

# MY SO STEM SHOWDOWN

## CONTENT, RECOMMENDED MATERIALS & SCORING

### STEM SHOWDOWN CONTENT

The STEM Showdown will consist of a series of online multiple-choice questions. Middle school (Grade 6-9) Participants in both Middle School (Grade 6-9) will answer questions about planet formation and structure in our solar system and how it relates to that observed in extrasolar systems while High School (9-12) participants will answer questions about the variability of low & mid-mass stars. A Showdown participant will have 50-minutes to answer as many questions as possible.

***The middle school (Grade 6-9) content and skills covered by the Showdown this month are as follows:***

1. Participants must be knowledgeable about the different types of terrestrial and gaseous planets, moons, and minor bodies in the Solar System, their formation, structure, and properties, and the typical surface and atmospheric features of these planets as they appear on diagrams, plots, maps, or images.
2. Participants must be knowledgeable about the formation, structure, and properties of various types of terrestrial and gaseous exoplanets, including, but not limited to; hot Jupiters, mini-Neptunes, and super- Earths, and be able to compare and contrast them with those of the Solar System planets.
3. Participants must be knowledgeable about the formation, structure, and properties of the objects listed below. If applicable, they may be asked to identify and analyze surface and/or atmospheric features on these objects as they appear on diagrams, plots, maps, or images.
  - Solar System Objects: Venus, Jupiter, Saturn, Uranus, Neptune, Io, Iapetus, Triton, Pluto, Arrokoth (2014 MU69)
  - Extrasolar Systems/Planets: HL Tauri, HIP 67522b, TOI-561, Kepler 138, K2-18b
4. Participants may also be tested on the following topics:
  - Planet formation and internal and atmospheric structure and evolution of terrestrial and gaseous planets within and beyond the Solar System.
  - Scientific questions addressed by relevant planetary missions and observatories, including, but not limited to; Magellan, Galileo, Juno, Cassini, Voyager 2, New Horizons, ALMA, Kepler, and TESS.
  - Qualitative understanding of orbital mechanics and gravitational interactions between objects, including, but not limited to; Kepler's Laws, planetary migration, and tidal forces.
  - Exoplanet detection and characterization techniques (limited to transits, radial velocity, and direct imaging).
  - Internal, surface, and atmospheric compositions and structures for each of the objects outlined in (3).

**The high school (Grade 9-12) content and skills covered by the Showdown this month are as follows:**

1. Using information which may include Hertzsprung-Russell diagrams, spectra, light curves, motions, cosmological distance equations and relationships, stellar magnitudes and classification, multi-wavelength images (gamma-ray, X-ray, UV, optical, IR, radio), charts, graphs and JS9 imaging analysis software, teams will complete activities and answer questions related to:
  - a. Stellar and galactic evolution including stellar classification, spectral features and chemical composition, luminosity, blackbody radiation, color index and H-R diagram transitions, proto-stars, T Tauri variables, Herbig-Haro (HH) objects, red giants, Mira variables, RR Lyrae variables, carbon stars, white dwarfs, planetary nebulas, neutron stars, dwarf & recurrent novas, Type Ia supernovas, magnetic cataclysmic variables (MCVs).
  - b. Use orbital mechanics, Kepler's laws, rotation and circular motion to answer questions relating to the orbital motions of binary and multiple star systems; use parallax, spectroscopic parallax, period-luminosity relations, and the distance modulus to calculate distances to RR Lyraes, and Type Ia supernovas; use hydrostatic equilibrium and the Stefan-Boltzmann law to answer questions relating to stellar structure and interiors.
  - c. Identify and answer questions relating to the content areas outlined above for the following objects:
    - HOPS 383
    - HH 24-26
    - V1331 Cyg
    - iHBC 672
    - Orion Nebula
    - Alpha Tauri
    - RR Lyrae
    - Mira
    - IC 4593
    - U Antliae
    - LP 40-365
    - ASASSN-16oh
    - V Sagittae
    - AR Scorpii
    - SDSS 1035+0551
    - Tycho's SNR ESO 577-24

## **Recommended Materials**

- Each Showdown participant will need a computer with internet access, scratch paper, something to write with, and a stand-alone, non-programmable, non-graphing calculator (e.g., a TI-83 or NSPIRE)
- Showdown participants may use resources available to help them answer the questions asked during the Showdown. These resources could be a collection of notes on the topics listed below, copies of magazine or journal articles, a textbook, or any combination of these items.

## **Scoring**

- High score wins.
- Ties will be broken using:
  - a. The time it takes to complete the test; and
  - b. The results to the questions indicated as tiebreakers.

## **Additional Resources**

- The Science Olympiad Store ([store.soinc.org](http://store.soinc.org)) carries a variety of resources for Electric Wright Stuff and Wright Stuff that may be useful for this topic.
- Other resources can be found on the Solar System (middle school) and Astronomy (high school) Event Pages at [soinc.org](http://soinc.org).