

Cornerstone Program Evaluation

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Prepared by

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Part I—Site Visits to Cornerstone Schools

In 2004, there were 23 approved Cornerstone mathematics courses delivered in eight Cornerstone schools: Cle Elum, Colville, Ferndale, Manson, Ocasta, Winlock, White River, and Zillah. The total student counts in these classes were as follows: Pre-calculus I (n = 75), Pre-Calculus II (n = 86), Calculus I (n = 57), and Calculus II (n = 8). The evaluator was able to visit all sites except Ferndale in Spring 2004, observing instructors teaching Pre-calculus I, Pre-Calculus II, Calculus I, and Calculus II. During the site visits, the instructor observed at least one Cornerstone class taught by each instructor, except in the case of Ocasta, where Calculus II was observed, but no Cornerstone students were enrolled.

Site visits were important for three major reasons. First, presence in the Cornerstone schools by a representative of the Department of Mathematics at Central Washington University was considered essential in promoting communication between Cornerstone mathematics instructors and the CWU Department of Mathematics. Second, the National Alliance of Concurrent Enrollment Partnerships (NACEP) guidelines stipulate concurrent enrollment courses should be assessed in as rigorous a manner as standard college courses. For this reason, the evaluator administered instructor evaluations identical to those within the Department of Mathematics at Central Washington University (See Appendix 1: Classroom Observation form below). Third, the evaluator gathered data about program quality (See Appendix 2: Cornerstone Site Visit Questionnaire below). That data, then, came from two sources, from interviews with instructors and administrators and from classroom observations. On occasion, statements from students were added to the qualitative data. Data were combined around naturally emerging themes: (1) A Variety of Formats; (2) Similarities Among Sites; (3) Successes; and (4) Challenges.

A Variety of Formats

Using the recommended text varied by school. Four of the schools used the recommended text for at least one of their Cornerstone courses. Several schools used high school versions of a text for a course, while others used college versions. Importantly, most publishers have no marketing protocols to support both high schools and colleges. Teachers have complained that it is difficult to get service from the higher education publishers' representatives. In an effort to streamline the process, the Cornerstone Mathematics Coordinator has contacted Thomson, Brooks/Cole, not the publisher of either of our recommended texts, in an effort to streamline the process. Consideration of this publisher's product is favored, because the publishers' representative has provided excellent service in the past and because their allied on-line software may solve the problem of consistency in taking final exams.

Course duration, delivery, student segregation, and content segregation varied by site. Course duration varied from quarter length to semester length among the sites. Cornerstone schools employed block schedules, traditional schedules, and at one site, the class was split around lunch (which seemed not hinder, and may even have facilitated the flow and effectiveness of the class). In nearly all of the courses, students taking the class for Cornerstone credit were combined with those who were not. One questionable situation involved three Cornerstone Calculus 1 students, simultaneously taught with Cornerstone Pre-Calculus 2 students. (Here, the evaluator took pause, biased by doubts that this arrangement could lend itself to a quality experience. However,

upon observation of the class, the evaluator was impressed by the intensity and efficiency of the Calculus students collaborative effort, clearly on par with or superior to any he had witnessed in the college setting.) This was the only instance where two courses were taught simultaneously, and a student teacher was regularly available to assist one group, while the instructor managed the other.

Similarities Among Sites

The evaluator was impressed by the affable manner of the instructors and the easy-going atmosphere in *every* high school classroom he visited. Such an open atmosphere is conducive to learning and informal assessment of understanding and, unfortunately, not common in college classrooms. The evaluator attributes this openness to the freedom commonly felt by instructors and students in high-level high school courses. In this setting, instructors and students seem to relax a bit, basking in the notion that the best are learning from the best.

Most of the observed classes seemed traditional in nature. That is, the common protocol involved homework review, followed by presentation of new material and examples. Often, students were intermittently assigned practice problems with the final few minutes of a class, devoted to new homework. Even those teachers known for their more integrated approaches presented traditional lessons. *The evaluator seriously wonders if either the course content or the process of being evaluated somehow promotes a more traditional approach to teaching.* When queried, some of the teachers mentioned giving students projects or extended assignments, while others maintained their traditional stances. That stated, the evaluator was impressed by the organization, knowledge, classroom management, and delivery of *every* instructor observed. Notably, in one class, students superbly presented many of that day's examples, a practice encouraged by the National Council of Teachers of Mathematics. In another class, the teacher provided cans of different sizes to prompt the students in a real-world minimization problem. The evaluator would like to have seen more of these practices, although students were actively involved in most of the observed classes. Also, the evaluator would like to have seen students solving more substantial problems, since the ability to do so separates success from failure in college mathematics courses.

Every Cornerstone teacher believed he/she taught rigorous Cornerstone courses. All but one instructor, when asked about the rigor of their courses, responded that Cornerstone courses were more rigorous than "regular" high school courses. That dissenting instructor was careful to note that *all* the courses she taught were demanding! Consider the different instructors' comments:

- "Before Cornerstone, I did not push as hard...They [students] struggle...I put pressure on myself."
- "I expect college level work, to step up to that next level."
- "[There is] more material to cover in a semester...not as much flexibility." This comment comes from an instructor who could convince none of her Calculus 1 students to sign up for her Cornerstone Calculus 2 class. Interviews with three revealed they dreaded the amount of course work!
- "I am more demanding in quality and quantity...[the] nature of the class makes it more demanding...Credit from CWU means something, [it is a] driving factor for the kids."

- “I push my kids in any class I teach...[I give] tests way beyond what the text book wants.” This comment came from a former AP calculus teacher who noted that she still taught at that level.
- “The challenge is similar [to college] but there is more hand-holding in high school...[With Cornerstone, I am] pressured to get more content done. It depends on how you weave it.”

Successes

The 2003 Evaluation showed three major Challenges: (1) establish consistency among the different Cornerstone Mathematics courses of the same type; (2) find a solution to the problem of a resource poor Cornerstone Mathematics Coordinator; and (3) continue to pursue statistics that drive decision making toward program quality. The evaluator noted considerable progress toward resolving many of last year’s issues.

(1) Establish consistency among the different Cornerstone Mathematics courses of the same type.

Exams for Pre-Calculus 1, Pre-Calculus 2, and Calculus 1 were distributed to Cornerstone Mathematics instructors along with grading rubrics. Additionally, at the 2003 Summer Cornerstone Conference, a session was devoted to content, rigor, and grading the final exam. Instructors expressed gratitude for this guidance and for other information provided at the conference. Six Pre-Calculus 1 and 3 Pre-Calculus II tally sheets were returned to the Cornerstone Mathematics Coordinator. The results from those tally sheets will be considered in the Part II of this report.

The Cornerstone Mathematics web site was expanded to include the chapters and content of the new text and re-organization of the Pre-Calculus and Calculus courses on campus. Examples of daily outlines, student outcomes, and syllabi are also on that site. Finally, that site is being revised to align with the CWU style guide and should be available before summer.

(2) Find a solution to the problem of a resource-poor Cornerstone Mathematics Coordinator.

The search committee is in the final stages of hiring a person as a half-time Cornerstone Mathematics Coordinator/half-time GearUp Coordinator. This is a natural marriage of duties, which should complement each other. The evaluator recommends that the new staff member work toward that suggested synthesis, since the two duties combine in single longitudinal mission: To provide middle and high school students with mathematics and science experiences of the highest quality, better enabling their achievement in college.

(3) Continue to pursue statistics that drive decision making toward program quality.

The Continuing Education Director and Cornerstone Coordinator have been working with the Admissions and Institutional Research offices to secure data to compare Cornerstone students with other groups, especially in the areas of attendance at Central Washington

University and achievement there. Such a comparison is the basis of Part II of this study. Unfortunately, there have been no solutions to the logistical and legal problems of tracking former Cornerstone students at other higher education institutions. Effort should be continued here, since the results of those comparisons could enhance the credibility of the Cornerstone program.

Challenges

The Cornerstone Program stands to grow quickly, especially in lieu of Washington State's higher education "double crunch," rising costs and fewer available seats. Furthermore, admissions requirements among Washington's public universities are soon to change, reflecting a preference for students taking more rigorous mathematics courses in high school. Consequently, an overarching challenge is to grow the program in a quality conscious manner that protects the program's image until assessment data unequivocally supports it. With this projection in mind, the evaluator forecasts the following challenges.

- (1) In the last year, tremendous achievements have been made in data keeping and data analysis for the Cornerstone Program. The results tend to validate the high caliber of students taking Cornerstone courses. However, at this stage of development quality and consistency go hand in hand with program image. The appearance of quality must be maintained, and that appearance is tied to cultural beliefs, norms, and practices of higher education. Potential consequences for breaching accepted practices include the loss of faculty or administrative support or accreditation failure, based on breaking accepted (but not necessarily valid) cultural rules endemic to higher education. Specifically, protocols must be developed to deal with Cornerstone courses delivered simultaneously to Cornerstone and non-Cornerstone students and especially when a single instructor delivers more than one Cornerstone course at simultaneously. This is NOT to say that quality cannot be maintained under either condition. Rather, special care must be taken to ensure and demonstrate quality in those cases, and evidence supporting that quality should accompany course requests.
- (2) Although efforts have begun to ensure that consistency be maintained within each type of Cornerstone course, texts and tests vary by school and instructor. Based on the history of Advanced Placement courses, as long as course objectives are well stipulated and a summative assessment instrument is in place, a particular text need not be mandated. However, a system that provides a valid and reliable assessment for each Cornerstone course is critical to both credibility and program assessment. Specifically, an assessment system, based on student outcomes, must be implemented for each Cornerstone course. Such a system should provide valid and reliable feedback to students, to Cornerstone Instructors, to Cornerstone Administrators, and to department heads and faculty. That system need not be limited to a traditional final exam, but should be more comprehensive and adequately reflect students' abilities and efforts throughout their Cornerstone experience.
- (3) The most credible models of concurrent enrollment programs are based on true partnerships between secondary and higher education. Both levels contribute to the stewardship of these programs. Strengthening Cornerstone partnerships will require, most of all, more communication among players. Specifically, that communication should entail longer

summer workshops, especially for new Cornerstone instructors, and stronger ties between the Mathematics Department and Cornerstone schools. Specifically, the evaluator recommends that prospective (new) Cornerstone Instructors spend a minimum of two days in the summer with the Cornerstone Math Coordinator to discuss content and process issues associated with teaching Cornerstone courses. Also, the evaluator suggests creating a one-year Cornerstone Mathematics Instructorship within the mathematics department to further connect secondary mathematics to university mathematics. Also, the evaluator recommends more frequent site visits with more in-depth assessments to provide feedback to instructors and program administrators.

Part II—Comparative Statistical Analysis of College Freshman Achievement Among Traditional-Aged Cornerstone, Running Start, and Non-Dual Enrollment Students at Central Washington University

First year college achievement was compared among populations of traditional-aged freshman at Central Washington University (CWU) by type of cohort from the years 1999 to 2003. See the Table below. In this comparison the records included those of former Cornerstone students (n = 510), former Running Start students (n = 197), and former Non-Dual Enrollment (NDE) (n = 3480). Note, however, that only 6% (n = 30) of the Cornerstone students and 26% (n = 50) of the running start students had recorded Grade Point Averages (GPAs) at Central Washington University during years, 1999-2003. The evaluator used the presence of GPAs to determine residence at CWU. It is important to note that there were no Cornerstone entries for the years 1999 and 2000, although there were Running Start entries. To increase the size of the Running Start population, we assumed that pooling all five years of entries did not sacrifice the validity of our results. Also, it is possible that the Non-Dual Enrollment cohort included those who may have enrolled in Advanced Placement or dual enrollment courses other than Cornerstone or Running Start. These were not disaggregated from the NDE Cohort. Achievement indicators included (1) Percent of Cohort Taking Freshman Mathematics Classes, (2) Type of Mathematics Course Taken and Respective Grades, and (3) High School and College Freshman GPAs.

Statistics at a Glance

	Cornerstone	Running Start	NDE
Number (Tot) CWU records examined from 1999-2003	510	197	3480
Number (% Tot) taking cohort math in HS	174 (34%)	45 (23%)	*
Number (% Tot) enrolled at CWU	30 (6%)	50 (25%)	3478 (99%)
Number taking math as CWU freshmen	19	33	2595
Number who took freshman math at CWU and math within HS cohort	5	7	*

*unknown or not applicable

(1) Percent of Cohort Taking Mathematics Courses

63% (n = 19) of the 30 former Cornerstone students who enrolled a CWU took mathematics courses their freshman year, but only five of them had a previous Cornerstone *Mathematics* course. 66% (n = 33) of the 45 former Running Start students took mathematics classes at CWU as freshmen, but only seven of them took Running Start *mathematics* courses in high school. In comparison, 75% of all traditional-aged freshman in the years 2000-2002 took mathematics classes their first year at CWU.

(2) Type of Mathematics Courses Taken

All five former Cornerstone Mathematics students took mathematics courses at CWU as freshmen. One received a grade of “A” in Math 130 (Finite Mathematics), another, a grade of “A” in Math 101 (Math in the Modern World), and third student, a “B” in a Math 172.2 (Calculus 2) after taking the prerequisite as a Cornerstone course. Two grades are still pending until the end of Spring quarter 2004, one for Math 130 and another for Calculus 1. Although the sample of students who took Cornerstone courses and subsequently attended CWU is small, the statistics indicate that all of them took more mathematics, and none repeated Cornerstone courses. The small sample size and its restriction to Central Washington University does not statistically support answering a fundamental question: Is taking Cornerstone Mathematics associated with quality mathematics course-taking behavior and achievement in college? Gathering enough data from other colleges and universities is paramount for this question is to be answered in the future.

20% (n = 39) of the 197 Running Start students who entered CWU passed Running Start mathematics courses, and four others had grades pending. 32 of them took no follow-up mathematics courses at CWU their freshman year, meaning that 18% (n = 7) did take subsequent mathematics courses as freshmen. Of the seven students that took subsequent mathematics as freshmen, none repeated courses, two had grades pending until the quarter’s end, and the other five received “A” grades in their courses.

The validity of comparing subsequent mathematics course-taking behavior among Cornerstone, Running Start, and the Non-Dual Enrollment cohorts is questionable, because the Cornerstone and Running Start samples are small. Also, Running Start students take a variety of courses unavailable to Cornerstone students. However, with due respect to the small sample sizes, both former Running Start and Cornerstone students, who have taken respective mathematics courses in high school, did well in their subsequent courses. *It seems reasonable to hypothesize that students from both Cornerstone and Running Start cohorts attending CWU take the respective mathematics courses in high school to satisfy requirements in college. Only 26% of former Cornerstone students and 21% of former Running Start students, who previously took these mathematics courses in high school, subsequently took a freshman mathematics class at CWU.*

(3) High School and College Freshman Achievement Indicators

On average Cornerstone students, meaning those who took any Cornerstone course, mathematics or not, were high achievers. Their average high school and freshman college GPAs were higher than that of either the NDE or the Running Start groups. See, especially, HSGPA and FirstYrGPA in the table below, which contains other mean indicators of high school and college achievement by cohort: ADMX (mean admissions index on which admission to CWU is partially based, First Math GPA (average of freshman mathematics grade), and HS GPA – College GPA (drop in GPA from high school to college).

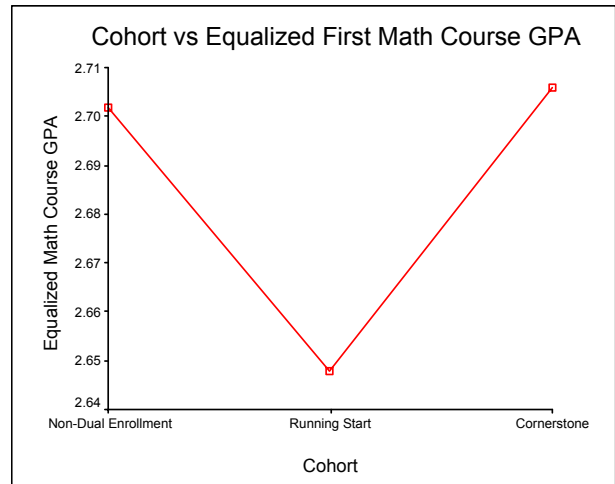
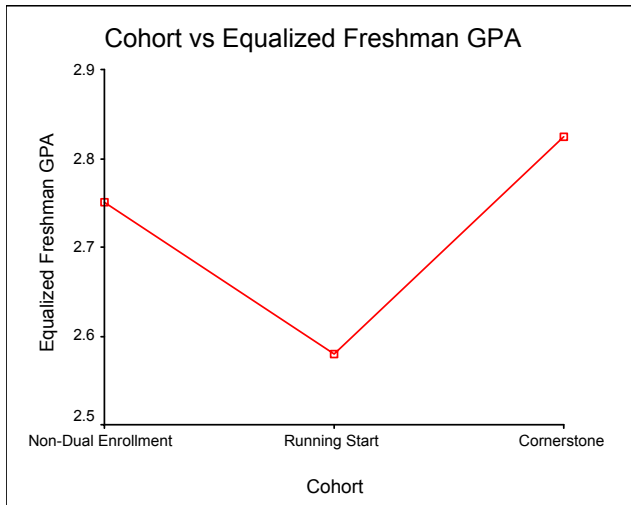
Cornerstone students at CWU come in with significantly higher high school mean GPAs than do Running Start or NDE students. Cornerstone and Running Start students have significantly higher ADMX scores than NDE students, but the mean Cornerstone ADMX score does not differ

from that of the Running Start group. Although the mean Cornerstone First Math Course GPA is higher than those of Running Start and NDE groups, it is not significantly higher. (This may be due in part to the relatively small sample sizes of the Running Start and Cornerstone groups.) While the Cornerstone mean FirstYrGPA is higher than that of both NDE and Running Start groups, it is significantly higher than that of NDE's mean only. Finally, there is no significant difference among the HS GPA-College GPA grade drop means.

Cohort Achievement Indicators

Cohort		HSGPA	ADMX corrected for 0s	First Math Course GPA	FirstYrGPA	HS GPA-College GPA
Non-Dual Enrollment	Mean	3.1503	46.82	2.6966	2.7428	.4072
	N	3479	3418	1930	3478	3477
	Std. Deviation	.49979	20.079	1.09747	.73929	.70430
Running Start	Mean	3.0121	60.98	2.9332	2.9056	.2104
	N	62	57	25	50	49
	Std. Deviation	1.16729	22.705	1.32983	1.08651	1.51625
Cornerstone	Mean	3.5464	67.60	3.1666	3.2038	.3791
	N	69	67	14	30	30
	Std. Deviation	.53327	15.224	.98500	.72041	.71711
Total	Mean	3.1555	47.44	2.7030	2.7490	.4043
	N	3610	3542	1969	3558	3556
	Std. Deviation	.52193	20.311	1.10036	.74625	.72165

The graphs below express a comparison of mean Freshman College GPAs and First Math Course GPAs by cohort, given that the scores are “equalized” by ADMX, the best traditional predictor of freshman performance at CWU. Note that the best performers are Cornerstone Students, although the difference is not statistically significant when equalized by ADMX.



Conclusion

Previous statistics and those of this study provide compelling evidence that Cornerstone students are high achievers. From previous studies, it is known that Cornerstone students, on average, *significantly* outscore non-Cornerstone students in the following measures: ACT Math Test, SAT Comprehensive Test, SAT Verbal Test, and on first quarter college GPA. While a previous study showed that Cornerstone students' GPAs dropped significantly less from high school to freshman year in college, we found the drop lower in this study, but not significantly so, when compared with that of NDE students. Conversely, Running Start students did have a significantly lower drop in mean GPA than the NDE students, and lower, but not significantly, than Cornerstone students. Equalizing on CWU admissions index (ADMX), this study showed that Cornerstone students had a higher adjusted mean College Freshman GPA and a higher mean First Math Course than either NDE or Running Start students, but insignificantly so.

Drawing statistical conclusions about former Cornerstone students who took Cornerstone Mathematics courses was not possible, since only five records were available. However, with respect to the small sample sizes of former Running Start and Cornerstone students who took mathematics in their respective programs and matriculated at CWU, we make a qualitative observation. Both groups performed well in mathematics as college freshmen by virtue of their choices of mathematics courses and their grades in those courses. Also, it is possible that most Cornerstone and Running Start Mathematics students take their high school mathematics courses to complete college requirements early, given the relatively small proportions of each groups taking college mathematics courses. The evaluator recommends a continuing effort to secure data from other institutions to generalize the three-way comparison among Cornerstone, Running Start, NDE students. Adding Advanced Placement students, as a fourth level, is also recommended. In particular, the question to be answered is the following: How does the Cornerstone Mathematics cohort compare with other cohorts in its association with quality mathematics course-taking behavior and achievement in college?

Finally, two previous statistics lend support that the Cornerstone representation at CWU is growing. In two years, subsequent enrollment by Cornerstone students at CWU increased from an estimated 10% to over 20% of the respective seniors taking cornerstone courses. However, the representation by former Cornerstone Mathematics students is still relatively small. The evaluator attributes this non-representation to the fact that Cornerstone students are high achievers. Students taking upper level mathematics in high school tend to be extremely high achievers. These students might be choosing most prestigious colleges and universities. This phenomenon deserves more exploration via the annual Cornerstone Survey.

Part III—Suggestions for Future Assessments of Cornerstone Mathematics Courses

1. For each course, create a Final Exam system with objectives well stipulated. There are essentially three directions to proceed. (1) Provide a Blackboard-based system where the Cornerstone Coordinator assumes responsibility for the content, management, and training on the system. (2) Provide a publisher-based system where the publisher assumes responsibility for content and the Cornerstone Coordinator assumes responsibility for training and management. (3) Provide final exams and practice final exams created by the Cornerstone Coordinator (at least 2 for each course per year) with rubrics and grading schemes. Whichever method is used should provide assessment feedback by learner outcome and by Cornerstone site. See the graphs below, generated from data submitted by Cornerstone Instructors for Pre-Calculus 1. Such instruments allow schools to compare themselves according to student outcomes. The evaluator strongly recommends that school names NOT be included in any public report. Instead, instructors should be informed ONLY of their graph as it relates to all others, which should remain anonymous.

As a method of implementing final exams, the evaluator favors method (3), which allows more control over content, promotes discussions on grading, assessment, and university practice, and avoids the inherent issues of on-going training, scheduling, and current limitations and failures associated with the technology. In brief, the evaluator favors an AP like model, which, while having its own limitations, also sets a standard.

2. The evaluator suggests that annual instructor portfolios be submitted for each Cornerstone course taught. The contents of each portfolio should include, but not be limited to, (i) course syllabus; (ii) course schedule; (iii) exams; (iv) quizzes, (v) projects or extended problem-solving exercises (vi) graded final exams, (vii) final exam tally sheet, (viii) course grading scheme, and (ix) course grades.

Appendix 1

Classroom Observation

Faculty Member

Class Observed

Observed by

on

1. Describe the classroom format. That is, what did you see take place (e.g., 50 minute lecture, 20 minutes of group work followed by 30 minutes of lecture and discussion, etc.)
2. Did the students appear engaged and/or participating in the class?
3. Did the instructor appear well organized?
4. Did the instructor provide clear explanations of the subject matter appropriate for the level of the students?
5. Did the instructor provide clear objectives for the students?
6. List two or three aspects of this class that you thought were done well.
7. List two or three aspects that would improve, in your opinion, this class.

Appendix 2

Cornerstone Site Visit Questionnaire

As you might know, the purpose of my visit is to gather data to evaluate the quality of Cornerstone Courses. It may be important for you to know that the data from this evaluation will be confidential and that no entity or person will be named in public. Your name-linked responses may be made available to the Cornerstone Coordinators, CWU Mathematics Chairperson, and the CWU Continuing Education Supervisor, but they will NOT be distributed to any other party.

1. What Cornerstone Courses do you teach?
2. Will you share copies of syllabi for your Cornerstone courses?
3. What text do you use for each of your Cornerstone courses?
4. Will you share your exams or other materials you use for Cornerstone courses?
5. Will you share your final grade rosters for Cornerstone Courses you have taught (if these are different from the those sent to the mathematics department)?
6. Do you teach a Cornerstone Course differently from a “standard” high school course, especially one with the same title? If so, how?
7. How well, in your opinion, do the Cornerstone courses you teach challenge students, compared with their counterparts at CWU? If you perceive that there is a difference, please explain.
8. Do you grade students in Cornerstone courses harder, easier, or about the same as you would grade students in other courses, especially non-Cornerstone course with the same title.
9. Do you think that the Cornerstone Mathematics Program has been a success at your school? Why or why not? Is there evidence?
10. What are some barriers to quality in teaching cornerstone courses?
11. Is there anything else that is important for me to know about the quality of Cornerstone mathematics courses?