Epsilon School: Our Solution

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01

Introduction

Problem

The student body of the Epsilon School of Mathematics and Science will increase from 490 to 630 for the 2024-2025 school year.

Next year, the incoming sophomore class will have 140 more students than the graduating senior class.

To accommodate this increase, 7 additional faculty will be hired. Which subjects will get new faculty and how is this fair?

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Assumptions

Our Assumptions

- All art and music courses are electives and therefore optional
- 2 of the current foreign language teachers teach both Spanish and French, and the last one teaches only German
- English is required for each grade
- All classes are taken daily
- Class difficulty level is determined by grade level, and this does not affect the number of classes needed
- The ratios for students in each subject are the same for the incoming class

Our Assumptions (cont)

- The dropouts happen in 11th grade at a rate of 5%
- The original data does not include the dropouts
- New students only join in the 10th grade, they don’t join after that in the middle of high school.
- Each school day has 6 periods and teachers are required to teach 5 periods (the last period is a prep period for teachers)
- The art classroom is a large space, so one art teacher can accommodate a large amount of students

03

Process

Our Process

Class Sizes

We calculated the class sizes of the current and future classes

Rate of Students

We calculated the rate of students taking each subject per grade

Student:Teacher Ratio

We calculated the student to teacher ratio

Given Data

Subject	10th	11th	12th	Total	Current Teachers
Art	31	33	35	99	1
Biology	198	95	26	319	4
Chemistry	59	126	109	294	3
English	183	155	152	490	5
French	41	32	49	122	2 comb.
German	19	22	10	51	1 comb.
Spanish	51	26	33	110	2 comb.
Mathematics	184	201	262	647	6
Music	50	56	49	155	1
Physics	50	58	183	291	3
Social Studies	183	131	59	373	5

The 3 language teachers are split among the 3 languages: 2 of the teachers teach Spanish and French, while the last one teaches only German.

Number of Students per Subject

Subject	10th	11th	12th	Total	Current Teachers
Art	31	33	35	99	1
Biology	198	95	26	319	4
Chemistry	59	126	109	294	3
English	183	155	152	490	5
French	41	32	49	122	2 comb.
German	19	22	10	51	1 comb.
Spanish	51	26	33	110	2 comb.
Mathematics	184	201	262	647	6
Music	50	56	49	155	1
Physics	50	58	183	291	3
Social Studies	183	131	59	373	5

Since it is given that the total number of current students is 490 people and our assumption is that everyone takes one english course, the number of students taking English for each grade would indicate class sizes.

Grade	10th	11th	12th	Total
CurrentTotal	183	155	152	490

Incoming Class

- As mentioned in the assignment, the size of the incoming sophomore class is equal to the size of the graduating senior class, but next year there will be 140 more students in total
- Drop out rate is 5%: 155*0.05 = around 8 students dropping out
- The sophomore class for 2024-2025 should have 152+140+8 = 300 students
- We added the 8 dropouts to the incoming sophomores because if we didn’t, the total number of students would keep going down.

Grade	***10th***	***11th***	***12th***	***Total***
Class Sizes	183	155	152	490
Next Year	300	183	147	630

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Rate of Students per Subject

The rate of students per subject was found for each separate grade by **dividing the total number of students** in the grade by the **number of students taking classes** in a subject for the current class, which we assumed was the same for the incoming class. This rate was then used to find the number of students taking each subject per grade in the next year.

Subject	RateOfStuPerClass	Incoming10th	RateOfStuPerClass	Incoming11th	RateOfStuPerClass	Incoming12th
Art	0.1694	51	0.212903226	39	0.230263158	34
Biology	1.082	325	0.612903226	112	0.171052632	25
Chemistry	0.3224	97	0.812903226	149	0.717105263	105
English	1	300	1	183	1	147
French	0.224	67	0.206451613	38	0.322368421	47
German	0.1038	31	0.141935484	26	0.065789474	10
Spanish	0.278688525	84	0.167741935	31	0.217105263	32
Mathematics	1.005464481	302	1.296774194	237	1.723684211	253
Music	0.2732	82	0.361290323	66	0.322368421	47
Physics	0.2732	82	0.374193548	68	1.203947368	177
Social Studies	1	300	0.84516129	155	0.388157895	57

Incoming Students per Subject

Subject	Incoming10th	Incoming11th	Incoming12th	Total
Art	51	39	34	124
Biology	325	112	25	462
Chemistry	97	149	105	351
English	300	183	147	630
French	67	38	47	152
German	31	26	10	67
Spanish	84	31	323	438
Mathematics	302	237	253	792
Music	82	66	47	195
Physics	82	68	177	327
Social Studies	300	155	57	512

Using the rates of students per subject, we found the number of students in each grade taking a subject. Then, we added up the number of students taking a subject to get the total number of students in each subject for the next year.

Student:Teacher Ratio

Subject	#of Students per teacher
Art	124
Biology	115.5
Chemistry	117
English	126
French	76
German	67
Spanish	73.5
Math	132
Music	195
Physics	109
Social Studies	102.4

- Found by dividing the total number of enrollments by the total number of teachers teaching the subject.
- We tried to even out the number of students per teacher so that each teacher teaches around the same number of students.

For example: Each math teacher teaches 132 students per day while the German teacher teaches 67 per day. This isn't fair.

Number of Students Per Class

- The student to teacher ratio is the whole number of students that a teacher teaches throughout their 5 classes per day.
- To get the number of students in each class we divided the student:teacher ratio by the number of classes that the teachers teach in a day.
- We rounded the class sizes up because you cannot have a fraction of a student, and rounding up avoids underestimation of the number of students.

Subject	#of Students per teacher	Class Sizes	Rounded Class sizes
Art	124	24.8	25
Biology	115.5	23.1	24
Chemistry	117	23.4	24
English	126	25.2	25
French	76	15.2	16
German	67	13.4	14
Spanish	73.5	14.7	15
Math	132	26.4	27
Music	195	39	39
Physics	109	21.8	22
Social Studies	102.4	20.48	21

New Teacher Allotment

Below are the subjects we decided to add teachers to

1. Music - 1
2. Math - 2
3. English - 1
4. Biology - 1
5. Chemistry - 1
6. Physics - 1

Subject	#of Students per teacher	Class Sizes	Rounded Class sizes
Art	124	24.8	25
Biology	115.5	23.1	24
Chemistry	117	23.4	24
English	126	25.2	25
French	76	15.2	16
German	67	13.4	14
Spanish	73.5	14.7	15
Math	132	26.4	27
Music	195	39	39
Physics	109	21.8	22
Social Studies	102.4	20.48	21

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Conclusion

Is this fair?

Criteria for evaluating fairness:

- Evens out the number of students per class
- Gives priority to required classes

Subject	Number of New teachers
Music	1
Math	2
Biology	1
English	1
Chemistry	1
Physics	1

Is this fair?

This distribution of teachers is fair because it gives teachers to subjects with the highest average class sizes. The music classes are still larger than some, but because it is an elective, we allowed it to have a larger class size because it is optional and is less challenging than core subjects. This reasoning also applies to art classes.

Subject	Number of New teachers
Music	1
Math	2
Biology	1
English	1
Chemistry	1
Physics	1

Future Work

Incorporate a way to predict the amount of teachers needed for each subject based on different interest each year

Comparing the model to what actually happened in the school and see how accurate our model is

Adding new teachers if required based on the state of the school a few year later

We didn’t give a teacher to Art, so we would reevaluate the necessity of an art teacher

Acknowledgements

Ms. Burns!

Thank you!

Any questions?