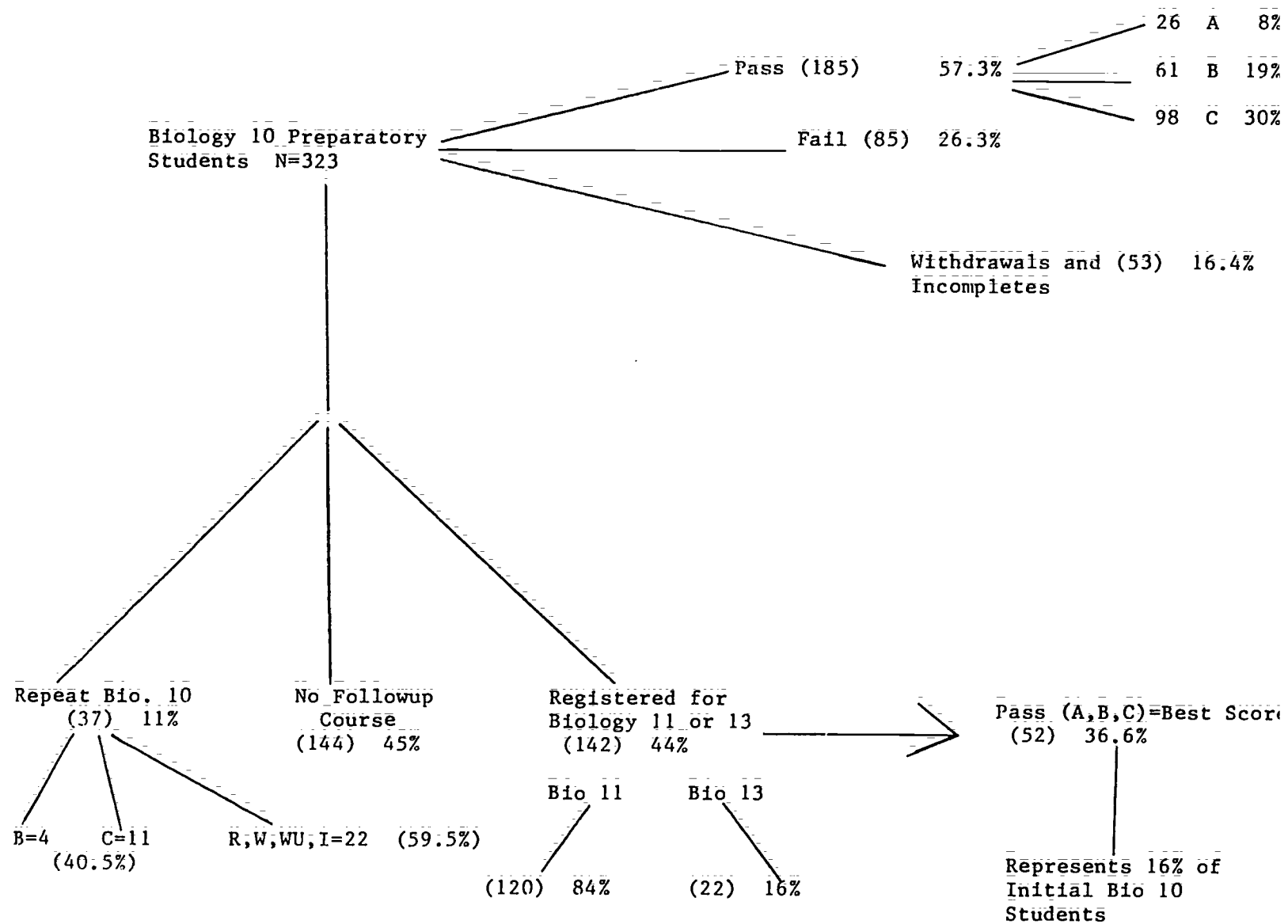TABLE I - <u>SUMMARY FLOW CHART - FOLLOWUP OF PREPARATORY STUDENTS (Biology 10)</u>

                                                                              26   A   8%

                                              Pass (185)   57.3%   61   B   19%

    Biology 10 Preparatory   Fail (85)   26.3%   98   C   30%
    Students   N=323

                                                     Withdrawals and (53)   16.4%
                                                     Incompletes

Repeat Bio. 10   No Followup   Registered for   Pass (A,B,C)=Best Score
    (37)   11%   Course   Biology 11 or 13   (52)   36.6%
                       (144)   45%   (142)   44%

B=4   C=11   R,W,WU,I=22   (59.5%)   Bio 11   Bio 13
    (40.5%)   Represents 16% of
                                              (120)   84%   (22)   16%   Initial Bio 10
                                                                           Students

    * Includes students who may have achieved grade after repeating course

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One-way analysis of variance showed that mathematics score, reading score, and type of high school degree were significantly related to passing or failing Biology 10, the preparatory course. The results were confirmed in later analysis.

Table II-Summary Table of One-Way Analysis of Variance Between Pass and Fail Groups in Biology 10 for Reading Score

Source	df	Sum of squares	Mean squares	F ratio
Between groups	1	391.97	391.97	14.68*
Within groups	268	7158.29	26.71	
Total	269	7550.26		

*$p \leq 0.0002$

Table III-Summary Table of One-Way Analysis of Variance Between Pass and Fail Groups in Biology 10 for Type of High School Degree

Source	df	Sum of squares	Mean squares	F ratio
Between groups	1	1.4781	1.4781	4.237*
Within groups	268	93.4875	0.3488	
Total	269	94.9656		

*$p \leq 0.040$

Table IV—Summary Table of One-Way Analysis of Variance Between
Pass and Fail Groups in Biology 10 for Mathematics Score

Source	df	Sum of squares	Mean squares	F ratio
Between groups	1	1420.84	1420.84	23.95 *
Within groups	268	15902.12	59.34	
Total	269	17322.96		

*$p \leq 0.000$

A stepwise discriminant analysis for pass and fail groups in the
preparatory course pointed to mathematics as being the primary
discriminating variable. This result was not surprising since a
similar study (Biermann, 1985) exhibited mathematics as being the best
discriminator of pass/fail for an upper level biology group from the
same college. Mathematics was followed by reading score, type of high
school degree, and birthplace.

Table V — Order of Variables Stepwise Discriminant Analysis
Pass and Fail Preparatory (Biology 10 Groups)

Variable	Wilks' lambda	Significance
1. Mathematics	0.917979	0.0000
2. Reading Scaled Score	0.882754	0.0000
3. HS – GED Degree	0.869333	0.0000
4. Birthplace	0.861778	0.0000

Note. Nonsignificant variables were not included in this table.

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Table VI - Classification of Pass and Fail Groups in Stepwise Analysis

Actual group		Number of cases	Predicted group membership	
			1	2
1	N	85	60	25
	%		70.6%	29.4%
2	N	185	64	121
	%		34.6%	65.4%

Note. Percent correctly classified 67.04%. Actual group 1 = Fail and actual group 2 = Pass.
One discriminant function was generated with a canonical correlation of 0.37 and an eigen value of 0.16.

A stepwise multiple regression analysis of the preparatory course grade using achievement and demographic variables determined that the first three variables (mathematics, reading, and type of high school degree) explained 33% of the variance of the preparatory grade. A good deal of the variance remained unexplained.

Table VII Summary of Stepwise Multiple Regression Analysis of Biology 10 Grade Using Achievement and Demographic Variables

Variable	Simple r	Beta	Standard error of B	F ratio
Mathematics	0.31	0.29	0.01	28.88*
Reading score	0.14	0.13	0.02	3.81**
HS-GED degree	-0.10	-0.10	0.15	2.08***
Age	-0.06	-0.07	0.01	1.33
Years in US	-0.08	-0.05	0.11	0.42
Writing Score	0.09	0.04	0.11	0.32
Sex	-0.01	-0.03	0.25	0.33
Birthplace	0.05	0.02	0.04	0.07

Multiple R^2 = 0.33
*$p \leq .001$
**$p \leq .025$
***$p \leq .05$

A comparison of preparatory students for high school and GED groups was performed. It was shown that the average age of GED students is 29.5 years, which is, on the average, eight years older than the high school group. The proportions of male and female students in the two groups is approximately the same. Mathematics, reading score, and writing scores are higher for the GED group. In the GED group, 59% passed the preparatory course as compared with 55% of the high school group. When comparing the two groups that proceeded to take the follow-up biology courses, 41% of the GED group passed, while only 17% of the high school group passed. Upon comparing the two groups for the best follow-up biology grade attained, only 29% of the high school group passed, while 51% of the GED group passed. Another interesting finding was that 60% of the GED group was foreign born as compared to 53% of the high school group.

A stepwise multiple regression of the follow-up biology course grade using achievement and demographics displayed the biology preparatory grade as being able to explain some of the variance in the dependent variable, along with age and mathematics score.

Table VIII—Summary of Stepwise Multiple Regression Analysis of
Follow-up Biology (11/13) Initial Grade Using Achievement and
Demographic Variables

Variable	Simple r	Beta	Standard error of B	F ratio
Biology 10 Grade	0.48	0.45	0.04	73.74*
Age	0.08	0.12	0.01	4.55**
Mathematics	0.24	0.08	0.01	2.38***
Sex	-0.05	-0.04	0.17	0.59
Years in US	-0.06	-0.08	0.01	1.30
Writing Score	0.08	0.04	0.07	0.56
Birthplace	0.04	-0.03	C.02	0.32
HS - GED Degree	-0.07	-0.01	0.10	0.05
Reading score	0.08	0.01	0.01	0.02

Multiple R^2 = 0.24
*$p \leq .001$
**$p \leq .01$
***$p \leq .10$

A further stepwise multiple regression analysis was performed to
determine the variables which explain the best follow-up score. The
analysis showed that the preparatory course grade and the initial
follow-up biology course grade explained 77% of the variance.
Students appear to be behaving consistently.

Table IX - Summary of Stepwise Multiple Regression Analysis of
Follow-up Biology (11/13) Best Grade Using Achievement and Demographic
Variables

Biology 11/13				
initial grade	0.87	0.80	0.03	72.76*
Biology 10 grade	0.53	0.14	0.03	19.63*
Sex	−0.0C	−0.04	0.10	1.84
Birthplace	0.02	−0.03	0.01	1.12
HS or GED	−0.06	0.02	0.06	0.49
Years in US	−0.06	−0.02	0.00	0.41
Age	0.05	0.02	0.00	0.27
Writing	0.09	0.01	0.05	0.08
Mathematics	0.24	0.01	0.00	0.03
Reading Score	0.08	0.01	0.01	0.02

Multiple $R2=0.77$
*$p \leq .001$

Note. If the multiple regression is performed without the first two
variables then mathematics becomes the variable explaining 7% of the
variance.

Conclusions and implications

The data seems to show that mathematics score and reading score
are significantly and positively related to achievement in the biology
preparatory course, while writing score is not. GED graduates appear
to perform better in the preparatory and follow-up biology courses
than do high school graduates. The discriminant analysis points to
mathematics score as the variable which best discriminates between
pass/fail preparatory groups. The reading score is also a significant
discriminator, but not the writing score. For those students who go

on to take the follow-up biology course, the preparatory grade is the best predictor of the follow-up course grade.

In a study of pre-nursing and nursing students at the same community college, Biermann (1985) found that the mathematics score was the variable which best predicted acceptance into the nursing program. Mathematics exhibited itself as an important variable in this study as well. It may be that analytical reasoning ability (as shown by mathematics scores) is a necessary prerequisite for many science related curricula. Students entering the nursing program must engage in superior work in three science-related courses (biology, chemistry, and psychology) in order to be accepted into the program.

One conclusion that is ultimately reached in the study is that the preparatory course, as given at this time, does not appear to be preparing many of the initially enrolled preparatory students to continue into follow-up courses. Only 142 students (44%) registered for the follow-up courses (most of them registered in anatomy and physiology). Another 144 students took no follow-up courses in biology at all. They seemed to discover that biology was not for them. Of the preparatory students who passed the follow-up biology courses (52 students), about half of these students were not required to enroll in a biology preparatory course at all. They may have enrolled because they felt they needed some extra help, or a refresher course before entering the mainstream courses in biology.

Discussion

The initial problem stated earlier, asked whether the biology preparatory course was preparing students who showed deficiencies in

essential skills so that they may proceed into more difficult and demanding biology classes. The findings illustrate that only a small group of the initial population succeeded. With this group, the biology preparatory course might have contributed to their preparation for the follow-up biology classes.

In order to enhance success (as measured by course grades) in biology courses, biology educators should realize that a strong analytical background in students seems to be indicated. It may be that students ought to take all their remedial or preliminary mathematics courses before enrolling in biology classes. Even though the biology preparatory course itself entailed a great deal of analytical reasoning, the course seemed unable to bring many up to par in required skills. There are many academic short-comings which students have accumulated over many years. Perhaps a mastery learning type of approach could be adopted to enhance skill development. This technique seems to work well with underprepared students.

In addition, fresh approaches to teaching preparatory biology courses may have to be attempted in the future to help poorly prepared students. The supplementary diagnostic prescription technique employed by Yeany, et al. (1981) might be applicable. A more flexible, modular approach to teaching biology on all levels might be indicated. The ultimate goal of the educator is obviously the success of their students despite their possible initial handicaps.

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