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Connecting Industry to Mathematics Instruction
NSF ATE Award # 1954291

Virus Growth and Vaccine Production
Student Activity Sheet

In partnership with

WAKE TECH

WAKE COUNTY PUBLIC SCHOOL SYSTEM

WakeEd PARTNERSHIP

Task

1. Below are four sets of data showing virus yield for a potential COVID-19 vaccine at various temperatures after a 24-hour period using different growth media. Determine the function (linear or quadratic) that best models each set of data and determine ideal conditions under which to grow the virus for each growth medium in order to maximize virus yield.

Media A		Media B	
Temperature (°C)	Yield $(\mu g/mL)$	Temperature (°C)	Yield $(\mu g/mL)$
32	16.9	29	6.2
29	7.6	35	29.5
34	13	32	19.9
35	8	35	30.1
36	1.3	36	33.6
32	16.6	33	23.2
35	8.1	34	28.4
36	1.8	30	11.3
33	15	32	20.1
34	13.1	36	33.4
36	1.7	31	17.2
32	16.8	29	8.3

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Media C		Media D	
Temperature (°C)	Yield $(\mu g/mL)$	Temperature (°C)	Yield $(\mu g/mL)$
29	7.5	33	16
32	19.9	31	15.7
33	25.3	30	12.7
34	27.5	30	12.6
36	34.3	34	13
35	32.8	33	15.9
30	13.7	29	7.2
32	18.7	30	11.9
33	24	32	16.6
31	18.3	35	8.4
34	26.3	31	15.6
30	12.4	29	7.4

2. Consider the following information:
    - All mixtures above contain 100mL of solution.
    - The incubator costs $250 per 24-hour period to operate at 25°C.
    - It costs $120 per additional degree above 25°C to operate the incubator for a 24-hour period.
    - The costs of growth media are:
        - $100 for A
        - $700 for B
        - $1,000 for C
        - $350 for D
    - Make a recommendation to Dr. Ramirez about which media to use and at which temperature to grow the virus. (***Do not make temperature recommendations outside of the range of temperatures analyzed.***) Provide an analysis and proper justification for your recommendation.

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Task 2

1. The seroprotections for two flu vaccines are being compared to the seroprotection of the current vaccine being manufactured. The data collected from studies of these vaccines are summarized below. Create a 95% confidence interval of proportion for seroprotection for each vaccine.

	Current Vaccine	New Vaccine A	New Vaccine B
Sample Size	80	135	110
Subjects Showing Seroprotection	72	123	80

2. Make a recommendation to Dr. Ramirez about which vaccine Seqirus should manufacture (the old one or one of the new ones). Provide proper justification for your recommendation.

Extension

Seqirus produces a flu vaccine that requires 35 μg of the virus per vaccine. Consider that an alternative to this vaccine is being sold by a competitor at a price of $33 per vaccine. Using the information from #1 and #2, determine conditions under which Seqirus can produce a vaccine to be sold at a cost lower than the competitor's while still maintaining a profit margin of 30%. Make a recommendation to Dr. Ramirez on how Seqirus can pursue producing that vaccine given the profit requirements.