Activity 2.2.5
My, Oh, Meiosis

One division too few, and a chromosome ends up in the wrong cell. Meiosis, nondisjunction, and how to read a karyotype for both number and structure. You work practice cases, then your own patient's.

DATE	PORTAL DAY	LESSON	TURN IN
Wednesday 2026-11-04	**Pedigree and risk CER**	**Lesson 2.2 Decoding a Diagnosis**	**CER**

Where this sits. Single day. Your class calendar calls today Pedigree and risk CER, and the PLTW activity is 2.2.5 My, Oh, Meiosis, which is meiosis, nondisjunction and karyotype analysis. Pedigrees and risk were Activity 2.2.3 on Monday. Search myPLTW for 2.2.5.

01 Why today matters

Yesterday you made a chromosome spread.

Today you find out what makes a spread come out with the wrong number in the first place, then you sort chromosomes into a karyotype and write a formal report on what you find.

02 What you already know

- You can prepare and count a chromosome spread. You know body cells hold 46 in 23 pairs and that mitosis produces two cells with the full 46 each.
- You know what an autosome and a sex chromosome are. Today the second kind of division arrives, and with it the errors that only it can make.

WHAT THIS SHEET WILL NOT TELL YOU

- No patient's karyotype finding is stated on this sheet, and no diagnosis is named. Both come out of your own analysis.

03 Vocabulary

TERM	WHAT IT MEANS, PLAINLY
Meiosis	The division that makes gametes. Two rounds of division from one starting cell, producing four cells that each carry half the chromosome number.
Gamete	An egg or a sperm. Carries 23 chromosomes in humans, one from each pair.
Diploid and haploid	Diploid means the full paired set, 46 in humans. Haploid means one of each pair, 23. Body cells are diploid, gametes haploid.
Meiosis I	The first division. The two members of each pair separate from each other.

Meiosis II	The second division. The sister chromatids of each chromosome separate. No copying happens in between.
Nondisjunction	A failure to separate. It can happen in meiosis I, when a pair fails to split, or in meiosis II, when sister chromatids fail to split. Either way one resulting cell gets an extra copy and another gets none.
Monosomy	A cell with only one copy of a chromosome that should be a pair. One of the numerical findings a report form asks you to check for.
Trisomy	A cell with three copies of a chromosome that should be a pair. The other numerical finding.
Chromosome arm	The centromere splits a chromosome into a shorter arm and a longer arm. Reports name the arm as well as the chromosome number, because where along it matters.
Deletion	A segment of a chromosome lost.
Duplication	A segment copied and inserted next to the original.
Inversion	A segment flipped so it runs the wrong way round relative to the rest.
Insertion	A segment removed from one chromosome and added to a different one.
Translocation	Two chromosomes swapping segments with each other.
Resolution	The size of change a method can see. A karyotype resolves whole chromosomes and large segments. It cannot see a single changed base, which is why sequencing exists as a separate test.
Cytogenetics report	The formal document recording chromosome count, sex, findings by category, the diagnosis and the notes for the caregiver.

Every term on this list is flagged for the illustrated glossary, scoped to this activity only. Terms are not shared forward or backward between activities, because a definition from a later activity can hand you an answer you were supposed to derive.

04 How to do the work

Meiosis first, then practice cases, then your patient. Do not jump to the patient's karyotype. The practice cases exist so that you have seen a normal result and both kinds of abnormal result before you look at one that matters.

1. Review mitosis, then sketch a four-chromosome cell through every stage of meiosis. Label the stages. Two full divisions, four cells at the end.
2. Write down three or more ways meiosis differs from mitosis. Number of divisions, number of cells produced, and chromosome number in each product are the three that matter most.
3. Answer in writing: why must a gamete carry half the chromosome number, and what would happen at fertilization if it did not?
4. Add nondisjunction to your meiosis drawing. Show it once in the first division and once in the second. The products of the two are not the same, so draw both and count what ends up in each cell.
5. Write the consequence in one sentence: if a gamete with an extra or a missing chromosome takes part in fertilization, what happens to the chromosome number in every body cell of the person who results?
6. Learn the two numerical findings, one copy where there should be two and three copies where there should be two, and the five structural findings: a segment lost, a segment doubled, a segment flipped, a segment moved to a different chromosome, and two chromosomes swapping segments. Sketch each of the five.
7. Answer this before you touch a board: which is easier to spot on a karyotype, a change in number or a change in structure? Say why, and say what you would need to see the harder one.

8. Get a practice case. Check the chromosome color matches the board color before you start; a mismatched set will produce a confident wrong answer.
9. Read the case notes printed on the board and copy the relevant details onto a blank report form.
10. Sort the chromosomes onto the board by size, largest first, sex chromosomes last. One of each pair is already printed on the board, so you are matching against it.
11. Analyze the completed karyotype. Count the total. Determine the sex. Then work through the findings categories one at a time rather than looking for something to jump out.
12. Complete the report: total number, sex, findings by category with chromosome number and arm where the form asks for it, then research the finding and complete the diagnosis section.
13. Display your board and findings. Then walk the room. You need to have seen, with your own eyes, a karyotype with no findings, one with a number change and one with a structural change. If you have not seen all three, keep walking.
14. Return every chromosome to the right side of the board and check around your seat before you leave the station.
15. Now your own patient. Get a blank report form. Analyze the karyotype for both number and structure, complete every section of the form, then research the finding alongside the symptoms in her record.
16. Write the caregiver notes: what life looks like, possible complications, treatments available, and support services. Under one page. The limit is the exercise.
17. Compare your report and recommendations with a partner and reconcile any differences by going back to the karyotype.

MATERIALS

- Chromosome sorting board and the matching chromosome set
- Blank cytogenetics report forms, one per case
- Lab notebook and colored pencils

WHAT A KARYOTYPE CAN AND CANNOT SEE

- It can see a whole chromosome that is present once or three times instead of twice.
- It can see a segment that has been lost, doubled, flipped, moved to another chromosome, or swapped between two, provided the segment is large enough to change the banding pattern visibly.
- It cannot see a single changed base, or a change involving a handful of bases. Those need sequencing, which is a completely different test asking a completely different question.
- So a normal karyotype does not mean no genetic condition. It means no condition of the kind this method can detect. Write that sentence into your report when it applies; it is the difference between a finding and an absence of evidence.

THE ETHICAL QUESTION ATTACHED TO TODAY'S REPORT

- You are about to write caregiver notes about a young child, for a parent, that will shape how a family understands their daughter for years.
- Should a doctor ever hold information back from a patient or a family to keep their spirits up? What if a family member asks you to?
- Take a position. Then notice what the one page limit on the caregiver notes is doing: it is not asking you to hide anything, it is asking you to decide what a frightened parent can actually absorb in one sitting, and to plan when the rest gets said.

05 Where students get stuck

- Mixing up the chromosome counts. Mitosis: one cell of 46 becomes two cells of 46. Meiosis: one cell of 46 becomes four cells of 23. Write both on your page before you start drawing and check every stage against them.
- Thinking DNA is copied again between the two meiotic divisions. It is not. That single fact is why the second division halves the number rather than maintaining it, and it is the most common misconception in this activity.
- Treating nondisjunction as one thing. It is two, and they produce different sets of gametes. In the first division a whole pair fails to separate. In the second, sister chromatids fail. Draw both, count the products of both, and note that the resulting mixes are not the same.
- Reading monosomy and trisomy as diagnoses. They are counts. One copy or three where there should be two. Which chromosome it happened to, and what that chromosome carries, is what turns a count into a condition, and that takes research.
- Sorting by length alone. Length gets you close. The banding pattern and the position of the centromere are what confirm a match, and a structural change is invisible if you are only comparing lengths. Look at the stripes.
- Looking at the patient's karyotype first. The practice cases exist so you have already seen what normal looks like. If your first karyotype is one that matters, you have nothing to compare it against and you will see whatever you were expecting.
- Concluding no condition from a normal karyotype. The method resolves whole chromosomes and large segments and nothing smaller. Say what the test ruled out, not what it proved.

06 What you turn in

CER

A completed cytogenetics report for your patient plus a claim, evidence, reasoning response. Claim: your chromosomal finding, stated in the report's own categories. Evidence: the total count, the sex, and what you observed in the specific chromosomes involved, including the arm where the form asks for it. Reasoning: how a finding of this kind arises during meiosis, why the karyotype is the test that could show it, and what a karyotype could not have detected. Attach your meiosis drawings with both kinds of nondisjunction, your practice case report, and your one-page caregiver notes. Add a short paragraph on the disclosure question in the box.

07 Check yourself

- [ ] A gamete carries 24 chromosomes. Name the two points in meiosis where that could have happened, and say what the matching gamete from the same division carries. (Vocabulary, nondisjunction)
- [ ] Why can a karyotype not detect the kind of change you studied last week in the sequencing report? (What a karyotype can and cannot see)
- [ ] You count 46 chromosomes and see nothing unusual in the banding. Write the sentence that goes in the findings section. (What a karyotype can and cannot see)