

## HOW IT WORKS

There is much evidence, anecdotal and research-based, that indicates that one-shot experiences do not provide ample conceptual change or knowledge gain. The workshops here are designed to be a series of experiences, based upon various state and national Standards, that together cause teachers to become knowledgeable and confident in their knowledge, avoid misconceptions, and to integrate astronomy with other subjects.

### How The Workshops Are Arranged

1. An anonymous pre-visit content questionnaire and a survey to determine concerns and topics that you, the teachers, want to go over are sent in advance..
2. An appropriate set of lessons, covering 1-2 hours per day after-school, or more on 'off days,' is created. These include correcting misconceptions and pointing out (the numerous) textbook errors. All lessons are interactive, hands-on, full of content and useful pedagogy, with between visit assignments.
3. A post-visit questionnaire and certificate of attendance will be given to document learning and participation.

**We will gladly come to your school to meet with you and discuss our workshops, to arrange visits and PLUs. Costs vary with time and numbers of teachers. An average after-school in-service of 90-120 minutes and <20 teachers begins at around \$200.**

## WHO IS DR. K?

### DR. LARRY KRUMENAKER...

has been an astronomer, high school science teacher, college astronomy instructor and planetarium instructor. His BS and MS astronomy degrees are from Case Western Reserve University, an MAT in Planetarium Education from Michigan State University, and a Ph.D. in Science Education from the University of Georgia.



His dissertation was a nationwide survey of high school astronomy courses and the effects of No Child Left Behind on them. He has given workshops all over the South and Southeast, and also in Canada, Mexico, and Italy. In Korea and Germany he also taught university science education courses.

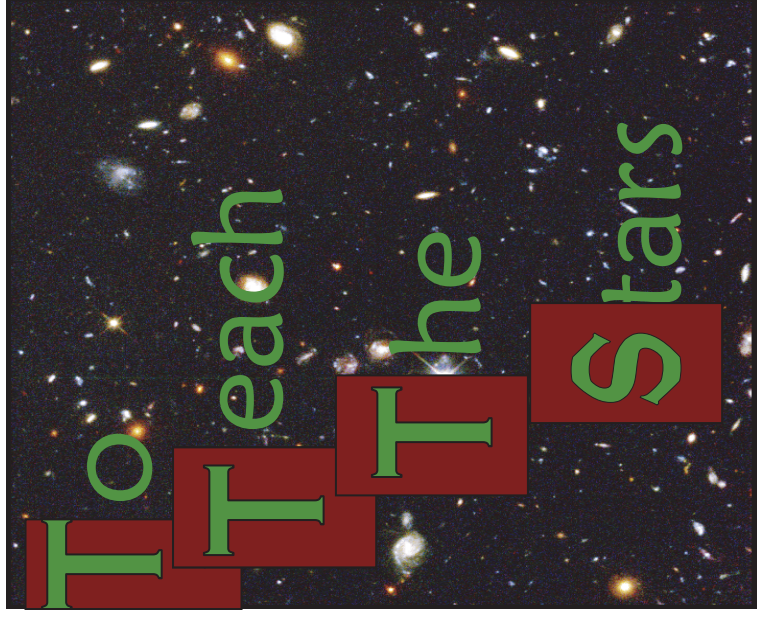
A well-published author (*Astronomy Education Review*, *Science, Sky and Telescope*, and others), Dr. Krumenaker was publisher/editor of *The Classroom Astronomer* magazine and the *Journal and Review of Astronomy Education and Outreach*. He has been a speaker at such diverse meetings sites as the Southeastern Planetarium Association, AAPT, NSTA, GSTA, and the Hungarian Academy of Sciences.

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*Larry Krumenaker is an incredible resource. He provides everything one would want from an in-service workshop: depth of experience in his field, engaging as a presenter, flexible for and responsive to his audience.*

*I had I not been able to use Larry's experience to inform my teaching I would have wasted valuable time looking for the solutions he so clearly provided.*

*I highly recommend a "Larry" workshop for anyone interested in an efficient way to increase the content and pedagogical depth in the astronomy classroom. —Kevin McReynolds, high school science teacher, Winder, GA*



## Astronomy Workshops for Teachers for Learning Content and Science Education Pedagogy

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## WHY TEACH ASTRONOMY WELL?

Astronomy is the **most interdisciplinary** science, covering topics from physics to biology to chemistry, math to language to history. It is in our various **world cultures**, from the calendar to myths to today's **modern technology**. Kepler's 17<sup>th</sup> century laws of planetary motion govern GPS and communication satellites and your remote's infrared light was discovered by William Herschel, the discoverer of Uranus. In addition, astronomy is the rare science that even non-professionals can **make a contribution**, it can be a **life-long** hobby, and students always love to do things involving astronomy even in other classes and lessons. Knowledge of astronomy will help you understand more about science works.

Finally, teach astronomy because it is THE science that can **capture and inspire** nearly every child's interest and imagination. Even if astronomy isn't in your particular grade or course standards, it CAN be incorporated, to make students spark!



**Jigsawing craters with Canadian student teachers**

*Dr. Larry Krumenaker's extensive background experience and expertise in the science of astronomy, physical sciences, and science education was the backbone of our collaborative work with teachers, students and administrators at Talliaferro County K-12 school as part of a DOE Improving Teacher Quality Grant. — Deborah J. Tippins, Ph.D., Professor of Science Education, University of Georgia*

## ASTRONOMY WORKSHOP OFFERINGS

**THIS SET OF TOPICS IS A SAMPLING; LIKE THE UNIVERSE, TOPICS ARE UNLIMITED!**

### THE SUN

- Safe Observing
- Sunspots
- Effects on Earth – Magnetometers
- Sun Size – a Primer in Measuring

### THE MOON

**Phases – Causes and Misconceptions**

The Moon's surface during its phases - rotation  
Details of the Moon's surface – craters and Moon maps

### THE PLANETS

Kepler's Laws

**The Orbits of the Planets, and When Can You See One?**

**Heliocentric vs. Geocentric & Retrograde Motion**

Categorizing – A science skill to use on planets  
**Seasons and Unteaching Misconceptions on them**

### STARS

Star Distances and Lives of the Stars

The H-R diagram- How it is like your classroom

The Speed of Light and Supernovae

Astrobiology – Life on Other Worlds (with chemistry, too)

Three Pieces of Data Tell Us Everything



### THE SCALE OF THE UNIVERSE

### EARTH MOTIONS

Rotation, Revolution- units of time

The Zodiac (ha ha ha)

### CONSTELLATIONS

**Current Night Sky** (we can do it real or simulated)

Star Legends (Cherokee, Hindi, and others)

Sky Maps and Body Angles

## OTHER WORKSHOP OFFERINGS

### PEDAGOGICAL INSIGHTS

Science is Tentative  
Reasoning Skill processes  
The Errors in your Textbook  
Inquiry Investigations in Astronomy  
Techniques – Think-Pair-Share and “clickers”

- Bloom Taxonomy, a way to improve inquiry questions
- Using Movies
- Tutorials in Astronomy, and things that rank

### PHYSICS

Newton's Laws and the orbits and “weights” of planets

Spectroscopy without emission gas tubes

### MISCELLANEOUS / CROSS-CURRICULAR

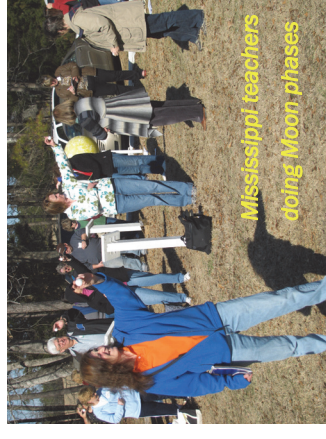
**Using Modeling to Unteach Misconceptions**

How to Use a Telescope, Day or Night

Simple Uses for Statistics in Labs and Inquiry

**How the Spectra of Street Lights Can Measure “Greenness” and Where Our Atoms Came From** (connecting biology, chemistry, physics, and astronomy with environmental science!)

*Dr. Krumenaker helped me to learn new information and to change some misconceptions that I had about topics relating to astronomy! His knowledge about astronomy and ideas about how to teach it make him an incredibly valuable resource. I would recommend Dr. Krumenaker and his services to any teacher who teaches astronomy at any level. — Lindsay Phillips, Fourth Grade Teacher, Dekalb County, Atlanta, GA*



**Mississippi teachers doing Moon phases**