

## **COURSE OUTLINE Winter 2019**

### **Planets, Stars, Galaxies and the Universe.**

It's impossible to look at the night sky and not experience a sense of awe. Throughout this series of twelve lectures (two sessions per evening, two nights per week, for 3 weeks), we'll touch on many of the wonders of the night sky. Using scale models, a digital planetarium, telescopes and our own 5 senses, we'll examine every day phenomena, such as night and day, seasons, and the motions of the Earth, Sun, and planets. We'll also probe the origin and fate of the stars (and ourselves), including our own Sun, our galaxy (the Milky Way), and the universe itself. On clear nights, telescopes will be available to help us observe the planets, stars, galaxies and the Universe.

### **Lesson Summaries**

#### **EVENING 1**

##### **Session 1: Earth Turning Consciousness I - Introduction**

- The Story of Night and Day
- Path of the Sun
- Height of the Sun (Seasons)
- Lunar Phases
- Eclipses (Solar, Lunar, other)

##### **Session 2: Earth Turning Consciousness II - Planetarium Session I**

- Motions I: day by day
- Motions II: year by year (seasons)
- Motions III: grander cycles (precession)
- Lunar Phases
- Eclipses

#### **EVENING 2**

##### **Session 3: Electromagnetic Radiation and Astronomical Observations**

- Properties of Light
- Spectra – Signature of the Stars
- Radio Waves to Gamma Rays
- Blackbody Radiation
- Kirchoff's Law and Spectroscopy
- Telescopes of different wavelengths
- Effect of Earth's Atmosphere

##### **Session 4: The Solar System**

- Earth/Moon System
- Tides
- The Inner Planets
- The Outer Planets
- Rings and Jupiter's Moons
- Pluto and Kuiper Belt
- Comets
- Meteors and Asteroids

### **EVENING 3**

#### **Session 5: Stars – What are they?**

- Colours and Temperatures
- Distances to the Stars
- Luminosity vs. Apparent Brightness
- How Bright is that Star?
- The Hertzsprung-Russell Diagram – Making Sense of Stars
- Where are Stars Going and How Fast?

#### **Session 6: Stellar Evolution – Birth and Early Stages**

- The Space Between the Stars
- How Our Sun Came to Be
- How Stars Shine
- Different Types of Stars
- Failed Stars – Brown Dwarfs
- Binary Stars

### **EVENING 4**

#### **Session 7: Stellar Evolution – Later Stages**

- What Fate Awaits Our Sun?
- The Fate of Massive Stars
- The Fate of Binary Stars?
- The Spectacular Fate of Super-Massive Stars

#### **Session 8: Star Clusters**

- Examples of Star Clusters
- The Mass-Luminosity Relationship
- Open Clusters
- Globular Clusters – the Stellar Beehives
- The Age of Star Clusters
- How Far Away are Star Clusters?

### **EVENING 5**

#### **Session 9: The Milky Way Galaxy**

- Appearance – The Backbone of Night
- Shape
- Structure (A Modern View)
- Milky Way at Different Wavelengths
- What's Lurks at the Centre of Our Galaxy?
- How Fast is the Milky Way Rotating?

#### **Session 10: Galaxies**

- Evolution of Our Understanding
- Hubble's Work
- How do Galaxies Form?
- Where are all the Galaxies?
- When Galaxies "Collide"
- How Far Away are Galaxies?
- Exotic Galaxies

## **EVENING 6**

### **Session 11: Cosmology**

- Olber's Paradox
- Hubble's Law and its Significance
- How Old is the Universe?
- Large Scale Structure of the Universe
- Big Bang Theory
- Cosmic Microwave Background
- Dark Matter, Dark Energy, and the Accelerating Universe

### **Session 12: Life in the Universe**

- Life in Our Solar System
- Exo-Planets Around Other Stars
- The Habitable Zone
- The Drake Equation
- Search for Extraterrestrial Intelligence (SETI)
- Astronomical Hazards to Life

Each class will be 2 hours (7-9 PM) plus an optional hour (9-10 PM) for additional activities.

Optional activities are the instructor's choice and may include:

- Time inside the planetarium
- Observing with telescopes - maximum of 2 sessions, if weather permits
- Laboratory Exercise
- Final Quiz (~24 questions)

The laboratory exercises are to apply knowledge and they may be completed in class or at home if participants so choose.

### Note about the planetarium:

The planetarium consists of a portable inflatable dome that is 5 m (16 feet) in diameter and 3.2 m (10.5 feet) high. Inside the dome, a state-of-the-art digital projector displays bright, high resolution images of the night sky in a 360-degree immersive environment. We'll be able to observe the sky from Guelph, or any place on Earth, and at any time. We'll be able to fly out into space, and travel to other worlds such as the Moon, Mercury, Mars, or Jupiter's strange moon Europa.