Far Out Math!

Using Slide Rules to Teach Logarithms

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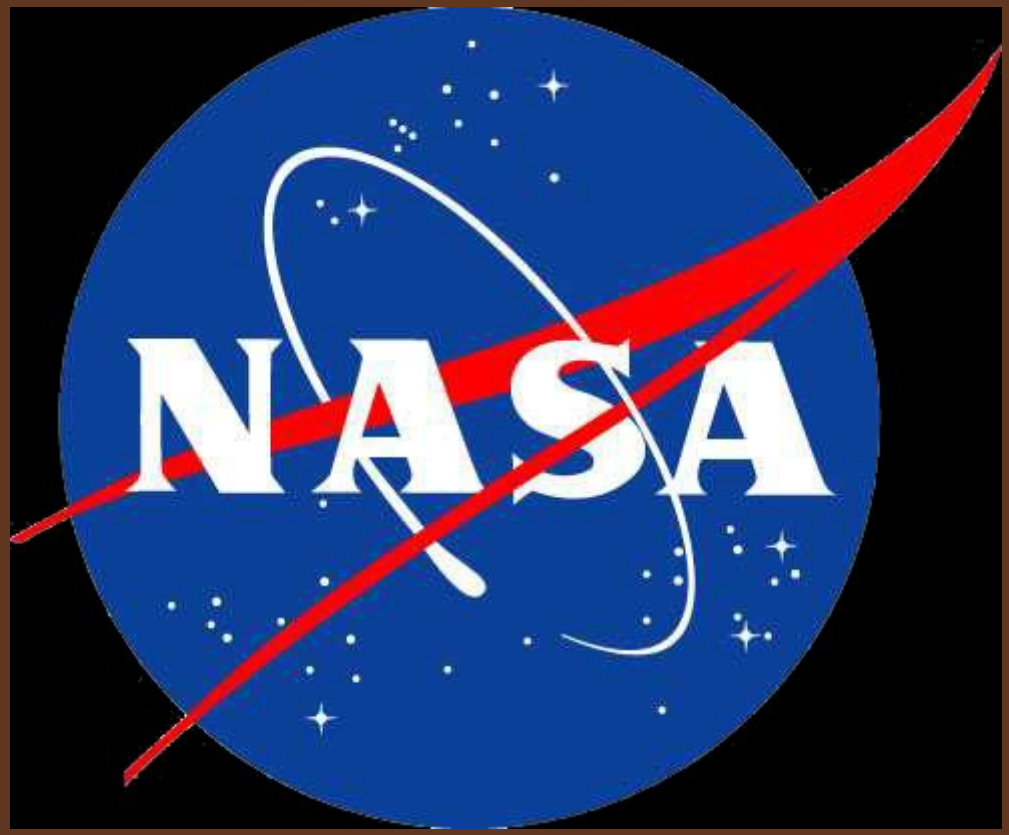
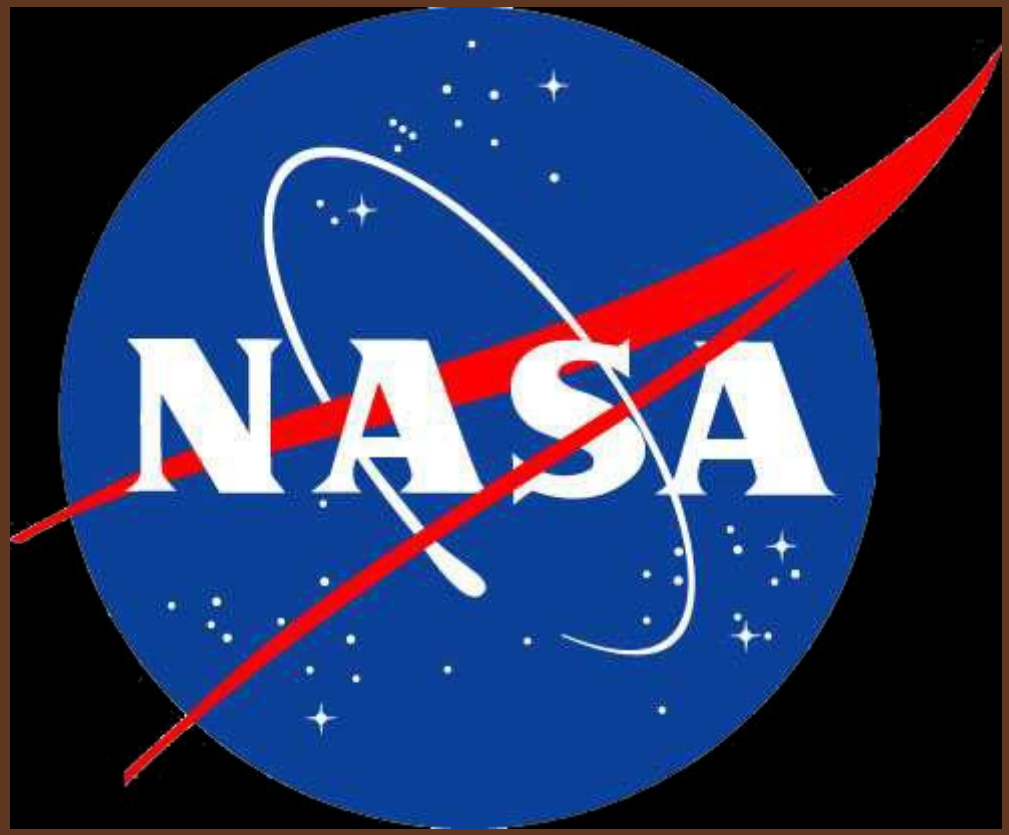
GLAST

Gamma-ray Large Area Space Telescope • *Education and Public Outreach*



National Aeronautics and Space Administration



Space

NASA ENTERPRISES

- Education
- Biological and Physical Research
- Mission Safety
- Earth Science
- Space Science
- Human Exploration and Development of Space
- Aerospace Technology

Astronomy and Physics Division

Infrared, Visible and Ultraviolet

Radio, Microwave, X-ray, Gamma-ray, Gravity, Cosmic Rays

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Structure and Evolution of the Universe

1. To explain structure in the Universe and forecast our cosmic destiny;
2. To explore the cycles of matter and energy in the evolving Universe;
3. To examine the ultimate limits of gravity and energy in the Universe ranging from the closest stars to the most distant quasars.

Structure and Evolution of the Universe Missions

ACE	HETE-2
ASTRO E2	INTEGRAL
Chandra	*LISA*
CHIPS	MAP
Constellation-X	RXTE
GALEX	SWAS
GLAST	*Swift*
Gravity Probe B	XMM-Newton

Not yet launched

In orbit

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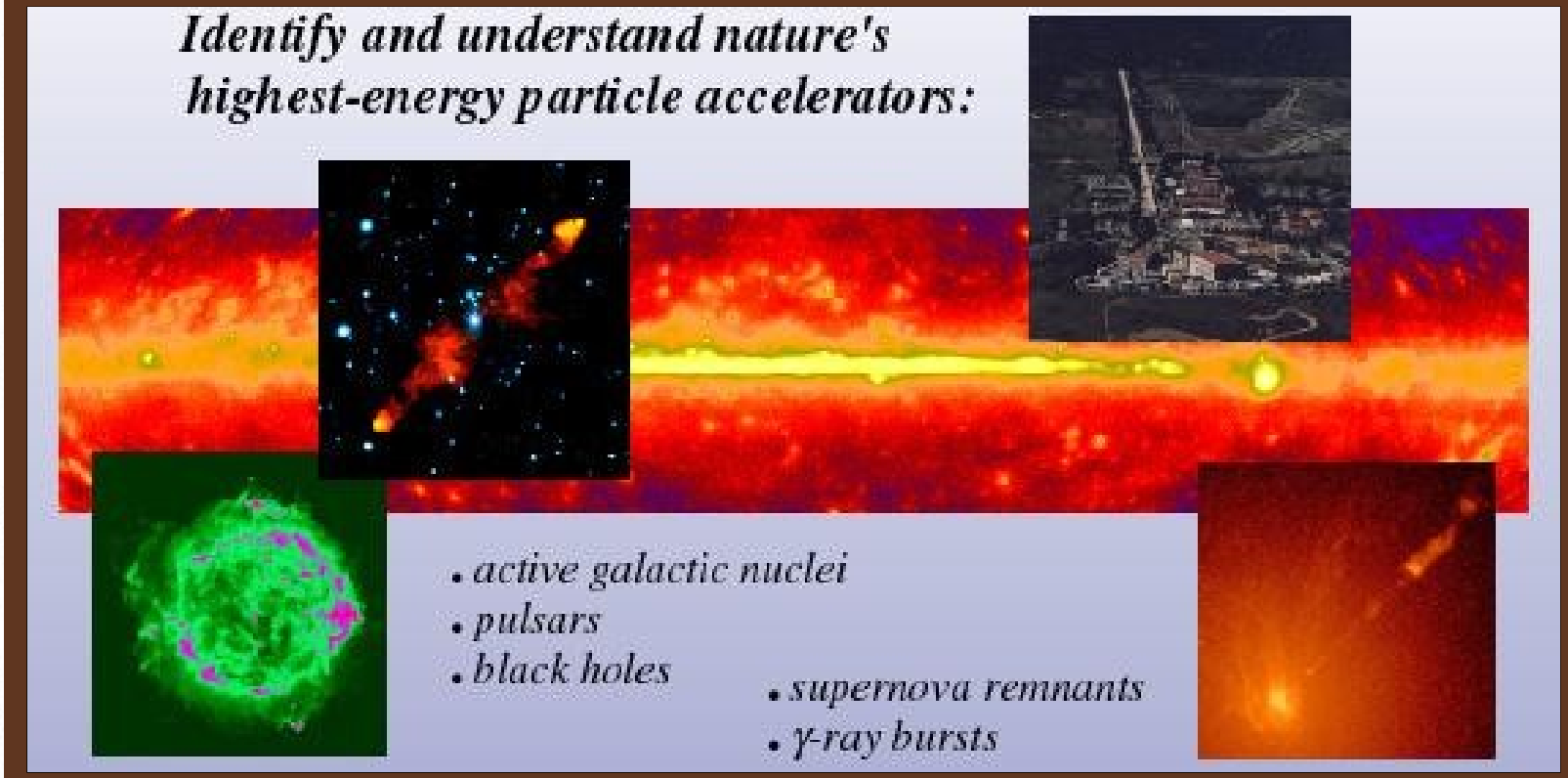
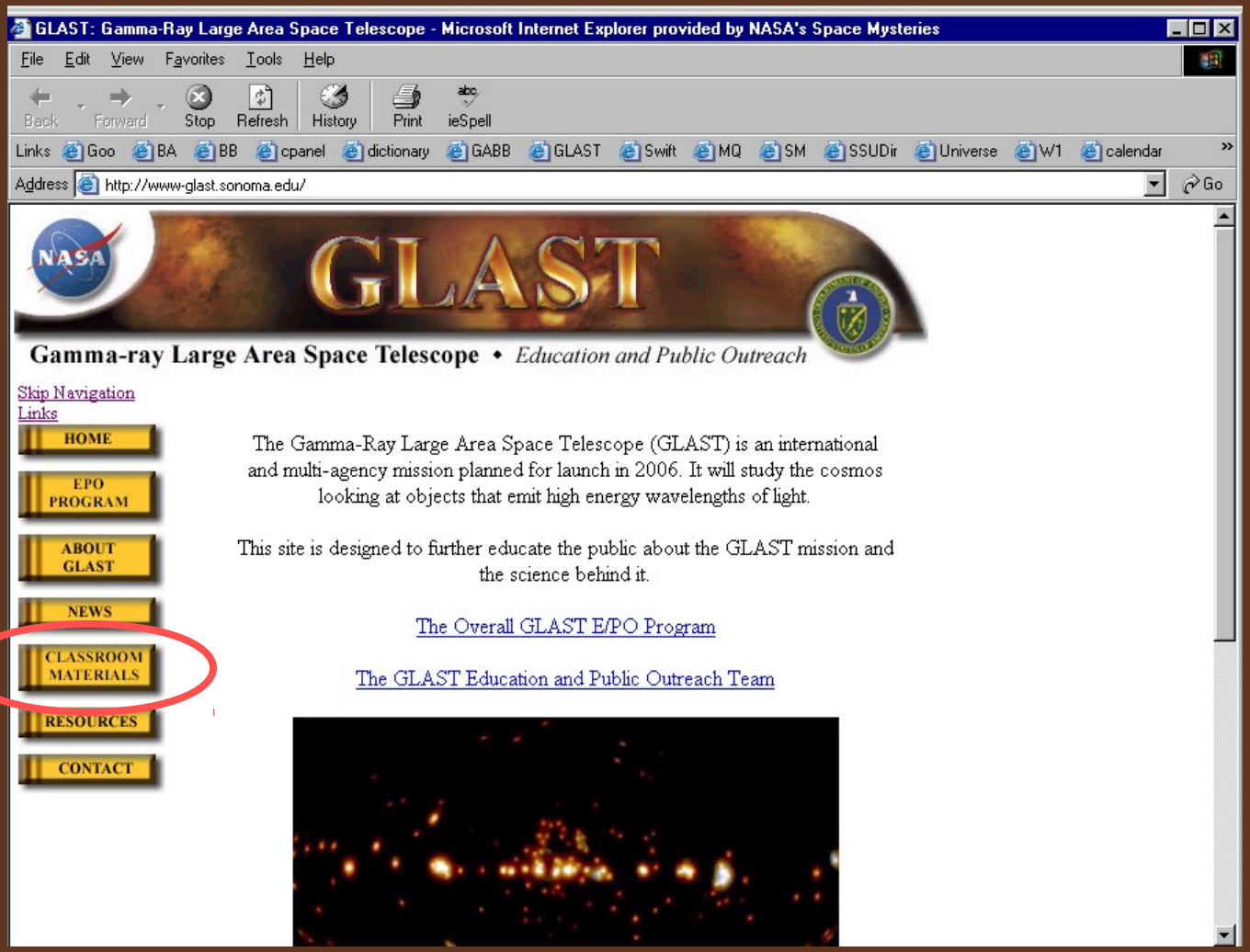
GLAST Science



Explore the era of star formation in the universe, the physics of dark matter and the creation and evolution of galaxies

All about GLAST



http://glast.sonoma.edu

GLAST • Education and Public Outreach
Gamma-ray Large Area Space Telescope

Educator Ambassadors

- 10 top-notch educators from nationwide search(5 GLAST, 2 Swift, 3 SEU)
- Help develop, test and disseminate NASA E/PO materials
- Travel to local, regional, and national conferences for workshops
- $2500/year stipend + travel to a conference
- 8 more slots in 2004 (5 GLAST, 3 LISA and/or GALEX)
- Do you have what it takes? Apply in ’04!

TOPS Learning Systems

- Develops simple, non-tech activities
- Non-profit run by husband-and-wife team Ron and Peg Marson
- 20+ years of instructional development experience

http://www.topscience.org

Far Out Math!

- Uses slide rules (yes, slide rules!) to teach logarithms
- Uses materials you already have
- Builds on previous student knowledge

Logarithms

- 1615: John Napier & Henry Briggs needed to simplify HUGE calculations in Physics and Astronomy
- Why do we NEED to know where it comes from when my calculator does it for me?

Logarithms are Exponents

$\log 10^{exp} = exp$

$N = 10^{exp} = \text{antilog } exp$

Log rules:

$\log(a) + \log(b) = \log(ab)$

$\log(a) - \log(b) = \log(a/b)$

$\log(a^b) = b \log(a)$

Applications?

- Sound

$$\beta = 10 \log \frac{I}{I_o}$$

Applications?

- Radioactive Decay

$$N = N_o e^{-kt}$$

because

$$\ln N = -kt + \ln N_o$$

Applications?

- pH Scale

$$pH = -\log[H^+]$$

Applications?

- Compound Interest

$$A = Pe^{rt}$$

because

$$\ln \frac{A}{P} = rt$$

Applications?

- Population Growth

$$N = N_o e^{+kt}$$

because

$$\ln N = +kt + \ln N_o$$

Applications?

- Richter Scale

$$M = \log A + 3\log(8\Delta t) - 2.92$$

Richter's Distance Correction Factor

Modern Fudge Factor

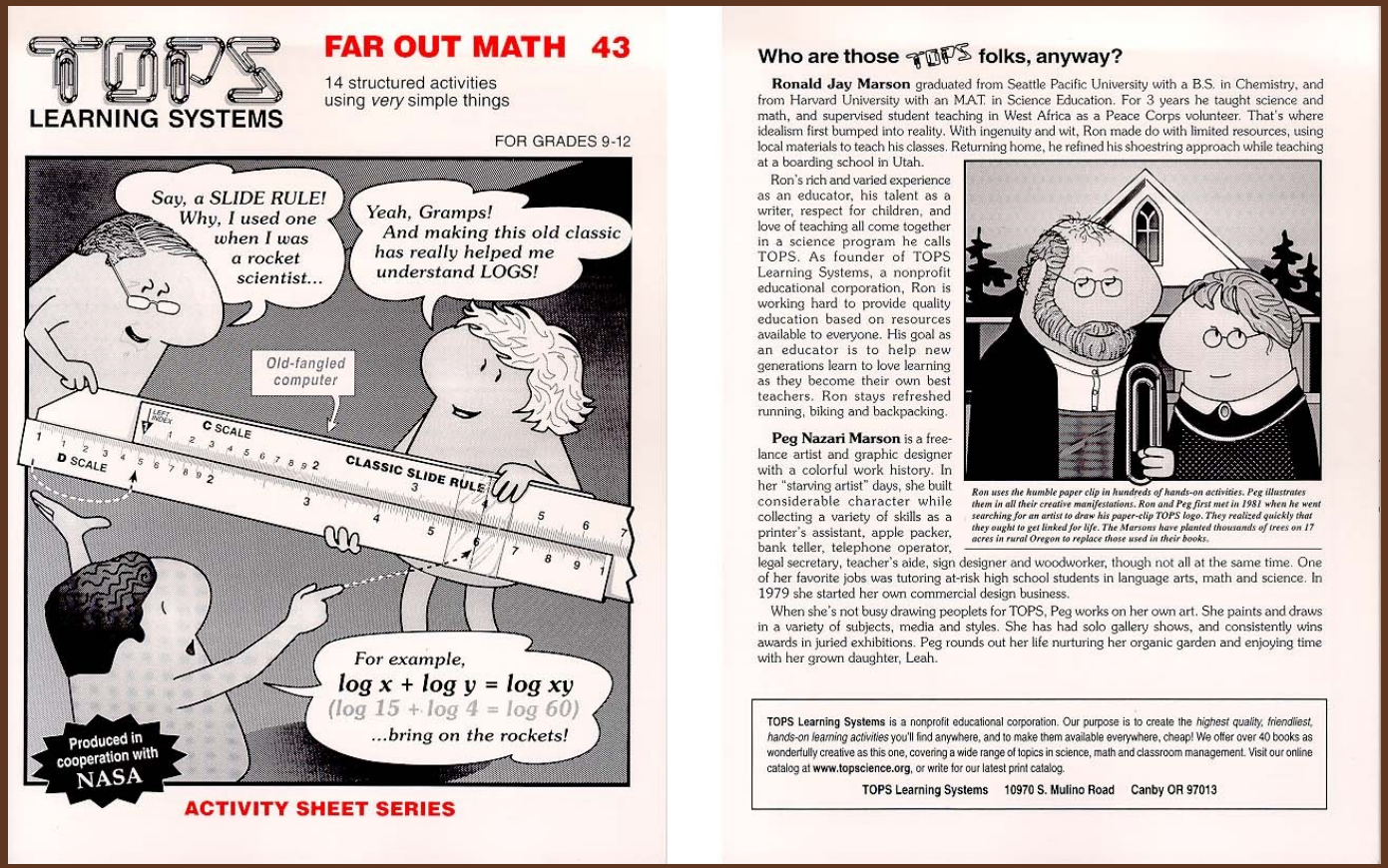
Applications?

- Even Motion Picture Flicker!
- f_{min} = min. frequency at which flicker disappears

$$f_{\min} = K \log I$$

$$f_{\min} = K \log\left(\frac{k}{d^2}\right)$$

Time to get to work



TOPS LEARNING SYSTEMS

FAR OUT MATH 43

14 structured activities using *very* simple things

FOR GRADES 9-12

ACTIVITY SHEET SERIES

Who are those TOPS folks, anyway?

Ronald Jay Marson graduated from Seattle Pacific University with a B.S. in Chemistry, and from Harvard University with an M.AT. in Science Education. For 3 years he taught science and math, and supervised student teaching in West Africa as a Peace Corps volunteer. That's where idealism first bumped into reality. With ingenuity and wit, Ron made do with limited resources, using local materials to teach his classes. Returning home, he refined his shoestring approach while teaching at a boarding school in Utah.

Ron's rich and varied experience as an educator, his talent as a writer, respect for children, and love of teaching all come together in a science program he calls TOPS. As founder of TOPS Learning Systems, a nonprofit educational corporation, Ron is working hard to provide quality education based on resources available to everyone. His goal as an educator is to help new generations learn to love learning as they become their own best teachers. Ron stays refreshed running, biking and backpacking.

Ron uses the humble paper clip in hundreds of hands-on activities. Peg illustrates them in all their creative manifestations. Ron and Peg first met in 1981 when he went searching for an artist to draw his paper-clip TOPS logo. They realized quickly that they ought to get linked for life. The Marsons have planted thousands of trees on 17 acres in rural Oregon to replace those used in their books.

Peg Nazari Marson is a free-lance artist and graphic designer with a colorful work history. In her "starving artist" days, she built considerable character while collecting a variety of skills as a printer's assistant, apple packer, bank teller, telephone operator, legal secretary, teacher's aide, sign designer and woodworker, though not all at the same time. One of her favorite jobs was tutoring at-risk high school students in language arts, math and science. In 1979 she started her own commercial design business.

When she's not busy drawing peoplets for TOPS, Peg works on her own art. She paints and draws in a variety of subjects, media and styles. She has had solo gallery shows, and consistently wins awards in juried exhibitions. Peg rounds out her life nurturing her organic garden and enjoying time with her grown daughter, Leah.

TOPS Learning Systems is a nonprofit educational corporation. Our purpose is to create the *highest quality, friendliest, hands-on learning activities* you'll find anywhere, and to make them available everywhere, cheap! We offer over 40 books as wonderfully creative as this one, covering a wide range of topics in science, math and classroom management. Visit our online catalog at **www.topscience.org**, or write for our latest print catalog.

TOPS Learning Systems 10970 S. Mulino Road Canby OR 97013

Let's go logging!

TOPS: Far Out Math!

A) Sliding Scales

Adding slide rules

Multiplying slide rules

B) Log Tape

C) Base-Two Slide Rule

D) Classic Log Scales

E) Log Graphs

Don’t forget the GLASToids… The curiously strong word problems

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Resources

- **GLAST E/PO web site http://glast.sonoma.edu**
- **TOPS Far Out Math! http://www.topscience.org**
- **Logarithms through Applications by Robert Frank, Seton Hill College**

http://www.ma.iup.edu/MAA/proceedings/vol1/frank/frank.pdf

- **University of Nevada, Reno Seismology class notes**

http://www.seismo.unr.edu/ftp/pub/louie/class/100/magnitude.html