Ka Hawewe Kukuna Lā

ʻŌwehe Laulā:

ʻO ka hapanui o nā kinoea make i puka aku mai ka lua pele ke kinoea hanu ʻole kūnalohia, no laila hoʻohana nā kānaka ʻepekema i nā hawewe electromagnetic ma waho o ka visible spectrum i mea e ʻike i nā kinoea make. Ma kēia haʻawina, e aʻo ana nā haumāna i nā mea pili i ka electromagnetic spectrum, ke kōā hawewe kukuna lā, ka ikehu kuawehi (ultraviolet energy), a me ka ikehu infrared.

Nā Pahuhopu:

E aʻo ana ka haumana:

- e kūkulu i kekahi makaaniani "ānuenue" mai ka diffraction grating;
- e kahakiʻi i ka visible color spectrum i ke komo ʻana o ka makaaniani;
- e wehewehe kahi o nā kukuna lā visible, infrared a me ke kuawehi (ultraviolet) ma ka electromagnetic spectrum; a me
- e wehewehe i nā kōā hawewe pili i nā māhele.

Nā Pono Haʻawina:

- Ka pepa pelaha
- Nā pepa diffraction grating (13,500 mau laina)
- Nā ʻūpā
- Nā kala penikala
- Ka leki
- Nā pepa pōaka kinowai (liquid crystals) a i ʻole ka huinahā like (23 a i 27º C ka laulā)
- Ka Māliko: "Ka Hawewe Kukuna Lā"
- Ka Pepa Haʻawina Haumana: "Ka Hawewe Kukuna Lā"
- Ka Pepa ʻIke Haumana: "Ka Makaaniani Ānuenue"

Nā Pane I Ka Pepa Haʻawina Haumana:

1. Pono nā haumāna e ʻōlelo e ʻike ana lākou i nā "ānuenue" a i ʻole nā kala ke nānā lākou i ke kukui.
2. ʻO kēia ke kaʻina o nā kala ʻUlaʻula, ʻAlani, Melemele, ʻŌmaʻomaʻo, Polū, a me Waioleka (Violet) (a i ʻole kaʻina ʻokoʻa).
3. ʻO kēia nā hawewe: ʻulaʻula = 650 nanometers, ʻalani = 590 nanometers, melemele = 570 nanometers, ʻōmaʻomaʻo = 510 nanometers, polū = 475 nanometers, waioleka = 400 nanometers.
4. Aia ka waioleka ma kahi ē o ka spectrum; aia ka infrared ma kahi ē o ka ʻulaʻula ma ka spectrum.

Ka Hawewe Kukuna Lā

Ke Kaʻina Hana Haʻawina:

1. E noi i nā haumāna e kākau i nā hawewe (waves) ʻokoʻa. E nīnau he aha lā ka mea e holo ʻia e ka nalu. (ka ikehu, ʻaʻole ka wai. Holo ka ikehu i ka wai).
2. E wehewehe ʻo ke kukuna lā kekahi hawewe: he hawewe electromagnetic. ʻAʻole like ka hawewe electromagnetic me ka hawewe mechanical, ʻo ia nō ka nalu i ke kai, ʻaʻole pono ka hawewe electromagnetic e holo i loko o kekahi mea: hiki ke holo o ka lewa (space).
3. E wehewehe ʻo ke kukuna lā visible light kekahi māhele o ka electromagnetic spectrum. ʻO ka mālamalama o ka lā, a i ʻole ke kukui mai ka ipukukui ke kukuna lā keʻokeʻo. Loaʻa nā kala a pau i ka visible spectrum. E hōʻike i ka Māliko: "Ka Hawewe Kukuna Lā" e hōʻike i kēia mau manaʻo.
4. Wehewehe ʻia nā kōā hawewe (light) a i ʻole nā alapine frequencies (e like me, nā hawewe radio) i ka hawewe electromagnetic. Ana ke kōā hawewe mai hoʻokahi hokua i ka hokua aʻe o ka hawewe, a i ʻole mai hoʻokahi honua hawewe a i ka honua hawewe aʻe. Liʻiliʻi loa nā kōā hawewe o ke kukuna lā--ʻo ke kōā hawewe o ke kukuna lā visible ma waena o 400 a me 700 nanometers (hoʻokahi billionth o ka mika ka nanometer).
5. ʻO ke kala ke kukui e hōʻaka ai mai nā mea like ʻole. Eia naʻe, omo ka lau i nā hawewe a pau koe naʻe nā mea i 500 nanometers (ʻōmaʻomaʻo). Hōʻaka hou ke kukui i 500 nanometers i nā maka a ʻōʻili i ke kala ʻōmaʻomaʻo. (He memo: ʻōʻili ke kala mai ke kukui i hōʻike a i ʻole hoʻouna aku. Inā hoihoi hiki ke kūkākūkā e pili ana i kēia manaʻo).
6. E wehewehe ʻaʻole hiki ke ʻike i ka hapanui o nā hawewe i ka electromagnetic spectrum. Akā naʻe, hoʻohana nā kānaka ʻepekema i nā ʻanopili o ke kuawehi (ultraviolet light) a me ke kukui (infrared) e ʻike i nā ʻakano i ʻike ʻole ʻia e nā kānaka, e like me ke kinoea kūnalohia i puka aku mai ka lua pele.
7. E kākaʻahi i ka Pepa Haʻawina Haumana: "Ka Hawewe Kukuna Lā" a me ka Pepa ʻIke Haumana: "Ka Makaaniani Ānuenue." E wehewehe i nā haumāna e hana ana lākou i kekahi makaaniani "ānuenue" e ʻike maka i nā mea i hiki ke ʻike ma ka electromagnetic spectrum. Inā pono, e hōʻike i ka māliko e kōkua i nā haumāna e hana i ka pepa haʻawina haumana.
8. Ke pau nā haumāna i ka pepa haʻawina haumana, kākaʻahi i nā pepa pōaka (crystal). E wehewehe, omo ka ikehu infrared a malele ʻia (radiate) e ka ʻili o kānaka ma ke ʻano wela. ʻAʻole hiki ke ʻike i ka ikehu infrared akā hiki ke hoʻohana i nā mea e kōkua no ka ʻike ʻana e like me nā pepa pōaka kinowai. Hiki i nā kānaka ʻepekema ke ʻike mua i ka wela mai ka lua pele me kekahi mau mauhaʻa like.
9. Hiki i nā haumāna ke hoʻokolohua me nā pepa pōaka kinowai. Inā kaomi ka lima ma ke pākaukau, hiki i nā pepa ke hōʻike i ka meheu lima. Hana pū nā pepa pōaka i ka lima, ka ihu, a pela aku.
10. E kūkākūkā i nā mea maikaʻi o ka infrared (hiki i nā kānaka ʻepekema ke ʻike i ka wela o ka lua pele mai o aku, ʻaʻole pono lākou e komo i loko o ka lua pele). Hiki ke nānā i ka punaewele NASA's Infrared Light Lessons pili i ke kukui infrared. Aia nā kumuhana ʻē aʻe: environmental monitoring, law enforcement, archeology, a me navigation: (http://coolcosmos.ipac.caltech.edu/cosmic_classroom/light_lessons/our_world_different_light/index.html).

Ka Manaʻo Hou Aʻe: Ka punaewele o NASA's Infrared Zoo (http://coolcosmos.ipac.caltech.edu/image_galleries/ir_zoo/index.html) hiki ke ʻike i nā holoholona me ke koko mehana a me koko huʻihuʻi.

Inoa:_____ **Pepa Haʻawina Haumana**

Ka Hawewe Kukuna Lā

Ka ʻIke Hou Aʻe:

Aia nā waihoʻoluʻu a pau i ke ānuenue i ke kukui keʻokeʻo. I ka holo ʻana o ke kukui keʻokeʻo i kekahi ʻōpaka (prism) a i ʻole ka diffraction grating, ua pelu ʻia nā waihoʻoluʻu pākahi i ke kukui ma nā huina (angle) ʻokoʻa. Haki ka pelu ʻana o nā waihoʻoluʻu i mau ʻauina kala (ānuenue). ʻAʻole hiki ke ʻike i nā kukui like ʻole, e like me ke kukui kuawehi (ultraviolet) a me ka ikehu infrared, akā naʻe hiki ke ʻike i kēia ʻano kukui me kekahi mauhaʻa.

Nā Pono Haʻawina:

- Ka pepa pelaha
- Diffraction grating
- Nā ʻūpa
- Nā kala penikala
- Ka leki

Ke Kaʻina Hana Haʻawina:

1. E ʻoki i nā mahele a pau o ka makaaniani ma ka pepa ʻike haumana.
2. E leki i nā kahi lōʻihi (stems) o nā makaaniani i ka mahele nui i hoʻokahi apana. E hoʻohana i kēia makaaniani ma ke ʻano he lauana no ka hana ʻana i nā maka aniani ʻē aʻe.
3. E kau i ka lauana makaaniani ma ka pepa pēlaha. E hoʻomeheu puni o ka lauana me ka penikala. E ʻoki i nā makaaniani.
4. E ʻoki i nā ʻāpana ʻelua o ka diffraction grating ma kahi o 1/2 kenimika nui aʻe o nā puka. E hoʻohana ana kēia ma ke ʻano he aniani (lens) no ka makaaniani.
5. E kau i nā aniani ma luna o nā puka o nā maka ma ka ʻaoʻao hope o ka makaaiani. E hoʻohana i ka leki e paʻa nā lihi o ka diffraction grating i ka makaaniani. Mai pale i nā puka o nā maka me ka leki.
6. E pane i nā nīnau ma lalo nei.

Nā Nīnau:

1. E nānā i nā kukui like ʻole i ka papa me ka makaaniani diffraction hou. E wehewehe i nā mea āu e ʻike ai.

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   _____

2. E nānā i kekahi pukaaniani me ke komo ʻana i ka makaaniani. E kala i nā pahu ma lalo nei i ke kaʻina o nā waihoʻoluʻu e ʻike ai me ka makaaniani:

3. E hoʻohana i ka ʻike mai ke kumu a i ʻole kekahi kumu aʻe, e lepili i nā waihoʻoluʻu pākahi i luna me ka hawewe i nanometers.

4. ʻAʻole hiki ke ʻike i ke kukui kuawehi (ultraviolet) a i ʻole ke kukui infrared, akā aia ia i loko o ka electromagnetic spectrum. E lepili i kahi ma ka spectrum ma hea ke kukui kuawehi (ultraviolet) a me ke kukui infrared ma ka spectrum.

Ka Makaaniani Ānuenue