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# Astronomy and the Bible: Joshua's Long Day

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The analysis of covariance data for the subjects using pretest attitude as the covariate appears in Table IIC. Adjustment in the posttest achievement for student attitude prior to the start of the study resulted in an F-ratio of 0.050 which is not statistically significant. Hypothesis 2C was not rejected.

IIC. Criterion, Achievement Posttest and Covariate, Pretest Attitude.

Source	DF	MS	Adj. F-ratio
Between Groups	1	22.412	0.050
Within	47	477.936	

Not significant at .05 level of confidence  $F_{1,47} = 4.05$

## CONCLUSION

In this study of low ability eighth-grade math students, there was no evidence that the use of traditional computational drills and lecture increased student achievement to a significant degree as compared with the achievements of students in "modern" mathematics who were not exposed to drill and lecture. There was no apparent relationship between drills and student attitude toward mathematics.

Prior to the study the teacher decided she wished all students achieve eighty percent on the achievement test. Pretesting indicated that nine of the experimental and eight of the control students scored eighty percent or higher. However, on the posttest fourteen of the experimentals reached the criterion of eighty percent while only nine of the controls scored at or above this level.

Although significant results were not found in the study the instructor learned that pretesting will identify students who needn't go through some instructional steps and that neither the "modern" nor the traditional presentations resulted in even fifty percent of the pupils reaching an eighty percent level in achievement. Thus more alternatives in teaching and additional time in learning computational skills need to be presented to students.

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## Astronomy and the Bible: Joshua's Long Day

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The Bible has served as a multipurpose text for thousands of years. From its pages lessons in history, geography, literature, law, language, and health, as well as theology, have been taught. However, the Bible has been ignored in the area of astronomy. Several teaching points can be demonstrated utilizing the Bible stories and modern astronomical principles. One such example is contained in the Book of Joshua when the Israelite commander ordered the sun and moon to halt their movement across the sky.

"Sun, stand thou still upon Gibeon; And thou, Moon, in the valley of Aijalon, And the sun stood still, and the moon stayed, Until the nation had avenged themselves of their enemies. Is not this written in the Book of Jashar? And the sun stayed in the midst of heaven, And hastened not to go down about a whole day. (Joshua, X, 12-13).

The Biblical authors tended to interpret history rather than record it. They were not particularly interested in wars, politics, and economic trends for their own sake, but only to illustrate some religious truth (Neil, 1975, p. 143). The ancients recorded what they saw and its interpretation was based upon God's meaning.

In this tale of Joshua, let us concentrate on what was seen. From the Biblical description it is possible to determine the time of day, the phase of the moon, and the month in which Joshua made his command. It is stated in the Biblical passage that the sun was in the "midst" of heaven; therefore, it must have been about noon. Joshua infers that he can also see the moon in the heavens over Aijalon. As the Aijalon valley is west of Gibeon, the moon must have been in its last quarter. The moon could not have been full for it would have set before noon. A new moon would have been hidden by the glare of the sun. It is understood that the moon rose before the sun since it was setting in the west as the sun was overhead. The suggestion is that the moon is near its last quarter, not first.

If Joshua were standing between Gibeon and the Aijalon valley, the moon would appear on one side, in the west and the sun on the other, toward the east. However, Joshua states that the sun is "upon Gibeon" and in the "midst of heaven". The only location permitting Joshua to see the sun above Gibeon and in the middle of the sky at the same time is at Gibeon, itself.

Reading further into the Biblical account, it was possible for E.W. Maunder (1909, pp. 351-384) to ascertain the month in which the miracle occurred. There are two definite dates mentioned in the narrative;

"And the people came up two of the Jordon on the tenth day of the first month, and en-

camped in Gilgal (Joshua, IV, 19)

and later,

"The children of Israel encamped in Gilgal; and they kept the passover on the fourteenth of the month at even in the plains of Jericho (Joshua, V, 10)".

As the Hebrew month began with the new moon, and a week is required for the passage of each major phase, the passover would have commenced when the moon was full and ended during the last quarter of the first month. Then preparations were made for the siege of Jericho, and another week elapsed in the daily processions around the city before its final destruction. It would now be near the new moon, or the beginning of the second month. The following events occur rapidly: a reconnaissance force was sent to the city of Ai followed by an attack and an Israelite defeat. It was believed that this setback was God's punishment for the theft of some spoils from Jericho. An investigation was conducted and Achan, an Israelite soldier, was found guilty and stoned to death. A second attack was planned and successfully executed. Then Joshua proceeded to the mountains of Ebal and Gerizim for the Reading of the Law, a command given to him by Moses. No date is mentioned for this ceremony; however, the original Giving of the Law at Mount Sinai occurred on the third day of the third month. It seems likely that an anniversary would be chosen for this historic event.

News of the successful Israelite conquests spread rapidly throughout the land. It was during the third month that an Ammonite confederation was organized under the leadership of Adoni-zeder, King of Jerusalem, to halt the Israelite invasion. The Hivites, in Gibeon, believing themselves to be the next Israelite victims, defected from the alliance and sued for peace. That was a matter of great concern. With Joshua in control of Gibeon, about six miles from Jerusalem, the Israelites would be at Adoni-zeder's gates. The Ammonite leader immediately requested and received aid from the neighboring kings and marched on Gibeon. The Hivites, realizing their grave situation, sent for help. The close proximity of the combatants suggests that the battle was conducted during the fourth month. Remembering that the moon was in its last quarter at the time of Joshua's miracle, the confrontation must have happened near the beginning of the third week.

In brief summary Joshua issued his command during a confrontation with the Ammonites at noon in Gibeon, with a last quarter moon visible in the west in the third week of the fourth Hebrew month.

The Biblical account does not describe the actual battle but E.W. Maunder (1909, pp. 351-384) abstracted enough information to demonstrate the generalship of Joshua and the circumstances surrounding his request for a miracle. After receiving the message from Gibeon, Joshua force-marched his soldiers by night, surprised the enemy, and chased

them to the west via Beth-horon, Azekah, and Makkedah. This was an interesting escape route for it leads away from the Ammonite cities which were to the south. Another point of interest concerns Joshua's slaughter of the enemy at Gibeon (Joshua, X, 10). It is written that escaping Ammonite soldiers sustained heavy losses as hailstones fell upon them from Beth-horon to Azekah, and "They were more who died with the hailstones than they whom the children of Israel slew with the sword (Joshua, X, 11). If the Israelites were in such hot pursuit after an initial slaughter, why were no Israelites affected by the storm? The above discussion suggests a different scenario than the Biblical account.

Joshua must have been concerned by the number of fortified cities which occupied the Promised Land, and in the inability of his army to deal with this problem. A siege against such citadels were costly in terms of time and lives. The Ammonites relieved Joshua of his concerns when they left their protective walls to attack Gibeon. Joshua had to catch and annihilate his enemies in the open.

It must be noted that Gilgal, Joshua's headquarters, was located on the plain of Jericho near the banks of the Jordan. Approximately 17 miles to the west and 3400 ft. above the river stood the ridge on which Jerusalem and Gibeon were situated. The retreat of the Ammonites toward Beth-horon suggests that they were some distance from Joshua since they, alone, sustained heavy losses during the hailstorm.

On learning of Adoni-zeder's attack on Gibeon, Joshua's first concern was to cut the Ammonite king from his capital. In accomplishing this task, he employed a time-tested tactic: envelopment. This maneuver proved successful on two previous occasions: Jericho and Ai. With the Ammonites engaged in Gibeon, Joshua divided his army sending one force through the valley of Achor to attack from the north, while Joshua would cut the Jerusalem road and attack from the south. To the east there was no escape; to the north and south stood the Israelite army. Out-manuevered, Adoni-zeder either realized or was informed that he was between two advancing Israelite forces. He fled the only way open: to the west. Joshua had done his best: an excellent battle plan, a successful march which severed the enemy escape route, and the saving of his Gibeonite allies. However, the campaign was only partially successful. The enemy must be annihilated before they returned to the safety of their cities.

It was noon when Joshua reached Gibeon. His men had been on the march since sunset covering almost 20 miles which included an ascent of 3400 ft. They must have arrived exhausted during the heat of the day. Joshua, needing more time, prayed for the Lord's intervention. "Sun, stand thou still upon Gibeon, And thou, moon, in the valley of Aijalon". As if in answer to his prayer, storm clouds swept in from the sea

hiding the blazing sun. The Israelites continued after their escaping foes. It was not until they reached Beth-horon did the Israelites see the Ammonites below being bombarded by hailstones. Joshua must overtake the Ammonites. This task was accomplished, according to the Bible, by God extending the length of that day: "And the sun stayed in the midst of heaven, and hastened not to go down about a whole day" (Joshua, X, 13).

It is understood that Biblical history is intended to teach religious truth as opposed to historical fact; however, the author of the Book of Joshua is a bit over-zealous in making his religious point. The Biblical narrative implies that, in addition to the all night march, the 3400 ft. climb, the capture of the Jerusalem road, and the arrival at Gibeon during heat of the day, the exhausted Israelite army pursued the Ammonites approximately 30 more miles past Mekkadah, returned to attack and capture that city, and dispense justice to five Ammonite kings found hiding in a cave: all in one day. On the contrary, the lengthened day rather seems to favor the enemy escape. The Ammonites slept the previous night and also had a several mile lead on their pursuers. Even after the hailstorm, the surviving remnant still would be in better condition to arrive safely in the towns along the maritime plain than be captured by the fatigued Israelite soldiers. I believe the slaughter of the Ammonites took longer than one day. The Biblical author seems to have exaggerated in glorifying God's power. The Old Testament scribe also admits that he consulted a secondary source. "Is not this written in the Book of Jashar? And the sun stayed in the midst of heaven, and hastened not to go down about a whole day" (Joshua, X, 13). Also the phrase "about a whole day" infers an estimate: that the long, hot afternoon pursuit by the Israelites felt as if it lasted an entire day. Figuratively, to Joshua's soldiers it had been a long day.

Yet the Bible can be employed as a scientific reference. From this tale we learned the time of day, phase of the moon, location of Joshua, and the approximate week and month of the battle. Bible "tales", interpreted in the light of modern scientific principles, can serve as an interesting and useful teaching aid in the study of the sciences.

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## Division with Fractions: The New Unit vs. Old Unit Dilemma

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As a firm believer that teachers teach as they are taught, the writer suggests that, in college methods and content courses, every effort at model teaching should be attempted. While reading an article entitled "Division with Fractional Numbers: Invert and Multiply" in the November, 1975 issue of *School Science and Mathematics*, I recalled an incident which occurred to me while I was explaining division with fractional numbers in a mathematics class for prospective elementary school teachers. The incident was enlightening for me, in that it indicates that the same difficulty can occur in a college class as does occur in an elementary school classroom.

Morganstein and Pincus, the authors of the article mentioned above, present a series of methods that can be used to explain division with fractional numbers. The authors refer to the question of what to do when dividing two fractions and there is "something left over." The method described below helped me explain to my students what to do with the "something left over." Perhaps it also will help you?

When teaching a new concept an attempt is always made to build on previous information, using pictures, diagrams, concrete objects, equations, and anything else available. When I introduced division with fractions, I put the following on the chalkboard and asked for some help:

$$\begin{array}{l} 8 \div 8 = 1 \qquad 8 \div \frac{1}{2} = \square \\ 8 \div 4 = 2 \qquad 8 \div \frac{1}{4} = \square \\ 8 \div 2 = 4 \qquad 8 \div \frac{1}{8} = \square \\ 8 \div 1 = 8 \end{array}$$

The students (hopefully, almost all of them!) saw the pattern and responded 16, 32, and 64, respectively. After a short discussion, in which I asked why?, and they generally stated, "invert and multiply," I drew a few pictures:

$$8 \div 2 = 4$$

