TEACHING TRAINING COURSE ON ASTROBIOLOGY

- **Lectures Topics**
  - 1 – Evolution of the Stars
  - 4 – Solar System
- **Workshops Topics**
  - 7 – Astronomy beyond the visible
  - 9 – Planets and exoplanets
  - 10- Elements of Astrobiology
  - 11- Cosmological Timeline

WS7: Astronomy beyond the visible

Summary
Celestial objects radiate in many wavelengths of the electromagnetic spectrum, but the human eye only distinguishes a very small part: the visible region.
There are ways to demonstrate the existence of these forms of electromagnetic radiation that we do not see through simple experiments. In this presentation, you will be introduced to observations beyond what is observable with a telescope that can be used in a primary or secondary school.

Goals
This activity aims to show certain phenomena beyond what may be observable with amateur telescopes, such as the existence of:

-Celestial bodies that emit electromagnetic energy that our eye cannot detect. Astronomers are interested in these other wavelengths because visible radiation alone does not offer a complete picture of the Universe.

-Visible emissions in the regions of radio waves, infrared, ultraviolet, microwave and X-rays.

List of Materials

Activity 1: Construction of a spectrograph (spectra)

- ✓ Template to make the spectrograph (provided)
- ✓ 1 CD out of use (or a DVD)
- ✓ Common adhesive or paper tape.
- ✓ Strong scissor
- ✓ Tack (cutter, stylet, scalpel) for fine cutting.
- ✓ Glue to be glued (preferably in a bar)
- ✓ 1 filament, halogen or LED bulb
- ✓ 1 fluorescent bulb
- ✓ 1 lamp holder

Activity 2: Sodium lines visualization

- ✓ 1 candle
- ✓ 1 tablespoon of common salt (Na Cl)
- ✓ some water

Activity 3: Natural decomposition of light (rainbow)

- ✓ 1 hose with diffuser
- ✓ a court or garden

Activity 4: Infrared detection (Herschel)

- ✓ 1 large cardboard box (type of sheets for photocopier)
- ✓ 1 prism
- ✓ 4 laboratory thermometers.
- ✓ Common adhesive tape
- ✓ clock

- ✓ paper, pencil

Activity 5: IR detection with a cellular phone
- ✓ 1 or more remotes with IR LED
- ✓ CCD camera of cellular phone (also serves the digital camera)

Activity 6: IR detection through interstellar medium with a bulb
- ✓ 1 flashlight with filament bulb (no led)
- ✓ a piece of cloth
- ✓ mobile phone camera

Activity 7: Constellation with LEDs
- ✓ IR LEDs
- ✓ base for installing LEDs
- ✓ wire
- ✓ resistances

Activity 8: Constellations with remote controls
- ✓ Several remote controls (depends on the constellation you want to play)

Activity 9: Detection of radio waves.
- ✓ 1 9V battery
- ✓ 2 wires with peeled tips, 20 cm long
- ✓ a radio receiver.

Activity 10: Uses of UV (Black light)
- ✓ 1 black light bulb (365nm recommended)
- ✓ bills, cards, passports
- ✓ 2 glasses
- ✓ 1 bottle of water
- ✓ 1 bottle of tonic water

Activity 11: Phosphorescent matter and UV
- ✓ 1 black light bulb
- ✓ phosphorescent material

Activity 12: Fluorescent and UV material
- ✓ 1 black light bulb
- ✓ fluorescent material
- ✓ piece of glass or glass glasses
- ✓ plastic or organic glasses

WS9: Planets and exoplanets

Summary
This workshop provides a series of activities to compare the many observed properties (such as size, distances, orbital speeds and escape velocities) of the planets in our Solar System. Each section provides context to various planetary data tables by providing

demonstrations or calculations to contrast the properties of the planets, giving the students a concrete sense for what the data mean.

At present, several methods are used to find exoplanets, more or less indirectly. It has been possible to detect nearly 4000 planets, and about 500 systems with multiple planets.

Goals

- Understand what the numerical values in the Solar System summary data table mean.
- Understand the main characteristics of extrasolar planetary systems by comparing their properties to the orbital system of Jupiter and its Galilean satellites.

List of Materials

Activity 1: Scale of distances to the Sun

- 1 piece of calculating machine paper of just over 4.5 meters
- 1 roll of toilet paper of more than 30 units

Activity 2: Diameter model

- 1 piece of yellow paper or yellow cloth to cut a circle of 1.39 m in diameter
- Paintings to draw the planets or paper with different colors to cut the disks of different sizes

Activity 3: Model of distances and diameters

- 1 basketball ball
- 2 pins of 1 mm head
- 2 pins of 2 mm head
- 1 ping pong ball
- 1 golf ball
- 2 glass marbles

Activity 4: Model in the city

- 1 map of the city
- 1 calculator

Activity 5: Model of times

- 1 calculator

Activity 6: Sun from the planets

- 1 circles template

Activity 7: Density model

- 3 similar fragments of pyrite
- 3 similar fragments of sulfur
- 1 fragment of clay
- 1 fragment of pine wood
- 1 fragment of blende

Activity 8: Flattening Model

- Cardboard
- 1 stick 50cm long and 1cm in diameter

Activity 9: Rotational model

- 1 a meter string
- 1 lead or something that weighs a little and can be easily tied

Activity 10: Model of superficial gravities

- 1 mechanical bath scale (other than electronic) for each planet
- 1 pliers to open the scale
- 1 card
- 1 marker

Activity 11: Model of craters

- 1 pack of 1 kilo of flour
- 1 pack of 400 gr of cocoa powder. Those that are difficult to dissolve are better, those that are difficult to dissolve in the milk
- 1 fine sieve
- 1 old newspaper
- 1 soup spoon

Activity 12: Escape velocity model

- 1 tube of pills or medicines whose lid has no thread but is under pressure. It also serves a tube of food for fish, a capsule of photographic film
- Water and an effervescent pill
- Bicarbonate and vinegar
- Coca cola and mentos

Activity 13: Doppler Effect

- 1 transparent plastic box
- 1 stopper with chair
- Flash of 1 mobile

Activity 14: Transit simulation

- 1 large ball about 10 cm
- 1 small ball about 2 cm

Activity 15: Simulation of micro lenses

- 2 wine glass feet
- 1 small ball about 1 cm

Activity 16: Model of solar system and exoplanets

- 1 extensible meter
- 1 little ball of 0.2 cm
- 1 little ball of 0.3 cm
- 2 little ball of 0.6 cm
- 2 balls of 2.5 cm
- 1 ball of 6 cm
- 1 ball of 7 cm
- 1 paper lamp of 35 cm
- 1 ball of 5.5 cm
- 1 ball of 7 cm

- 1 ball of 9 cm
- 1 ball of 10 cm
- 1 paper lamp of 45 cm
- 1 little ball of 0.8 cm
- 1 little ball of 1.1 cm
- 1 little ball of 1.6 cm
- 1 ball of 10 cm
- 1 little ball of 0.7 cm
- 1 little ball of 1.7 cm
- 1 little ball of 1.8 cm
- 1 ball of 2 cm
- 1 ball of 2.4 cm
- 1 paper lamp of 22 cm
- 2 little ball of 1.0 cm
- 1 little ball of 1.2 cm
- 1 little ball of 1.3 cm
- 2 little ball of 1.4 cm
- 1 little ball of 1.5 cm
- 1 ball of 4 cm

WS10: Elements of Astrobiology

Summary
This workshop is essentially divided into two parts. The necessary chemical elements for life, a simple study of the periodic table corresponding to the objectives of this work and some concepts of astrobiology are introduced.

Goals
- Understand where from or how the different elements of the periodic table arise
- Understand the main characteristics of extra-solar planetary systems.
- Understand the habitability conditions necessary for the development of life
- Study the minimum guidelines of life outside the Earth.

List of Materials

Activity 1: Formation of the planetary system from gas and dust
- no material

Activity 2: Emission spectrum
- 1 DVD

Activity 3: Periodic table classification
- 3 basket (blue, yellow, red)
- 1 golden ring
- 1 drill bit coated with titanium
- a child’s balloon with helium inside
- 1 pan scourers of nickel
- 1 mobile/button battery
- 1 car spark plugs

- 1 electric cooper wire
- 1 iodine solution
- 1 water bottle
- 1 old cooking pan
- 1 black pencil lead
- 1 sulfur for agriculture
- 1 can of soft drink
- 1 wrist watch of titanium
- 1 silver medal
- 1 pipe lead
- 1 zinc pencil sharpener
- 1 thermometer
- 1 matchbox

Activity 4: Children of the stars

- no materials

Activity 5: Fraunhofer lines of the Sun

- 1 DVD

Activity 6: Liquid water on Mars?

- 1 disposable syringe of 10 ml
- Hot water closes to boiling
- 1 microwaves or 1 pot to put on the fire and heat water

Activity 7: Greenhouse effect

- 3 thermometers
- 3 empty plastic bottles
- 1 cutter
- dark earth to put inside each ½ bottle
- few drops of water to simulate atmosphere with water vapor

Activity 8: Oxygen production by photosynthesis

- 1 punch
- 2 sheets of spinach
- 25g of sodium bicarbonate
- 1 disposable syringe of 10 ml
- 1 disposable syringe of 20 ml
- 1 foil of red cellophane paper
- 1 foil of blue cellophane paper
- 2 light LED bulb (not less than 70W)
- 2 lamps to put both light bulbs

Activity 9: Life in extreme conditions.

- 1 small packet of yeast to make bread (1 tablespoon is enough)
- 1 glass of warm water (between 22º and 27º)
- 10 tablespoon of sugar that will be consumed by microorganisms
- 1 disposable syringe of 20 ml.
- 6 zipper bags
- 1 tablespoon baking soda

- 1 tablespoon of sodium chloride (common salt)
- 1 squirt of vinegar or lemon juice
- 10 or 12 pieces of ice
- 1 UV lamp (used to grow vegetables)

Activity 10: Looking for a second Earth

- no materials

WS11: Cosmological Timeline

Summary

This workshop is focusing in the Cosmological Timeline and a set of different activities involved in it. The process and the adaption of life.

Goals

- Visualize the history of the Universe with a time line
- Understand the important processes that were necessary to arrive at the formation of life.
- Understand the adaptation of life to very varied conditions.

List of Materials

Activity 1: Timeline

- 14 meters of cloth tape
- 1 pen
- 5 rattles
- 1 eye
- 1 piece of nickel sponge
- 1 piece of plastic plant
- 1 suction cup to make an umbrella with a needle
- 1 small dinosaur
- 1 small mammal
- 1 small humanoid
- 1 little doll
- 1 chick

Activity 2: Filamentous model

- a splash of soap
- 1 small tray
- 1 or 2 straws

Activity 3: Simulation of the formation of spiral galaxies

- 1 cylindrical and transparent glass
- 2 tablespoons of sand, baking soda or salt
- 1 dessert spoon

Activity 4: Simulation of edible micrometeorites

- 1 microwave or a saucepan on the fire

- 75 ml chocolate shake or fruit juice before boiling add
- 1 gram of agar-agarin in the form of rain (it can be substituted for the gelatin obtained by cooking 2 chicken thighs)
- 1 fine strainer to pass the mixture
- 1 cylindrical container 30 cm long
- ½ liter of sunflower oil (freeze for at least 30 min)
- 1 syringe to place small amounts of mixture in the oil column

Activity 5: Search for Micrometeorites

Option a)

- 1 brush to collect sand from a gutter
- 1 sheet of paper
- 1 magnet

Option b)

- 1 tray
- 1 transparent cellophane paper or similar
- 1 sheet of paper
- 1 magnet

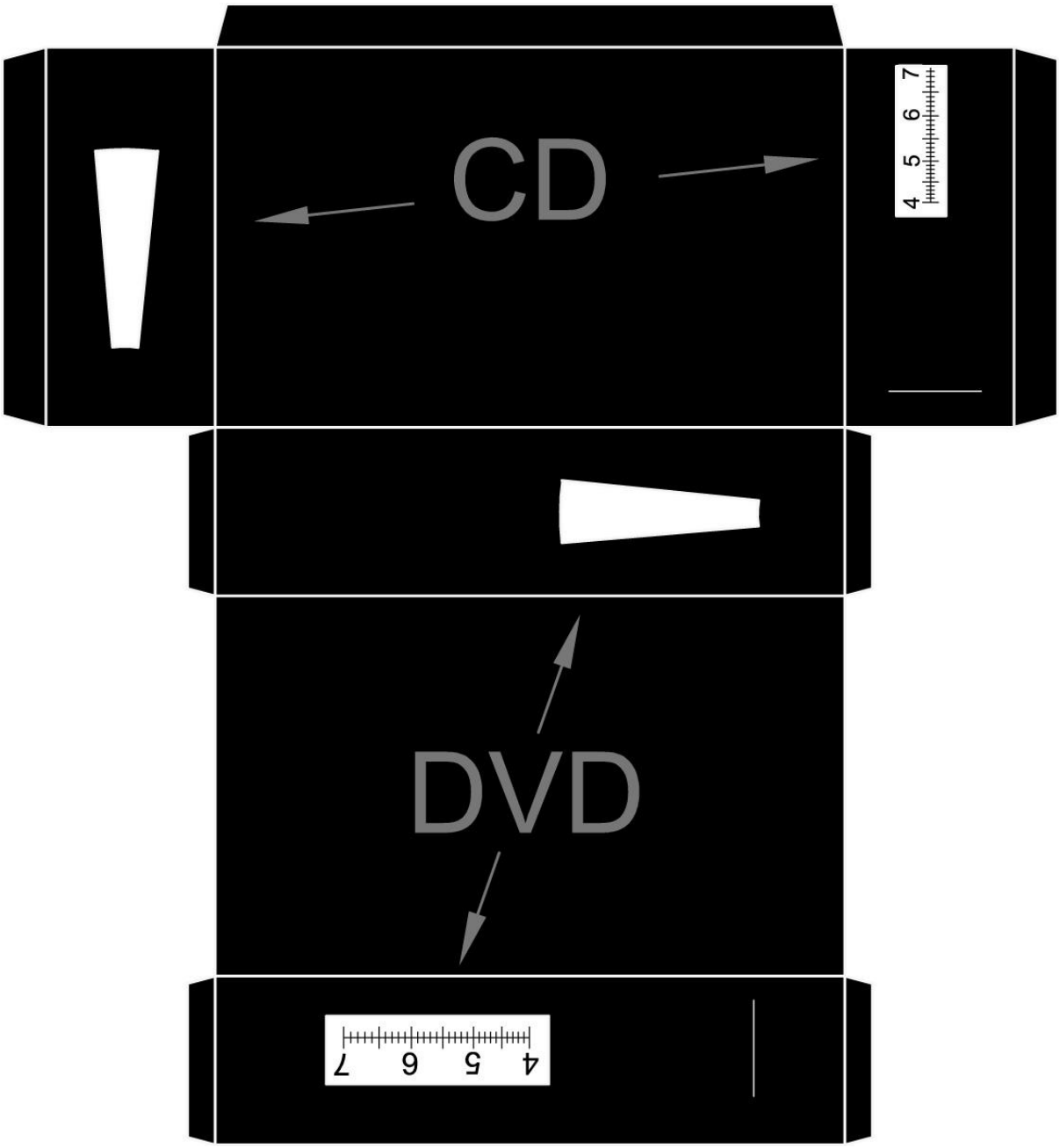
Option c)

- 1 paper cup for each participant
- 1 small magnet for each participant
- 1 meter of rope for each
- 1 sheet of paper each

Activity 6: DNA extraction.

- 3 glasses
- 1 teaspoon
- 1 fork
- ½ glass of water
- 1 teaspoon of Sodium Chloride or Salt to eliminate proteins
- 3 teaspoons of baking soda to keep the pH constant
- 1 splash of dishwasher until the mixture remains the same color
- 2 teaspoons of tomato pulp
- 1 fine strainer

WORKSHOP 7



WORKSHOP 10