Proxima Centauri b	1.30	1.10	~~0.05~~	0.12	M5V
HD 10613 b	~~12.60~~	~~2.39~~	~~0.09~~	1.07	F5V

Hitimisho

Conclusions

- Fahamu dhana ya kanda ya uwezekano wa kuwa na uhai
- Kuanzisha dhana ya Astrobiolojia
- Kuonesha namnya ya kutengeneza oksijeni na kupata gesi ya makaa.
- Namna ya kutambua Dunia ya pili.

- Know the concept of habitability zone.
- Introduce the concepts of astrobiology.
- Show how it is possible to generate oxygen and obtain carbon dioxide.
- How to locate a second Earth

Asanteni sana kwa usikvu wenu!

Thank you very much for your attention!