PROGRAM INFORMATION

Date submitted: ____~~April~~ October 2012_____

Degree Program(s):	BS Meteorology	**Department:**	Meteorology & Clim Sci
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Note: Schedule is posted at: http://www.sjsu.edu/ugs/programplanning/

ARCHIVAL INFORMATION

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Assessment schedule is posted at http://www.sjsu.edu/ugs/assessment
Please send any changes to the schedule or to student learning outcomes to Jackie Snell jacqueline.snell@sjsu.edu

Enter the number and text of the SLO in this box (we post reports by SLO)

SLO-7: Describe the fundamental processes responsible for atmospheric motions and the general circulation in a qualitative and quantitative manner.

***Note**: This report relates to data collected before we decided to change our SLO list*.

Initial Evidence of Student Learning:

In Spring 2011 we decided in a faculty meeting to conduct an assessment "across our curriculum" of the extent to which students continue to remember important concepts as they advance through our curriculum. In particular, and as dictated by SLO-7 (which we were assessing for the first time), our focus was on ***atmospheric dynamics***. This is the field in which mathematical methods are used to solve equations resulting from basic laws of physics in order to understand and predict atmospheric flow phenomena. This curriculum is delivered initially in a sophomore-level class (METR 61), and then throughout a two-semester junior-level sequence (METR 121A,B), and is extensively used in three senior-level classes (METR 171A,B & 172). Knowledge delivered is assumed (by the faculty) to be retained and carried from the sophomore through senior years. In the case of graduate students, this knowledge base is assumed and built upon further in METR 205A.

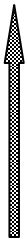
We decided to test this assumption (that key knowledge is retained and carried from the sophomore through senior and graduate years). We designed a survey in which we asked students to answer four questions covering basic points covered in all dynamics classes. Two examples were: (1) name the forces that cause air motions; and (2) name the "hydrostatic equation"[1]. Both required a written answer.

[1] A copy of all survey questions is on file in the department for future use.

The survey was given to students in MET 61 ("beginners"), MET 121A ("intermediate"), MET 121B ("advanced"), and MET 173 ("graduate"). In each class after MET 61, the content covered by each question will have been covered and reinforced several times. The "121A and B" students were a single cohort; the "61" and "173" classes were different cohorts.

The four survey questions were graded as follows: a good answer is a "+1"; a partially correct answer is a "0", and a wrong or missing answer is a "-1". Results are tabulated below. Note that the classes are listed in order of decreasing difficulty (i.e., grad/undergrad elective → sophomore class; arrow at right shows direction of increasing class difficulty level). The largest values for each class & question are shaded in light blue.

Class	Q1			Q2			Q3			Q4			# students in class
	+1	0	-1	+1	0	-1	+1	0	-1	+1	0	-1	
173	7	2	2	6	1	4	4	3	4	5	5	1	11
121B	8	0	4	8	0	4	0	7	5	1	8	3	12
121A	4	0	6	4	0	6	1	4	5	0	7	3	10
61	3	2	7	2	1	9	0	4	8	3	3	6	12



Looking at question 1 (where students were asked to name the forces that cause air to move): we see that the majority of sophomores (7 of 12 in MET 61) and 1st semester juniors (6 of 10 in MET 121A) could **not** give a satisfactory answer to the question. Meanwhile, the majority of seniors and graduates (7 of 11 in MET 173) and 2nd semester juniors (8 of 12 in MET 121B) **could** give a satisfactory answer. **This is encouraging**; it indicates that students **do** retain this knowledge once it has been introduced **and** reinforced in the curriculum. Many scientific concepts are difficult to understand and remember – nobody should expects all students to "get it" and "remember it" after a single exposure.

Looking at question 2 (where students were asked to *name* the hydrostatic equation (but not actually write the equation)): we see that the majority of sophomores (9 of 12 in MET 61) and 1st semester juniors (6 of 10 in MET 121A) could **not** give a satisfactory answer. On the other hand, the majority of seniors and graduates (6 of 11 in MET 173) and 2nd semester juniors (8 of 12 in MET 121B) **could** give a satisfactory answer. This again indicates that students do retain this knowledge once it has been introduced and reinforced in the curriculum.

For both questions, we would (of course) prefer a 100% correct answer to these questions. For the graduates (173), only 2 of 11 could not give a satisfactory answer to question 1. While this is a small number, it is troubling given the fact that the question addresses a fundamental point. In reviewing the way the questions were phrased, we believe they could be re-written in a way that more clearly asks for the information we want. Thus we may repeat this exercise with the questions better written. These incorrect answers were also given by the weakest students in our program (survey was not anonymous).

Looking at question 3 (where students were asked to identify terms in a given equation): we see that the majority of sophomores (8 of 12 in MET 61) and 1st semester juniors (5 of 10 in MET 121A) could **not** give a satisfactory answer. The majority of 2nd semester juniors (7 of 12 in MET 121B) gave partially-correct answers, and in the highest-level class (MET 173) the results were mixed. By and large, therefore, students had **not** retained this information very well. The key word missing from most answers was the word "advection", which is very familiar to meteorologists. Our conclusion (which remains to be tested) is that students fail to equate the *physical process* of advection with the *math* they were shown in the question.

Looking at question 4 (where students were asked to name some equations): we see that the majority of sophomores (6 of 12 in MET 61) could **not** give a satisfactory answer. The majority of juniors (7 of 10 in Fall and 8 of 12 in Spring) were able to give partially-correct answers. In the highest-level class (173) the

results were mixed with 5 of 11 giving a correct answer, and a further 5 of 11 giving a partially-correct answer. Again, students had **not** retained this information very well by their last year.

Looking at all questions, the students clearly make progress as they progress through our curriculum in terms of being able to remember the concepts taught. As sophomores (MET 61, bottom row of the table), most cannot answer the questions correctly. A year later in Met 121B (2nd row of table), most can give either the correct answer or a partially-correct answer (where usually the answer had missing information, as opposed to being wrong). Although we would prefer a 100% correct response in the more advanced classes, we are pleased that the "trend in understanding" is upward. Since the survey was not anonymous, we can see (especially in the most difficult class (173)) that students who gave wrong answers are those we had all independently labeled as "weak".

Change(s) to Curriculum or Pedagogy:

1. Based on the above results, the faculty have determined that math literacy is one of the fundamental challenges our students face. Students have difficulty in two respects: (a) completing the math sequence itself; and subsequently (b) linking math with physical processes in the atmosphere (e.g., when to use math to solve a problem, and what math to use etc.). In response to this, the faculty have agreed to spend extra time on fundamental math concepts, such as vectors etc., that seem to consistently cause the weaker students problems throughout their studies. In particular, we will offer additional emphasis (roughly one class meeting per course) on these math concepts in MET 60/61 (sophomore=beginners), METR 121A/B (juniors=intermediate), and METR 171A/B (advanced).

2. The questions we asked on our survey were all written in a fairly mathematical way (three of the four had either equations or symbols in the question). The general topic of "atmospheric dynamics" has *always* been taught from a very mathematical approach – the reader of this report is invited to confirm this via a review of any number of texts on the subject, going back to about the 1930's. Undergraduate students in programs across the USA (and beyond) very often have difficulty in "equating" the mathematics with the physical behavior of the atmosphere. This has been an informal topic of discussion at national meetings among faculty who teach dynamics – and yet no new paradigm has emerged on how to assist student learning and comprehension of this difficult topic.

3. At least one student in the 173 class did not meet the class prerequisites. Since this was the first time the class was offered, the instructor chose to allow the student to take the class. In future, we may enforce prerequisites more firmly.

4. The faculty are having two faculty meetings early this Fall to discuss assessment. One meeting will be dedicated to GE assessment results from last year, and curricular changes. The other meeting will be dedicated to: (a) discussing the results above and any curricular changes (including delivery methods) we might make in future; and (b) discussing which area we would like to assess next (AY 12-13).

Evidence of Student Learning after Change.

Two comments: (1) as the data shows, our students do show increased retention and understanding of important concepts as they advance through our program. Ideas and concepts that may seem completely bizarre and foreign to them as sophomores make more sense when they are juniors, seniors and grad students. These concepts have been presented several times in numerous classes, and have been applied to practical problems (e.g., in preparing forecasts). (2) Students who "failed" the assessment exercises in the most advanced classes were also those students previously identified as "weak" by multiple faculty in multiple classes. These are students who are weak as freshmen, and remain so as they advance. One of the students in this category is one who would have been on "probation in the major" had that been enforced at the time of the survey. The faculty are *not* of the opinion that *all* students admitted to SJSU will/can succeed in their chosen field.