

Patterns of Inheritance Summative Assessment Teacher Rubric

1. The genetic counselor recommended that the entire family be tested for Tay Sachs.
What does the counselor want to learn given that the brothers and sister are over the age of 5 and are healthy?

This item measures a student's understanding of the concept of being asymptomatic and a carrier/heterozygous for a recessive gene for a genetic disorder.

Criterion for a Correct Response:

1. Students respond by indicating that siblings may be carriers for the disease.

Code	Response
	<i>Complete Response</i>
10	Indicates that siblings may be carriers for the disease.
11	Indicates that siblings may be heterozygous for the disease.
19	Any other correct response.
	<i>Incorrect Response</i>
70	No mention of criteria.
71	Indicates that siblings may get the disease later.
72	Indicates infectious nature of the disease.
76	Repeats the stem of the question.
79	Any other incorrect response.
	<i>Non-Response</i>
90	Crossed out, erased, illegible, or impossible to interpret.
99	Blank.

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| <p>2. The genetic screening for Tay Sachs provided the evidence in Figures 1 and 2.</p> <p>a. Circle the specific mutation in the DNA sequence (Figure 1) that is responsible for Sarah’s disorder.</p> |
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This item measures a student’s ability to identify a mutation in a nucleotide sequence.

Criterion for a Correct Response:

- Students respond by circling the seventh base on Sarah’s first and second allele.

Code	Response
	<i>Complete Response</i>
20	Meets the criterion.
29	Any other correct response.
	<i>Partially Correct Response</i>
10	Meets the criterion but only circles one mutation.
19	Any other partially correct response.
	<i>Incorrect Response</i>
70	No mention of criterion.
71	Circles the incorrect bases.
76	Repeats the stem of the question.
79	Any other incorrect response.
	<i>Non-Response</i>
90	Crossed out, erased, illegible, or impossible to interpret.
99	Blank.

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| <p>2. The genetic screening for Tay Sachs provided the evidence in Figures 1 and 2.</p> <p>b. Identify the autosomal pattern of inheritance in which Tay Sachs is passed from one generation to the next using the evidence in Figures 1 and 2.</p> |
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This item measures a student’s ability to recognize varying patterns of inheritance.

Criterion for a Correct Response:

1. Students identify that it is a recessive pattern of inheritance.

Code	Response
	<i>Complete Response</i>
10	Meets the criterion by identifying a recessive pattern of inheritance.
19	Any other complete response.
	<i>Incorrect Response</i>
70	No mention of criterion (e.g., “it’s genetic”).
71	Indicates sex chromosomes.
72	Indicates dominant pattern of inheritance.
76	Repeats the questions or some other response already given.
79	Any other incorrect response.
	<i>Non Response</i>
90	Crossed out, erased, illegible, or impossible to interpret.
99	Blank.

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| 3. Identify both Mom and Dad’s genotypes based on the information provided in Figures 1 and 2 and in the family history. |
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This item measures a student’s ability to analyze a pedigree and make identify genotypes.

Criterion for a Correct Response:

1. Student responses must indicate that both parents must be carriers or are heterozygous for the Tay Sachs mutation.

Code	Response
	<i>Complete Response</i>
10	Both parents are heterozygous.
11	Both parents are carriers.
19	Any other correct response.
	<i>Incorrect Response</i>
70	Provides an inappropriate two-letter genotype.
71	Indicates sex chromosomes.
72	Provides phenotypic response.
73	Provides DNA or RNA sequence.
79	Any other incorrect response.
	<i>Non-Response</i>
90	Crossed out, erased, illegible, or impossible to interpret.
99	Blank.

4. Investigate how Sarah’s DNA sequence resulted in the absence of the protein necessary to break down fatty substances in the brain by using Figure 1.
- a. In the process of transcription, DNA is copied into mRNA.
 Identify the messenger RNA strand that is transcribed from Sarah’s DNA sequence.
 Identify the messenger RNA strand that is transcribed from Jennifer’s DNA sequence.

This item is intended to measure the student’s ability to transcribe DNA into mRNA.

Criteria for a Correct Response:

Student’s response must include:

1. Sarah’s mRNA would be UCUGAUAGU.
2. Jennifer’s mRNA would be UCUGAUGGU.

Code	Response
	<i>Complete Response</i>
20	Meets the criteria.
29	Any other complete response.
	<i>Partially Complete Response</i>
10	Meets one criterion (one sequence is correct).
11	Meets criteria except does not replace Thymine with Uracil.
19	Any other partially correct response.
	<i>Incorrect Response</i>
70	No mention of criteria (both sequences are incorrect).
71	Copies DNA strand and replaces Thymine with Uracil.
76	Repeats the stem of the question.
79	Any other incorrect response.
	<i>Non-Response</i>
90	Crossed out, erased, illegible, or impossible to interpret.
99	Blank.

4. Investigate how Sarah’s DNA sequence resulted in the absence of the protein necessary to break down fatty substances in the brain by using Figure 1.
- b. Referring to Figure 3, explain how Sarah’s DNA sequence results in her inability to break down fatty substances in the brain (Tay Sachs disorder).

This item is intended to measure a student’s understanding of the Central Dogma of Molecular Biology (DNA → mRNA → amino acid → protein).

Criteria for a Correct Response

Student’s response must include:

1. Different nucleotide sequence results in a change in the amino acid.
2. Different amino acid results in a change in the protein.
3. Different protein is unable to carry out its intended function.

Code	Response
	<i>Complete Response</i>
20	Includes all three criteria in the correct sequence.
21	Meets the criteria and mentions change in mRNA.
29	Any other complete response.
	<i>Partially Complete Response</i>
10	Includes two criteria in the correct sequence.
11	Includes one criterion and mentions mRNA in the correct sequence.
19	Any other partially correct response.
	<i>Incorrect Response</i>
70	No mention of criteria.
76	Repeats the stem of the question.
79	Any other incorrect response.
	<i>Non-Response</i>
90	Crossed out, erased, illegible, or impossible to interpret.
99	Blank.

5. Years later, Michael (Sarah’s oldest brother) and his new bride, Rebecca, began to plan for a family. Rebecca was tested for the presence of the Tay Sachs mutation because of Michael’s family history.
- a. Predict the probability of each genotype and phenotype in the offspring if Rebecca IS carrying a mutation for Tay Sachs.

This item is intended to measure a student’s ability to predict the probability of a genetic disorder in offspring.

Criteria for a Correct Response:

Students’ response must include:

1. Complete genotype of 25% homozygous dominant (ie.TT), 50% heterozygous/carrier for Tay Sachs (Tt), and 25% homozygous recessive (tt).
2. Complete phenotype of 75% healthy and 25% with Tay Sachs.

Students may, but are not required to, use any letter to represent the allele for Tay Sachs and normal. Students may also use percentages, ratios, or fractions to represent probability.

Code	Response
	<i>Complete Response</i>
20	Includes both criteria.
29	Any other complete response.
	<i>Partially Complete Response</i>
10	Meets the genotype criteria but not the phenotype.
11	Meets the phenotype criteria but not the genotype.
19	Any other partially correct response.
	<i>Incorrect Response</i>
70	No mention of criteria.
71	Uses inappropriate symbols for alleles—i.e., Nt.
73	Incorrect probabilities.
76	Repeats the stem of the question.
79	Any other incorrect response.
	<i>Non-Response</i>
90	Crossed out, erased, illegible, or impossible to interpret.
99	Blank.

5. Years later Michael and his new bride, Rebecca, begin to plan for a family. Due to Michael's family history they went to a genetic counselor for Rebecca to be tested for Tay Sachs Disease.
- b. Predict the probability of each genotype and phenotype in the offspring if Rebecca IS NOT carrying a mutation for Tay Sachs.

This item is intended to measure a student's ability to predict the probability of a genetic disorder in offspring.

Criterion for a Correct Response:

Students' response must include

1. Complete genotype of 50% homozygous dominant (ie.TT), 50% heterozygous/carrier for Tay Sachs (Tt), and 0% homozygous recessive (tt).
2. Complete phenotype of 100% healthy and 0% with Tay Sachs.

Students may, but are not required to, use any letter to represent the allele for Tay Sachs and normal. Students may also use percentages, ratios, or fractions to represent probability.

Code	Response
	<i>Complete Response</i>
20	Includes both criteria.
29	Any other complete response.
	<i>Partially Complete Response</i>
10	Meets the genotype criteria but not the phenotype.
11	Meets the phenotype criteria but not the genotype.
19	Any other partially correct response.
	<i>Incorrect Response</i>
70	No mention of criteria.
71	Uses inappropriate symbols for alleles—i.e., Nt.
73	Incorrect probabilities.
76	Repeats the stem of the question.
79	Any other incorrect response.
	<i>Non-Response</i>
90	Crossed out, erased, illegible, or impossible to interpret.
99	Blank.

6. Using the information in the introduction, explain why Tay Sachs would affect more males than females if it was a sex-linked disorder.

This item measures a student’s understanding of sex-linked inheritance.

Criteria for a Correct Response:

Students’ response must include:

1. The inference that males cannot be carriers of Tay Sachs because they only have one X chromosome and will either be healthy or die before the age of 5 and therefore not pass on the mutation to future generations.
2. Females can carry the Tay Sachs mutated chromosome but would never have the disease since the mutation could only be passed down from the mother.

Code	Response
	<i>Complete Response</i>
20	Includes both criteria in a substantial response.
29	Any other complete response.
	<i>Partially Complete Response</i>
10	Meets one criterion.
19	Any other partially correct response.
	<i>Incorrect Response</i>
70	No mention of any of the criteria.
76	Repeats the stem of the question or some other response already given.
79	Any other incorrect response.
	<i>Non-Response</i>
90	Crossed out, erased, illegible, or impossible to interpret.
99	Blank.