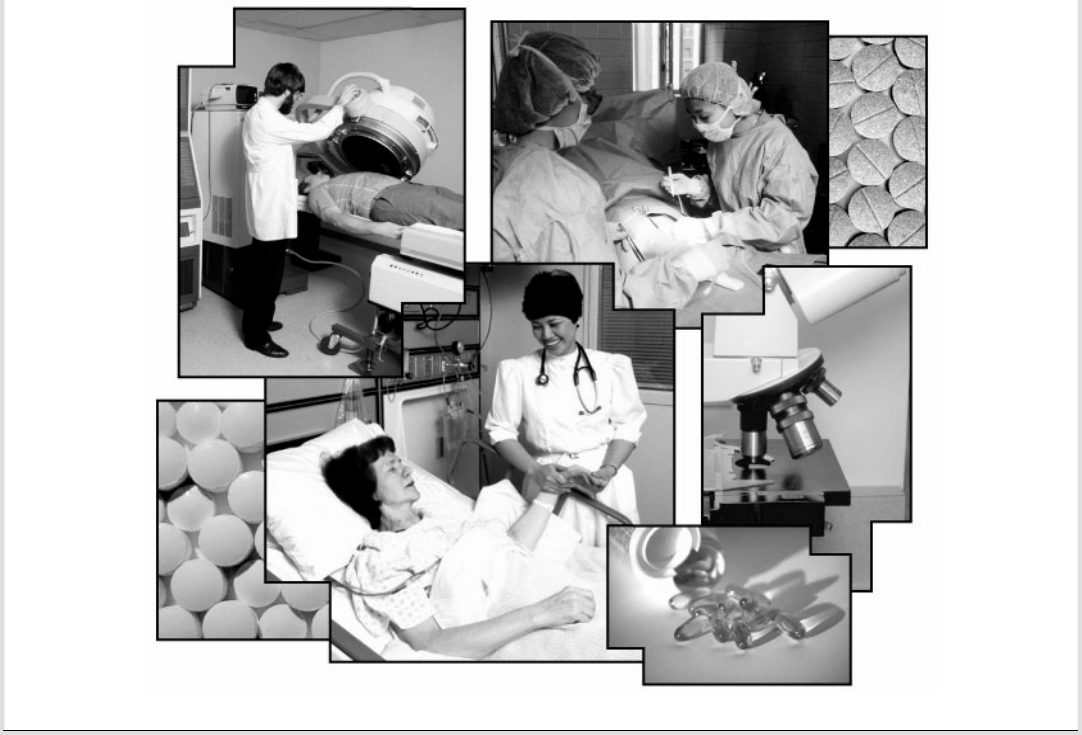
Applied Mathematics 30

Teacher Notes: Medical Mathematics

Case Study: Huntington Disease



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Introduction

This project relates to Huntington disease and allows students to use their knowledge from the Statistics and Probability unit; the Cyclic, Recursive, and Fractal Patterns unit; and the Finance and Spreadsheet unit. The project is designed to be completed in three to five hours of student time. The use of this project is optional; however, you may choose to use it as part of your assessment. A hard copy will be mailed to your school in August 2005. Sample solutions can be found on the Alberta Education extranet (https://phoenix.edc.gov.ab.ca). The general scoring guide for the project is the same as the one issued in September 2000.

One of the written-response questions worth 10% on the Applied Mathematics 30 January 2006 diploma examination will be related to this project. Students who do not complete the project but who have completed the course will have the knowledge to answer the written-response question; however, students who have completed the project will gain experience with the related mathematical skills.

Specific Notes

Teachers may want to

- encourage students to investigate further how missing doses at various times, or not finishing all the prescribed medicine, will affect the levelling off of the medication

- provide students with the following spreadsheet template for part B

	A	B	C	D	E
1	**Huntington Disease Medication**				
2	Initial daily dosage for first week		50	mg	
3	Weekly dosage increase		50	mg	
4	Maximum daily dosage		200	mg	
5	Percentage excreted		40%		
6	**Time (days)**	**Mass Excreted (mg)**	**Residual Mass (mg)**	**Dosage (mg)**	**Total Mass in the Body (mg)**
7	**Week 1**				
8	For week 1 the daily dosage is		50		
9	1	0	0	50	50
10	2				
11	3				

- tell students to round the spreadsheet cell values in part B to the nearest whole number

Program of Studies

The project relates to mathematics learned in the following units of Applied Mathematics 30.

Cyclic, Recursive, and Fractal Patterns

Specific Outcome 4.4: Use technology to generate and graph sequences that model real-life phenomena. [PS, T, V]

Statistics and Probability

Specific Outcomes 2.3: Use the normal approximation to the binomial distribution to solve problems involving confidence intervals for large-sample binomial experiments. [CN, E, PS, T]

2.4: Construct a sample space for two or three events. [PS, R, V]

2.5: Classify events as independent or dependent. [C]

2.6: Use expressions for $P(A \text{ and } B)$ to solve problems involving independent and dependent events. [CN, PS, R]

2.7: Solve problems using the probabilities of mutually exclusive and complementary events. [CN, PS, R]

Finance and Spreadsheets

Specific Outcome 3.1: Design a financial spreadsheet template to allow users to input their own variables. [C, PS, T]

Mathematical Processes

The seven mathematical processes identified in the *Program of Studies* are addressed in this project in the following manner.

Communication	Prepare a pamphlet to present findings and recommendations.
Connections	Relate mathematics to real-world situations, and connect different units within Applied Mathematics 30.
Estimation and Mental Mathematics	Check reasonableness of probability in a Punnett square. Estimate the amount of medication in the body when a dosage is missed.
Problem Solving	Construct a sample space to determine the probability of getting Huntington disease. Construct a spreadsheet to determine the buildup and excretion of medication in the body.
Reasoning	Determine a logical manner in which to determine the probability of getting Huntington disease. Determine a logical manner in which to find the length of time required for medication to leave the body.
Technology	Use a spreadsheet and/or a graphing calculator to solve and display problems.
Visualization	Use a Punnett square to visualize the probability of inheriting Huntington disease.

ICT Program of Studies

C.1—Students will access, use and communicate information from a variety of technologies.

Specific Outcome	4.2:	Select information from appropriate sources, including primary and secondary sources.

C.3—Students will critically assess information accessed through the use of a variety of technologies.

Specific Outcome	4.1:	Assess the authority, reliability and validity of electronically accessed information.

C.6—Students will use technology to investigate and/or solve problems.

Specific Outcomes	4.1:	Investigate and solve problems of prediction, calculation and inference.
	4.2:	Investigate and solve problems of organization and manipulation of information.
	4.3:	Manipulate data by using charting and graphing technologies in order to test inferences and probabilities.
	4.4:	Generate new understandings of problematic situations by using some form of technology to facilitate the process.

F.1—Students will demonstrate an understanding of the nature of technology.

Specific Outcome	4.2:	Solve mathematical and scientific problems by selecting appropriate technology to perform calculations and experiments.

F.2—Students will understand the role of technology as it applies to self, work and society.

Specific Outcome	4.7:	Use current, reliable information sources from around the world.

P.2—Students will organize and manipulate data.

Specific Outcome	4.1:	Manipulate and present data through the selection of appropriate tools, such as scientific instrumentation, calculators, databases and/or spreadsheets.

Terminology

Alleles — Alternative forms of a gene; e.g., the black gene (*B*) and the white gene (*b*) are two alleles for fur colour

Dominant gene — The gene that is always expressed when it is present; e.g., if the black gene (*B*) is present, fur colour is black

Heterozygous — Having two different alleles of a gene; e.g., *Bb*

Homozygous — Having two identical alleles of a gene; e.g., *BB* or *bb*

Mutated gene — A gene that has undergone a significant change

Punnett square — A diagram used to show the result of random fertilization in genetic crosses; e.g., *Bb* x *Bb*

	B	*b*
B	*BB*	*Bb*
b	*Bb*	*bb*

Recessive gene — A gene that is masked by the presence of a dominant gene and is only expressed when two copies are present; e.g., the gene for white fur is only expressed in the homozygous genotype (*bb*)