AstroChallenge 2020

Summary of Format Changes

Junior

No format changes are planned this year.

Senior

Several changes will be implemented this year:

- In the Theory Observation Round:
    - Race Against Time in Stellarium is removed and may be implemented as the Practical Observation Round wet-weather plan.
    - Constellation Identification will be replaced by an Open-Ended Question (OEQ).
    - Observation Plan will be replaced by a Night Sky Tour.
    - The weightages for both sections remain the same at 20 marks each.
    - The total mark for this round is now 85.

- AstroChallenge 2020 will contain a Data Analysis Question (DAQ). This question will replace one of the questions in the Team Round, and will be released on Day 0 itself. The DAQ will be due on Day 1.

- In turn, the Team Round will contain only 4 questions. The time limit for the Team Round will remain unchanged.

Details on these changes will be covered in the next few pages.

Open-Ended Question

With multiple parts testing numerous concepts in astronomy, the Open-Ended Question (OEQ) will test your ability to utilise analytical and problem-solving skills in an astronomical context.

For the OEQ, you will be given a series of questions based on a given chart of the night sky, which test concepts and skills in observational astronomy (stars, constellations, coordinate systems, motion of planets and the celestial sphere, DSOs etc.)

The total mark for this section is **20**.

Night Sky Tour

Astronomy, being a scientific discipline, involves jargon and complicated physics to explain many phenomena and processes. This drives the layperson away from astronomy due to a perceived steep learning curve. To combat this, educators in astronomy must be able to communicate effectively to captivate public interest.

You will be assessed on your ability to educate a general audience on astronomy and stargazing in an interesting, engaging and easy to understand way. You will need to display basic presentation skills such as flow and engagement and line them with understandable scientific facts to keep the audience hooked and teach them about astronomy.

Your team will be using **Stellarium**, a free open-source planetarium software, as well as a **projector screen** and **laser pointer** as the mode of presentation.

As per previous observation rounds, all teams will be split into two separate groups. All groups will be given the night sky for a specific date, time and location and will be allotted **10 minutes of preparation time** before the assessment.

Each group will present their night sky tour separately with the abovementioned tools to a panel of judges for a **5 to 8 min** presentation. Additionally, each group will be given a list of virtual optical equipment in Stellarium to aid their night sky tour.

The total mark for this section is **20**.

Night Sky Tour Assessment Criteria

Content: (55%)

Students are expected to:

- Give a night sky tour with **diversity** in subject matter (e.g. stars, constellations, asterisms, nebulae, clusters, galaxies, solar system objects, etc)
- Present scientifically **accurate** information. If simplifications are used to make the information more understandable, it should not be simplified to the point of being misleading or scientifically wrong.
- Be **comprehensive** in describing and explaining objects, such as explaining **interesting** facts, trivia, **mythology** or **history**, or describing **visually interesting features**.
- Describe objects only as far as their **visibility** permits them to be.
- Explain how to **locate** chosen objects (e.g. location with reference to visible nearby stars, shapes, asterisms etc.). Audience members should be able to follow the steps to get a sense of where the object is beyond just 'somewhere in the sky'.

Presentation: (30%)

Students are expected to:

- Explain information in a **clear** and **succinct** manner.
- Be able to explain **technical** vocabulary (e.g. nebula, galaxy, cluster) as needed such that adults with no scientific background can understand.
- Present information with good **flow** (e.g. ordering objects by location, direction, decreasing brightness, object category, mythology etc.) such that the audience can follow the presentation.
- Vary their **tone** of voice to convey emotions, show emphasis and stimulate audience interest.

Teamwork: (15%)

Groups are expected to display teamwork. Each student must make a substantial **contribution** to the night sky tour.

<u>Tips/Guidelines:</u>

1. Group presentations will be assessed in a **holistic** manner. In other words, you should prioritise the general quality of your presentation over sheer quantity of information presented.
2. Listing out an excessively large number of DSOs/constellations/objects in your presentation is not encouraged, particularly if presentation and depth of content suffers.
3. Similarly, you will not be given extra credit for presenting 'exotic' and difficult-to-find objects over more well-known and easy-to-find objects. (E.g. prioritizing M74 over Orion Nebula or Pleiades)
4. Do not treat the above assessment criteria as an exhaustive list of what you can present. If you can wow us by presenting something surprising and **relevant**, all the better!

5. Neither should you treat the assessment criteria as a checklist to strictly adhere to; it simply outlines the range of points that judges will be looking out for. Ultimately, a good presentation is one that meets most of the important criteria for the **purpose** of presenting to an audience.
6. Do take time to familiarize yourself with the software used for the presentation. You can download Stellarium for free at https://stellarium.org. Do note that the following settings will be used for the presentation:

Stellarium Settings:

1. Turn off constellation lines, names and art
2. Turn off cardinal points
3. Turn off equatorial and azimuthal grids
4. Turn off labels for planets, deep sky objects, exoplanets, satellites, and meteor showers
5. Turn off star labels and markers
6. Turn **on** ground (zero horizon landscape) and atmosphere
7. Stereographic Projection
8. Light pollution will be set to mimic the night sky of the given location
9. Ocular settings will be set according to the list of virtual equipment provided

Data Analysis Round

Background

Astronomy has, since its earliest pre-historic inceptions, been a data-oriented field. They may not have *consciously* known it, but our predecessors collected, manipulated, and analysed data from the heavens to gain knowledge and ideas, and philosophise about the world. Over time, our data collection techniques and tools have improved drastically, beginning with the mere use of the naked eye in clear, dark skies free of light pollution; then the sundial, set-square and other simple geometrical implements came into play—Eratosthenes famously used a simple stick in two cities to prove the spherical nature of Earth (and his solution was within 10% accuracy—a remarkable figure for a society with no surveying tools whatsoever).

In the Age of Exploration, sextants and star charts played a vital role in the discovery of the New World; shortly after, the use of the telescope by Galileo Galilei changed astronomy forever, and put Earth in its rightful place of nowhere special; during the Renaissance, the catalogues of various celestial objects and nebulae (which we, today, call *deep-sky objects*, or DSOs) by Messier and Caldwell kick-started the era of serious and formal data collection; finally, the explosion of technology in the 20th century from the rocket to the semiconductor, has caused an equally exponential increase in data collection, processing, analysis, and conclusions: huge server farms process terabytes of data every single day.

Motivation

Considering this, the QMs have decided that AstroChallenge 2020 will contain a data analysis segment, to expose you, the participants, to a real-life data source, teach basic data processing, analysis, and presentation skills, and give you a chance to link what you have learnt in theory, to *real*, observable data. In summary, it is hoped that you will gain enough insight to data-oriented and computational astronomy to spark further interest in the topic.

Format

The DAQ will be set in the format below.

1. The DAQ will be offered to students in the **Senior Category** only.

2. The DAQ will be attempted as **teams**, rather than individually. Teams are expected to attempt all questions.

3. The DAQ will be due on **Day 1**, **just before** the commencement of the Team Round. Late submissions will not be entertained.

4. An instruction booklet will be given to participants on **Day 0** of AstroChallenge 2020, containing complete instructions for data collection, processing, and analysis.
    a. The booklet will contain questions of varying degrees of ambiguity. In other words, some questions will have clear deliverables (carrying the lion's share of the marks), requiring students to follow a clear set of instructions and present some data.
    b. Others will be less clear; these questions will require students to think 'beyond the box'; they will also give leeway for students to conduct their own explorations and come to different conclusions.

5. The final deliverables include:
    a. A **digital report** prepared by the team.
        i. Any references **must** be cited; ideally, a bibliography should be appended to the report.
    b. A **digital deliverable**: the *processed* data used by the team in preparing their report, including any charts, diagrams, images, etc (and sources for the charts).

6. The mark allocation per question, and the marking format, will be provided in the instruction booklet.

Changes from Previous AstroChallenge competitions

The changes to the format of the entire AstroChallenge competition to accommodate the DAQ are as follows.

1. The **Team Round/**DRQ will have **one less question**, for a total of **4 questions**.

2. The DAQ will carry an **equal percentage** with **each** of the DRQ questions – 20 marks each.

3. The DAQ marks will be **re-combined** with that of the remainder of the **Team Round**'s score, and the Team Round would then be graded out of 80, as per AC 2019.

4. **Day 0** will include a basic data analysis and report-writing 'crash course' conducted by the QMs. This crash course will be conducted after the distribution of the instruction booklet. The proposed content for the crash course will be:
    a. **Statistical tools**, with a focus on `Microsoft Excel`
        i. Additional examples will be briefly mentioned
    b. The tools mentioned above will be used to demonstrate **basic data processing techniques**:
        i. Data clean-up: removing extraneous information like headers and unnecessary data, etc
        ii. Plotting charts (bar, scatter, pie, etc) from tabular data
        iii. Spreadsheet functions (`SUM()`, `AVERAGE()`, `STDEV.P()`, `LINEST()`, etc) to manipulate data
        iv. Basic regression
        v. Outlier detection, handling and analysis
    c. The crash course will end with a discussion on report writing, and expectations by the QMs:
        i. **A template** for the report will be presented; students are encouraged to build upon this as necessary.
        ii. **Bibliography management tools** will be introduced