Madison Astronomical Society

Capitol Skies

The newsletter of the Madison Astronomical Society **April/May 2003**

Upcoming Events

April 11	MAS Spring Banquet: JT Whitney's, 674 S. Whitney Way. See announcement bottom of this page.
April 23	Madison Metropolitan School District Planetarium – Public show. "Stargazer." One program only, 7:00 PM. Tickets $2. Tickets go on sale approximately 20 minutes prior to the show. First come, first served. Memorial High School, 201 S. Gammon Rd., 663-6102 or www.mmsd.org/planetarium for info.
May 9	MAS monthly meeting. 7:00 pm board meeting, 7:30 main presentation: Art Camosy and John Rummel: Seasonal changes in the sun's angular size. Space Place, 1605 S. Park St.
May 15	Total lunar eclipse. See the note on page 5.
May 21	Madison Metropolitan School District Planetarium – Public Show: Skywatching. One show only, 7:00 pm. Tickets $2. Tickets go on sale approximately 20 minutes prior to the show. First come, first served. Memorial High School, 201 S. Gammon Rd., 663-6102 or www.mmsd.org/planetarium for info.
June 14	Annual MAS picnic and officer elections. Yanna Research Station. Observing after the picnic, weather permitting. More info next newsletter....

For Sale

Girl Scouts of Black Hawk Council have two used telescopes, recently refurbished by Eagle Optics, for sale. Price is negotiable or will trade for a spotting scope.

The two telescopes are:

• a Meade Model 227, 2.4" altazimuth refractor with a 5x24 mm viewfinder and 9 mm and 25 mm eyepieces

• an Edmund 3" telescope with a tripod and a 15 mm eyepiece.

For more information or to make arrangements to see the telescopes, contact Jeanne Sears: Call 276-8500, ext. 3002 or email jeannes@girlscoutsofblackhawk.org

From the President's Desktop

by Neil Robinson

Greetings Fellow MAS'ers, spring is here and the usual seasonal issues have sprung up, like soft grass at YRS. We have put the barrier across the driveway and ask folks not to drive on the grass until the turf firms up and we can take the barrier down again.

This is the time of year for Messier marathons (because of the position of the sun in the largest gap between the M objects) and if folks are interested in a MM, give me a call or email. We're looking at the weekend of Mar 29-30 as the first good 'minimum moon' opportunity with the weekend of Apr. 4-5 as the next chance.

We're already looking ahead to October for the next Moon Over Monona Terrace. Last year's event was such a success that we are enthusiastic about this year's opportunity, and so is the Monona Terrace administration. Friday Oct. 3 looks like the likely date so mark your calenders now.

A Note from the Treasurer

by Mary Ellestad

MAS warmly welcomes the following new members: Darrel Degelau, Tracy Sundquist and Christine Zeltner.

Elizabeth Brinn Foundation Donation

After our last meeting, member Bill Jollie gave the Madison Astronomical Society another generous check from the Elizabeth Brinn Foundation. This donation will be added to the maintenance fund for Yanna Research Station that was created with the first donation last year. MAS truly appreciates Bill's continuing efforts on our behalf and his interest in maintaining our facilities at YRS. MAS will be sending a letter of thanks to the Brinn Foundation including an update on our new education outreach efforts that Matt Mills and A.J. Carver have been working on. It is very exciting that YRS can be a part of our outreach program as well as being there for all MAS members to enjoy for many years to come. Thanks again to the Elizabeth Brinn Foundation and Bill Jollie.

Spring Banquet April 11th

The Annual Spring Banquet will be Friday, April 11 at JT Whitney's, 674 S. Whitney Way. The bar will open at 6 p.m. and dinner will be served at 7 p.m. Entree selections: chicken cordon bleu for $18, prime rib au jus for $18, or vegetarian lasagna for $13. Send a check payable to MAS for the appropriate amount to Jane Breun, 1990 Oak Wood View Drive, Verona, WI 53593 before Friday, April 4.

How Close Mars?

by John Rummel

When it comes to observing the planets, Jupiter and Saturn probably amount to 90% or more of amateur astronomers' observing time. Both planets reach opposition about once per year. Both are large, spectacular targets, rich in detail, and endlessly rewarding of either cursory or close study. And between Jupiter's moons and Saturn's rings, both are real crowd pleasers at star parties as well.

Mars is most often an inconspicuous orange, starlike object that wanders eastward among the stars. But about every 2 years, it begins to brighten, reverses its course and is prominent as a fiery orange-red star in the evening sky. At times it even exceeds mighty Jupiter in brightness. Then, after a month or two, it begins to fade and resumes its anonymity among the starry host.

The oppositions of Mars, much less frequent than those of Jupiter and Saturn, are generally disappointing to observers. Its disk is tiny. Even at good oppositions like the one this summer, its angular size is just a bit more than half of Jupiter's average apparent size. In short, for all but the most dedicated observers, Mars often gets a quick glance, and the observer moves on to more interesting targets.

Having said all that, this summer will be of great interest to both casual and dedicated Mars observers. This year Mars reaches a rare "perihelic" opposition, in which it will be at its closest point in a cycle that causes its close-approach distance to vary by nearly half over a period of years.

How close this year?

Much has been made of the fact that this opposition of Mars in 2003 will bring the red planet closer to Earth than it has been at any time in thousands of years. Depending on who you read, the figures can vary widely. I've read credible reports that say Mars will be closer than at any time within the last 100,000 years. Or 70,000 years says another publication.

What exactly is going on here?

Part of the problem is in how you define your terms. Part of it lies in how mathematically rigorous you want to be. Here, in a nutshell, are the elements contributing to this issue.

Though Mars reaches opposition roughly about every 26 months, all these oppositions are not equal. Mars' orbit is significantly more elliptical than Earth's, so only those oppositions that occur close to Mars' perihelion will be extremely favorable for observation from Earth. These so-called perihelic oppositions occur roughly every 15 to 18 years, and always occur around late August or early September.

All perihelic oppositions tend to be pretty good. But this summer, the opposition is very close even by typical perihelic standards. For instance, in 2003, Mars will be 19,000 kilometers closer to the Earth than it was during the last exceptionally close opposition, the one of August 1924. This difference in distance is all but insignificant as far as observational variables are concerned (less than one-hundredth of an arcsecond growth in apparent size, for example).

Just how close these perihelic oppositions are depend on a number of variables, including the moment of Mars' own perihelion, or closest approach to the sun (this year it occurs on August 30th, about two days after the Earth-Mars opposition). The closer an opposition is to Mars' own perihelion, the closer the two planets are.

If this was the whole story, any yahoo with a computer and a copy of *Starry Night* software could settle the issue. Unfortunately, the situation is quite a bit more complex. First of all, like all planets, the orbits of Earth and Mars slowly precess around the sun. Their inclinations and points of perihelion slowly shift position. These critical

The 20 closest Mars oppositions 3000 BC to 3000 AD, computed by Dr E Myles Standish; JPL, and posted to DOME-L, a newsgroup for planetarium professionals, in response to a question about Mars' close approach this year. Dr. Standish's data is based primarily on the convergence of Earth's and Mars' aphelion/perihelion points. Note there is no historical opposition closer than the 2003 event, but seven even closer ones coming up over the next several hundred years

Ast. Units	*Kilometers*	*Date*
0.37200418	*55651033.*	*2729 SEP 08*
0.37200785	*55651582.*	*2650 SEP 03*
0.37217270	*55676243.*	*2934 SEP 05*
0.37225400	*55688405.*	*2287 AUG 28*
0.37230224	*55695623.*	*2808 SEP 11*
0.37238224	*55707590.*	*2571 AUG 30*
0.37238878	*55708568.*	*2366 SEP 02*
0.37271925	*55758006.*	*2003 AUG 27*
0.37279352	*55769117.*	*2208 AUG 24*
0.37284581	*55776939.*	*1924 AUG 22*
0.37292055	*55788120.*	*2887 SEP 16*
0.37296343	*55794535.*	*2445 SEP 05*
0.37302110	*55803163.*	*1845 AUG 18*
0.37305741	*55808594.*	*1482 AUG 03*
0.37310445	*55815632.*	*2855 AUG 31*
0.37321735	*55832521.*	*2492 AUG 24*
0.37325251	*55837780.*	*1561 AUG 07*
0.37326031	*55838948.*	*1766 AUG 13*
0.37327582	*55841268.*	*2129 AUG 19*
0.37339761	*55859488.*	*1119 JUL 31*

changes in position of perihelion and aphelion must be taken into account, but most desktop astronomy software uses static orbital elements and can't account for such long term periodic changes. Right now, the position of Mars' perihelion and Earth's aphelion are slowly converging, and in a few thousand years they will line up neatly. This situation is responsible for the fact that the close oppositions have been getting gradually closer over the past few thousand years. Dr. Myles Standish, orbital wizard at the Jet Propulsion Laboratory, has provided the table reproduced above. He notes that "…there is a slow evolution of the Earth and Mars orbits, so that the close approach distance is increasing into the past; decreasing into the future. Of course, the evolution of the orbits is periodic, so that the distance will eventually [begin to increase again]"

That's not the end of the story though. To split hairs even further, the eccentricities and inclinations of the planets' orbits also slowly change over time. Though this process is a bit less well understood, and therefore slightly more theoretical, the changes are predictable up to a point. Mars' orbit is gradually becoming even more eccentric than it is now, and this will continue for several thousands of years, before it will gradually begin to decrease toward its current value again. Mathematical astronomer Jean Meeus has investigated this question in some depth. In an article published in the March 2003 issue of *The Planetarian* (published by the International Planetarium Society), he elaborates on his earlier work in his excellent books *Astronomical Tables of the Sun, Moon, and Planets, Mathematical Astronomy Morsels* and *More Mathematical Astronomy Morsels*. His discussion includes several tables showing the evolutions of the eccentricities of the orbits of Earth and Mars, covering a period of some 2 million years. His work, and his collaborations with others, leads him to conclude that the last time Mars was closer to Earth than it will be in August of 2003 was September 12, 57617 BC. Accordingly, it has been about 60,000 years since Mars has been as close as it will be this year.

All of these cumulative sources of change reinforce the idea that no two perihelic oppositions of Mars are ever exactly the same. This fall, Mars will be extremely well placed for amateur observation. Professional astronomers, by the way, care little about such issues. Most professional examination of Mars is based on research by orbiting probes such as Global Surveyor and Mars Odyssey. The Hubble Space Telescope typically examines Mars around opposition, but the variations in distance discussed in this article are of no consequence.

If somebody knows you are an amateur astronomer, they may ask you about Mars being closer than it has in thousands of years. Disabuse them of any notions that Mars will loom larger than the full moon in the sky, and then tell them the truth.

Or maybe just let them take a look at Mars in your telescope.

Quick Facts - Mars 2003 Opposition

Angular size will be larger than 15 arcseconds from June 17 to November 3

Brighter than mag 0.0 from April 30 to Dec 20

Retrogrades from July 30 through September 29

April opens with Mars prograding in eastern Sagittarius.

April 21 enters Capricornus

June 9 enters Aquarius

December 4 enters Pisces

Mars 2003 at a glance

The magnitude, rise time (for Madison), and angular size of Mars on the 1st and 15th of each month from April through the end of the year.

Date	Mag.	Rise time	Ang. size
Apr 1	.5	2:06 am	7.5
Apr 15	.27	1:42 am	8.4
May 1	0.0	1:13 am	9.5
May 15	-.3	12:44 am	11
Jun 1	-.67	12:05 am	12
Jun 15	-1.0	11:30 pm	14
Jul 1	-1.4	10:47 pm	17
Jul 15	-1.8	10:04 pm	19
Aug 1	-2.3	9:04 pm	22
Aug 15	-2.7	8:09 pm	24
Sept 1	-2.9	6:46 pm	25
Sept 15	-2.6	5:40 pm	23
Oct 1	-2.1	4:30 pm	21
Oct 15	-1.7	3:33 pm	18
Nov 1	-1.2	2:34 pm	15
Nov 15	-0.8	1:48 pm	13
Dec 1	-0.4	12:59 pm	11
Dec 15	-0.1	12:19 pm	9.7
Jan 1	0.2	11:33 am	8.4

Unusual Eclipse Patterns In 2003

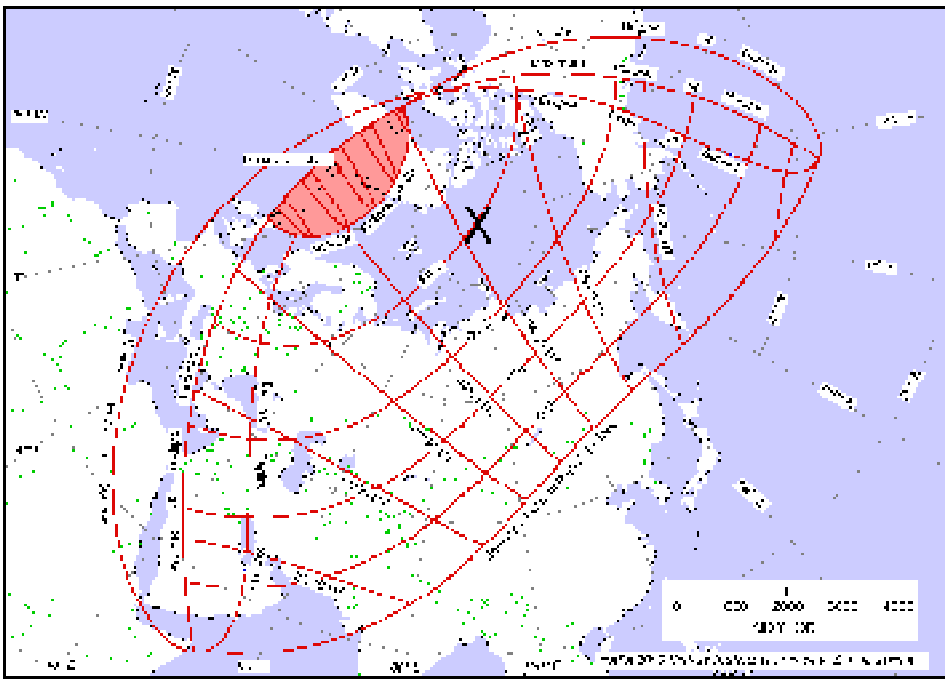
by John Quigley

In 2003 there are four eclipses, two of the moon and two of the sun, which at first glance fits into the normal pattern. However closer inspection reveals some unusual features this year that provide insight into the theory of eclipses.

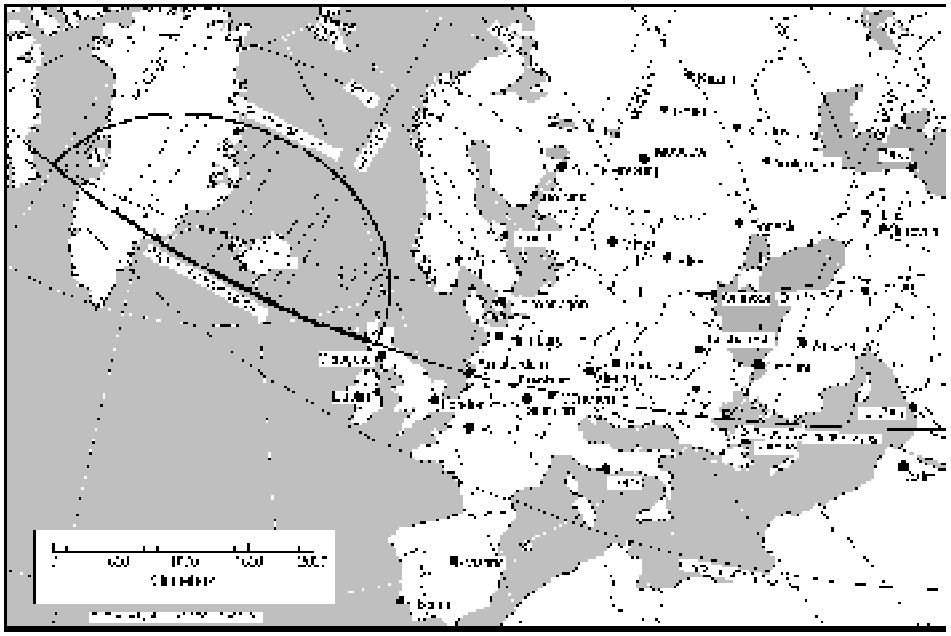
The two solar eclipses are remarkable in that they fall on the extremities of the earth: an annular eclipse on May 31 near the Arctic Circle, and a total eclipse on November 23 in Antarctica. What is really different here is that the eclipse tracks for both seem to defy the normal, generally west-to-east path for solar eclipses, since the new moon overtakes the sun from west to east. This year, both eclipses move (roughly) east-to-west, that is, "backward." Does the moon reverse its direction in 2003?

The reason for the strange geometry comes from the fact that in both solar eclipses this year, the shadow falls on the earth "beyond the pole," in or near the midnight sun area when the sun is seen low on the horizon. This causes the ordinary direction of an eclipse to be reversed according to our conventional marking of latitude and longitude.

Another oddity in 2003 is that a total lunar eclipse and a total solar eclipse occur during the same eclipse season (November 9 and November 23). The concept of "eclipse seasons" is key to the overall understanding of eclipses. Schoolchildren are taught that eclipses can take place only at new moon (solar) and full moon (lunar). A second necessary condition is that the moon has to be near either of its two nodes (points where the plane of its orbit around the earth cuts across the plane of earth's orbit around the sun). Since the sun must either lined up with or directly opposite the moon at an eclipse, the sun too must be in the vicinity of a node. Because the nodes move westward relative to the stars about 19 degrees per year, this creates two eclipse "seasons" each year slightly less than six months apart, and eclipse dates slip backward through the calendar from year to year.



Fred Espenak's global diagram of the May 31 annular eclipse. The 'X' marks the north pole, and the central portion of the eclipse occurs "beyond" the pole. Note the clipped ellipses of the central annular path. The shadow actually grazes the earth at this point and thus the entire shadow does not intercept the Earth.



Map of the May 31st event through Europe. Because of the "beyond the pole" effect mentioned in the text, the progress of this event is from east to west (right to left) instead of the usual west to east path.

Eclipse diagrams courtesy of Fred Espenak - NASA/Goddard Space Flight Center. For more information on solar and lunar eclipses, see Fred Espenak's Eclipse Home Page: sunearth.gsfc.nasa.gov/eclipse/eclipse.html.

Every eclipse season is wide enough in days (about 33) to normally cover a single full moon and a single new moon, producing one lunar and one solar eclipse (in either order). The magnitude and location of these eclipses depends on further factors, including the moon's distance from the earth, earth's distance from the sun, and how close the eclipse occurs to the moment when the sun is exactly at one of the nodes. This last factor I wish to elaborate on. If, for instance, a full moon takes place right at a node crossing, then we have a total lunar eclipse of maximum duration. Such an eclipse occurred on July 16, 2000 (not visible in Wisconsin). Move the full moon further away from the node, and we get, in turn, a shorter total eclipse, a partial eclipse, or a penumbral eclipse. The last type is so marginal and so difficult to detect that some references, such as Microsoft Encarta Encyclopedia, don't even classify it as an eclipse.

Similar logic holds for new moons and solar eclipses. If the new moon hits right at a node, we get a total (or annular, depending on the moon's distance) solar eclipse with a path falling on earth's tropical regions, as in the annular eclipse of June 10, 2002. Move the new moon instant further from the node crossing, and the central path of the moon's shadow will fall more towards earth's polar regions. Move it further away still, and the center of the shadow will miss earth entirely, leaving only a partial eclipse that can be seen from earth's northernmost or southernmost regions.

The usual case in an eclipse season is that either the solar eclipse or lunar eclipse is more central (closer to the node), leaving the other as a minor eclipse. In November 2003 however, the geometry works out so that each type occurs just close enough to the node to produce a total event. The inevitable compromise is that neither eclipse is of maximum totality: the lunar eclipse is total for only 25 minutes, and the solar eclipse shadow glances on earth's hard-to-reach Antarctic region for a peak duration of only about two minutes.

The coincidence of total lunar/total solar eclipse in the same season is fairly unusual: it last occurred in 1986 (a very marginal case) and won't happen again until 2015.

Another pattern, upheld in 2003, is that every sixth new moon or full moon produces an eclipse. More precisely, six such cycles take an average of about 177 days, versus the average of 173 days between the middle of one eclipse season to the next. As a result a series of "steps" of 177 days will bring a given lunar phase gradually from early in an eclipse season (with a minor eclipse) to more and more central (and hence a greater eclipse) to falling later in a eclipse season (with a minor eclipse again) to eventually outside the zone when an eclipse can occur. By the time this happens, an eclipse will occur after only 5 phase-cycles (instead of 6) early in the eclipse season, and then the 6-step pattern begins anew.

A consequence of these ongoing cycles is that for the two eclipses that typically occur in a season, the first type to occur lunar or solar is the kind that is gradually coming into "focus" (becoming more central) while the second type is moving out of focus. For instance, in July 2000 the lunar type was in perfect focus (simultaneous with the node) while by June 2002 the situation was reversed with a very central (annular) eclipse of the sun. In 2003 the lunar type comes first in both eclipse seasons and is "gaining" focus. This situation will culminate in 2004 with two more total eclipses of the moon. Inevitably the pattern will reverse and the solar eclipses will become more central again for a time while the lunar eclipses slip out of focus.

This concept of eclipses growing in magnitude by occurring closer to a node is complicated somewhat by another lunar cycle: its varying distance from the earth, which changes its speed and causes a phase (such as new moon or full moon) to come several hours earlier or later than it would if the moon were at a fixed distance from earth. Because of this factor, the progress of an eclipse type moving in and out of "focus" is not as regular as the discussion above implies.

Details on upcoming eclipses are available in any popular astronomy periodical. For this article I consulted the *Astronomical Calendar* by Guy Ottewell and the *Observer's Handbook* by the Royal Astronomical Society of Canada. Also invaluable was the website http://sunearth.gsfc.nasa.gov/eclipse/eclipse.html which has details and summaries of eclipses for centuries into the past or future. Another good eclipse website is http://www.hermit.org/Eclipse/.

Two Lunar Eclipses Present Unusual Photographic Opportunity

The evening of May 15th presents the first opportunity for North and South American observers to see a lunar eclipse since January of 2000. Here are the local circumstances:

Moonrise 8:02 pm
Penumbral eclipse begins 8:05 pm
Umbral eclipse begins 9:02 pm (with the moon just 8 degrees above the eastern horizon)
Total phase lasts about 53 minutes

The two lunar eclipses this year (May and November) present a chance to observe and photograph the moon very close to perigee and apogee. The eclipsed moon in May will appear to be about 12% larger (33.4 arcminutes, just .5 day after perigee) than that during the November event (29.4 arcminutes, 1.4 days before apogee). This size change will be unnoticeable to the naked eye since there is no way to remember how big the moon appeared on another night. The effect has, however, been frequently photographed during full moons. To my knowledge, there is no comparable photographic comparison taken during two lunar eclipses. Thus, in addition to having two wonderful opportunities to observe a lunar eclipse this year, astrophotographers have a great chance to document the angular size change of the moon's disk in spectacular fashion. (*contributed by John Rummel*)

Capitol Skies
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Madison, WI 53705

First Class

MAS would like to thank:

PRINT-TECH

and Tim Stanton for printing the newsletter and

IDC

for hosting our web presence

This resource list is made up of people who have special interests which they are willing, even eager, to share with others in the Society. Many members, not listed, also are interested in particular aspects of astronomy and have considerable expertise in viewing and imaging the skies. Members are encouraged to come to the monthly meetings, not only to get to know the other members, but to discuss and enjoy their special or general interests in various aspects of astronomy. This is a Society of beginners and experienced amateurs. From time to time we have seasoned professionals attending. The meetings are a good time to meet these people as well. See you there.

Resource People and Special Interests

- Newsletter Editor: open to appointment
- LX200 Observatory: Dick Greiner 233-6882 (ragreiner@mailbag.com)
- Photo Editor: Tim Ellestad 233-3305 (ellestad@mailbag.com)
- Webmaster: Dan Strome 241-3775 (dan.strome@mpcug.com)
- Variable Stars: Dave Weier 241-1444 (daveweier@att.net)
- CCD Imaging: Dick Greiner 233-6882 (ragreiner@mailbag.com)
- Jupiter Observations: Wynn Wacker 274-1829 (wkw@mailbag.com)
- Deep Sky Observing: Tom Brissette 833-4225 (tom.brissette@midplains.net)
- Minor Planet Search: Greg Sellek 848-6301 (orion98@charter.net)

MAS Membership Form

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Please circle membership type: *Enclose check and make payable to the Madison Astronomical Society. Mail to MAS Attention: Mary Ellestad, 2810 Mason Street Madison, WI 53705*

Student ($5.00)
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