Activity 5
Drugs and Development

NOTE: This is a 3-part activity (Part A, B and C)

Part A: Is John a drug baby?

Core Concept:
Prenatal drug exposure and many other factors may affect a developing baby.

Class time required:
Approximately 20 minutes.

Teacher Provides:
Copy of student handout entitled "**Is John a drug baby?**" for each student.

Suggested Class Procedure for Part A:

1. Distribute a copy of the student handout entitled "**Is John a drug baby?**" to each student.
2. Read the information in the box at the top of the page aloud.
3. Allow time for students to work individually to answer the two questions.
4. Have students share and discuss their answers to the two questions.

Note: It is important that you discuss the answers to this activity with your students. Students need to understand that there are MANY factors (both prenatal and postnatal) that can result in problems with learning and social interaction. You do not want students concluding that all learning problems are a result of prenatal drug exposure.

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Part B: Do drugs diffuse from a mother to her developing baby?

Core Concept:

Drugs can diffuse from the mother's blood into a developing baby's blood.

Class time required:

Approximately 20-40 minutes.

Teacher Provides:

- Copy of student handout entitled "**Do drugs diffuse from a mother to her developing baby?**" for each student.
- Access to hot tap water. Using hot tap water speeds up the diffusion process.
- Safety goggles for each student
- Kit of lab materials for each team of 2-4 students that includes:
  - Clear 10 oz. plastic cup or small beaker labeled "Placenta"
  - Two pieces of "Serpent Skin" dialysis tubing (purchase from Educational Innovations, www.teachersource.com) – cut one piece 6" long and one piece 8" long
  - Test tube (or cup or beaker) labeled "Mother's Blood Containing FLORATRYP" that contains 15 ml of pH 12 buffer + 1 teaspoon of red glitter to simulate blood cells.
  - Test tube (or cup or beaker) labeled "Baby's Blood" that contains 15 ml of water + 1 teaspoon of red glitter to simulate blood cells.
  - 4 Strips of pH 1-12 test paper (purchase from Microessential Laboratories, www.microessentiallab.com, catalog # 4800). Put the 4 paper strips into a small plastic bag and label the bag "FLORATRYP Test Strips"
  - Forceps (optional for handling the test strips)—If you provide forceps, you will need to explain when students should use them.

NOTE: The diffusion process for the placenta model requires at least 30 minutes for the simulated drug to diffuse out of the mother's blood and into the baby's blood. This lab activity cannot be completed in a single period. Consider the following options:

- Students complete instructions 1 and 2 at the end of one class. Allow the experiment to sit overnight and then complete the activity the next day.
- Students complete instructions 1 and 6 during one class and then complete the activity the next day.
- Teacher sets up the placenta model (in advance) as a demonstration.

Suggested Class Procedure for Part B:

1. Explain to students that this activity is a simulation. FLORATRYP is a fictitious drug name. NO real drugs are used in this activity. In fact, the activity uses a "poisonous" chemical that was selected because the molecules that make up this chemical are similar in size to many drug molecules.

2. Distribute copies of the student handout entitled "**Do drugs diffuse from a mother to her developing baby?**" to each student, if not done so earlier.

3. Read the information in the box aloud to the class. Encourage the students to refer to this information when they are answering questions in the lab instructions.

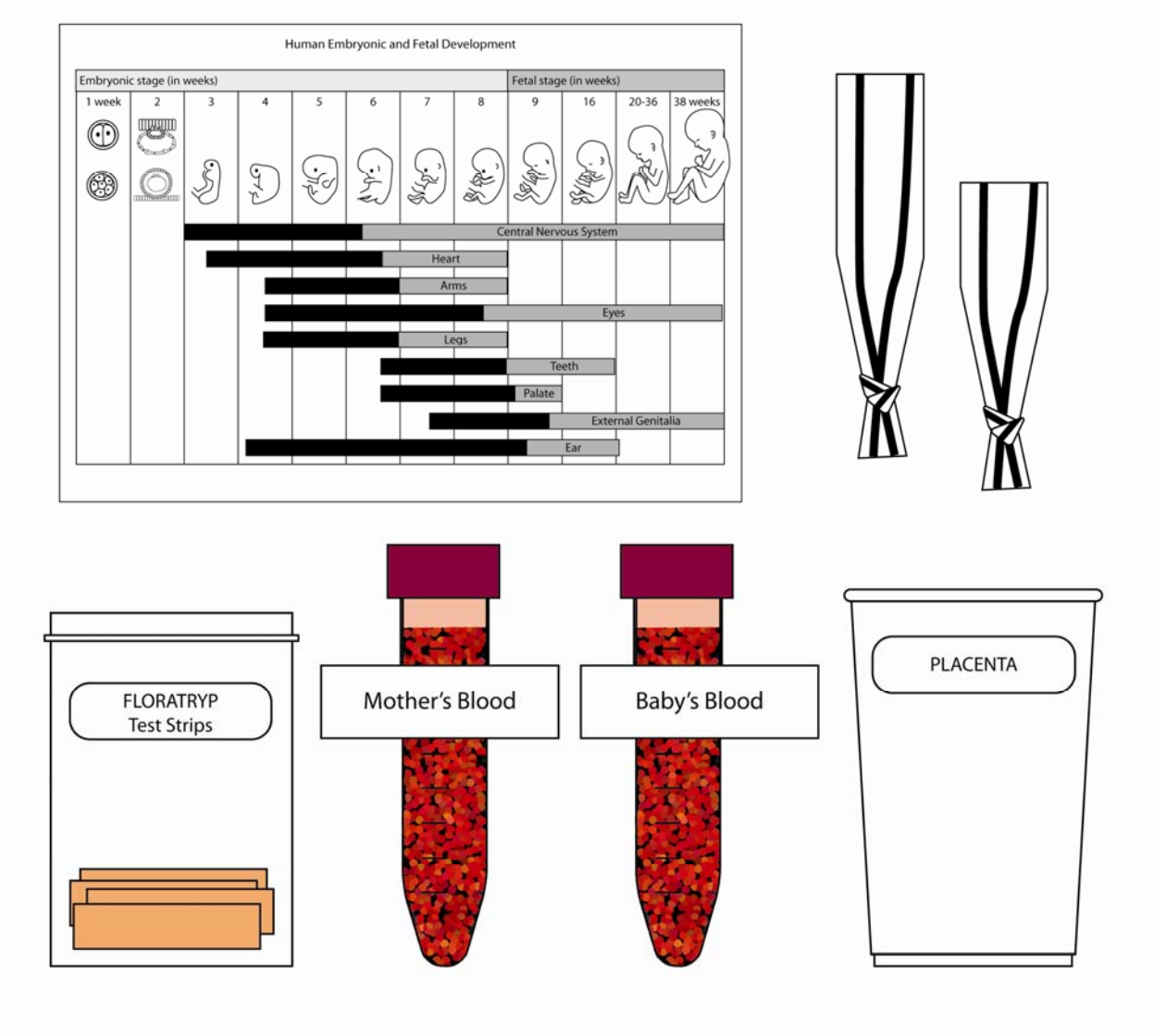
4. Distribute kits and safety goggles to teams of students. Explain that they will use the materials in the kits to determine whether a fake drug, called FLORATRYP, can move from the mother's bloodstream to the baby's blood stream.

5. Provide hot tap water for use in the model.

6. Allow time for students to work in teams to read the instructions and answer the questions.

7. If time permits, have students share and discuss their answers to questions in the activity.

Quick Guide:



Part C: When do drugs affect a developing baby?

Core Concept:

Drugs and other factors can disrupt the development process.

Class time required:

Approximately 20-40 minutes.

Teacher Provides:

- Copy of student handout entitled "**When do drugs affect a developing baby**?" for each student.
- Access to computer lab. If Internet access is not available, provide printed information for Internet sites that provide information on the effects of alcohol, nicotine, and cocaine on prenatal development.

Suggested Class Procedure for Part C:

1. Distribute copies of the student handout entitled "**When do drugs affect a developing baby**?" to each student if not done so earlier.

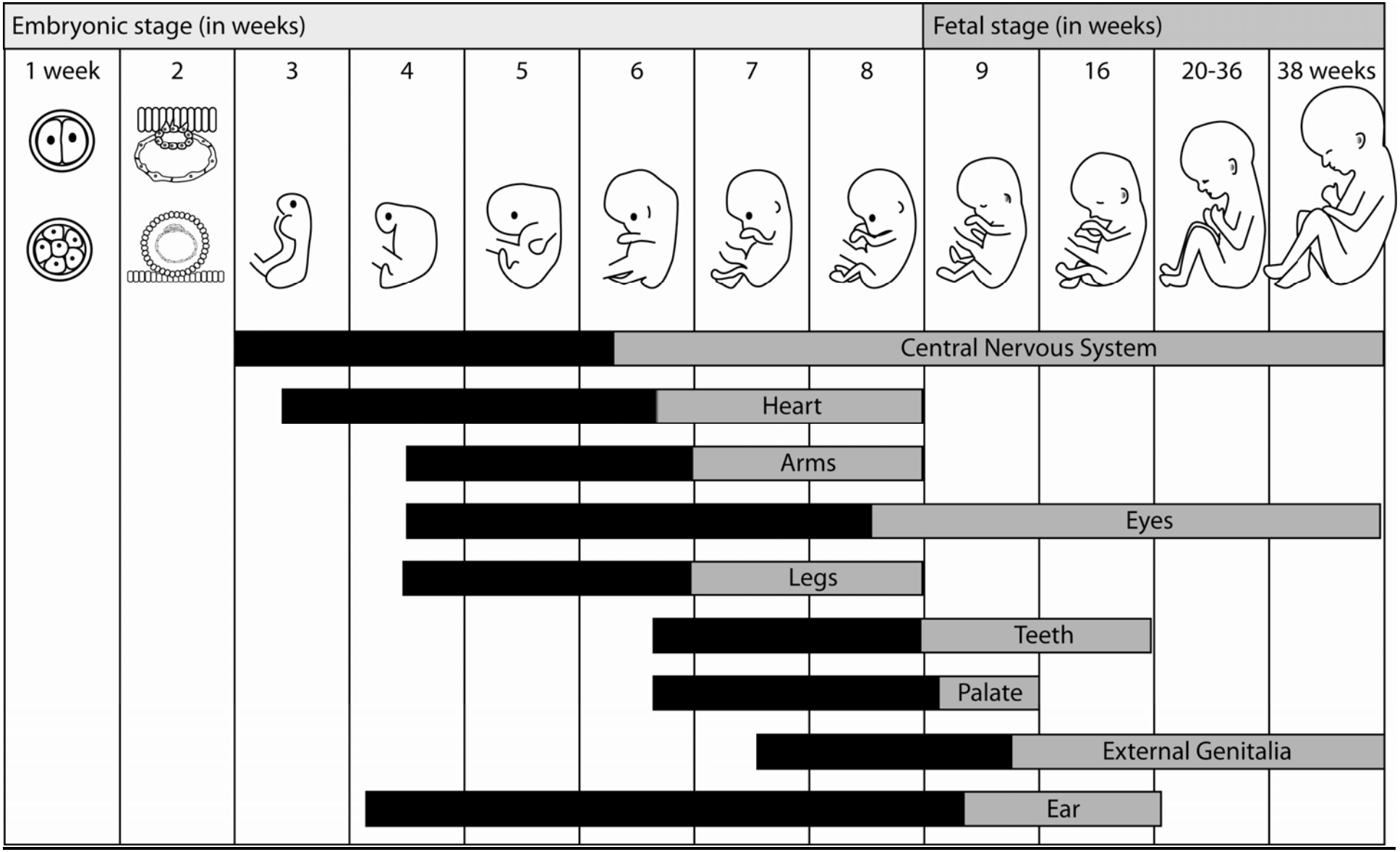
2. Consider also providing an enlarged copy of the graphic on the next page for each team of students.

3. Read the information in the box aloud to the class. Encourage the students to refer to this information and to the chart when they are answering questions in the lab instructions.

4. Ask students to read the instructions and complete the activity. NOTE: Computer access or print copies of information on the effects of alcohol, nicotine, and cocaine will be needed during the activity.

5. If time permits, have students share and discuss their answers to questions in the activity. Include a discussion of other harmful substances, in addition to drugs, that can interfere with normal embryonic or fetal development.

Human Embryonic and Fetal Development



Activity 5
Drugs and Development

Part A: Is John a drug baby?

Is John a Drug Baby?

John was small and weighed 1.8 kilograms (4 pounds) at birth. As a baby, John cried a lot and had difficulty eating and sleeping. His growth and development were slow. He was not as quick as other children to talk or walk or learn new words. When he played, he was not good at picking up blocks or sorting objects.

John's mother had used tobacco, alcohol, and a drug called "FLORATRYP" while she was pregnant. Following John's birth, his mother continued to use FLORATRYP. She also suffered from depression. John's mother found that raising a baby and supporting herself as a single mom was very stressful. There never seemed to be enough money for food and rent. As John was growing up, he had few toys or books. He rarely had a chance to interact with his mother, other adults or other children.

When John began kindergarten, he had trouble learning his letters and writing. He seemed "tuned out" and was easily distracted. He did not interact with his classmates. In elementary school he was diagnosed with learning disabilities. Testing, done by the school psychologist, indicated that John had slightly below normal intelligence.

Some people said that John's problems with learning and social interaction were caused by his mother's use of FLORATRYP during her pregnancy. They called him a "drug baby." But other people said that there could be many other explanations for John's problems.

1. Do you think that John's problems with learning and social interaction were caused by his mother's use of the drug FLORATRYP during her pregnancy? Explain why or why not.

   Student answers may vary. But students should recognize that John's problems with learning and social interactions could be caused by many different things.

2. List at least four other factors (before birth and after birth) that could have led to John's problems with learning and social interaction?

   Student answers will vary but may include: poor nutrition, prenatal alcohol exposure, prenatal nicotine exposure, exposure to other toxicants like lead, inheritance, germ exposure, poor parenting, few toys or books, little contact with others, stressful environment, etc. Encourage students to share their answers.

Part B: Do drugs diffuse from a mother to her developing baby?

Labels on cigarette packs warn that "Smoking by pregnant women may result in fetal injury, premature birth, and low birth weight." Labels on bottles of alcohol warn that "Women should not drink alcohol during pregnancy because of the risk of birth defects." Scientists know that nicotine and alcohol can move from a pregnant woman to her developing baby. They also know that alcohol and nicotine can harm a developing baby.

Does the drug FLORATRYP diffuse from a mother's blood into a developing baby's blood?

In this activity you will make a simple model to answer this question.

(Note: This activity is a simulation that does not use any real drugs.)

1. Before you make your model, use FLORATRYP Test Strips to test the mother's blood and the baby's blood for the presence of drugs.

    - Dip one FLORATRYP Test Strip into the sample of the "mother's blood". Is FLORATRYP present in the mother's blood?

      Yes

    If the FLORATRYP Test Strip turns DARK green or blue, the drug FLORATRYP is present in the blood.

    - Dip one FLORATRYP Test Strip into the sample of the "baby's blood". Is FLORATRYP present in the baby's blood?

      No

2. You will now make a model to see if FLORATRYP can diffuse from the blood of a pregnant mother into the blood of her developing baby. To make your model:

   - Prepare <u>two</u> membrane tubes:
     - Dip one end of each membrane tube into water to soften it.
     - Tie one end of each of the tubes into a knot and pull it tight to close it off.

   - Pour the entire tube of "Baby's Blood" into the <u>shorter</u> tube. The membrane tubing represents the baby's blood vessels.

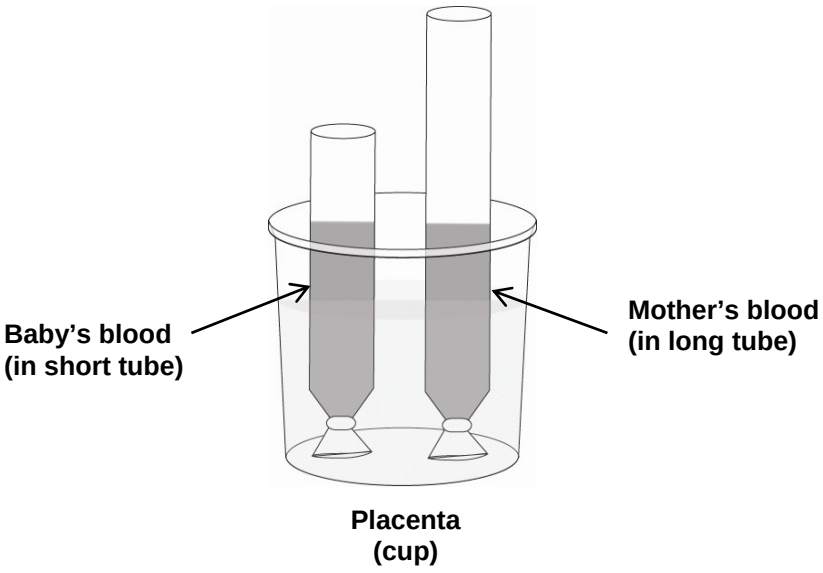
   - Pour the entire tube of "Mother's Blood" into the <u>longer</u> tube. The membrane tubing represents the mother's blood vessels.

   - Fill the cup labeled "Placenta" approximately ½ full of hot tap water.

   - Carefully set the membrane tubes containing the "Baby's Blood" and "Mother's Blood" into the cup labeled "Placenta." See the diagram below.

   - Wait for at least 30 minutes to allow the diffusion process to occur.

     Start time _____ End time _____



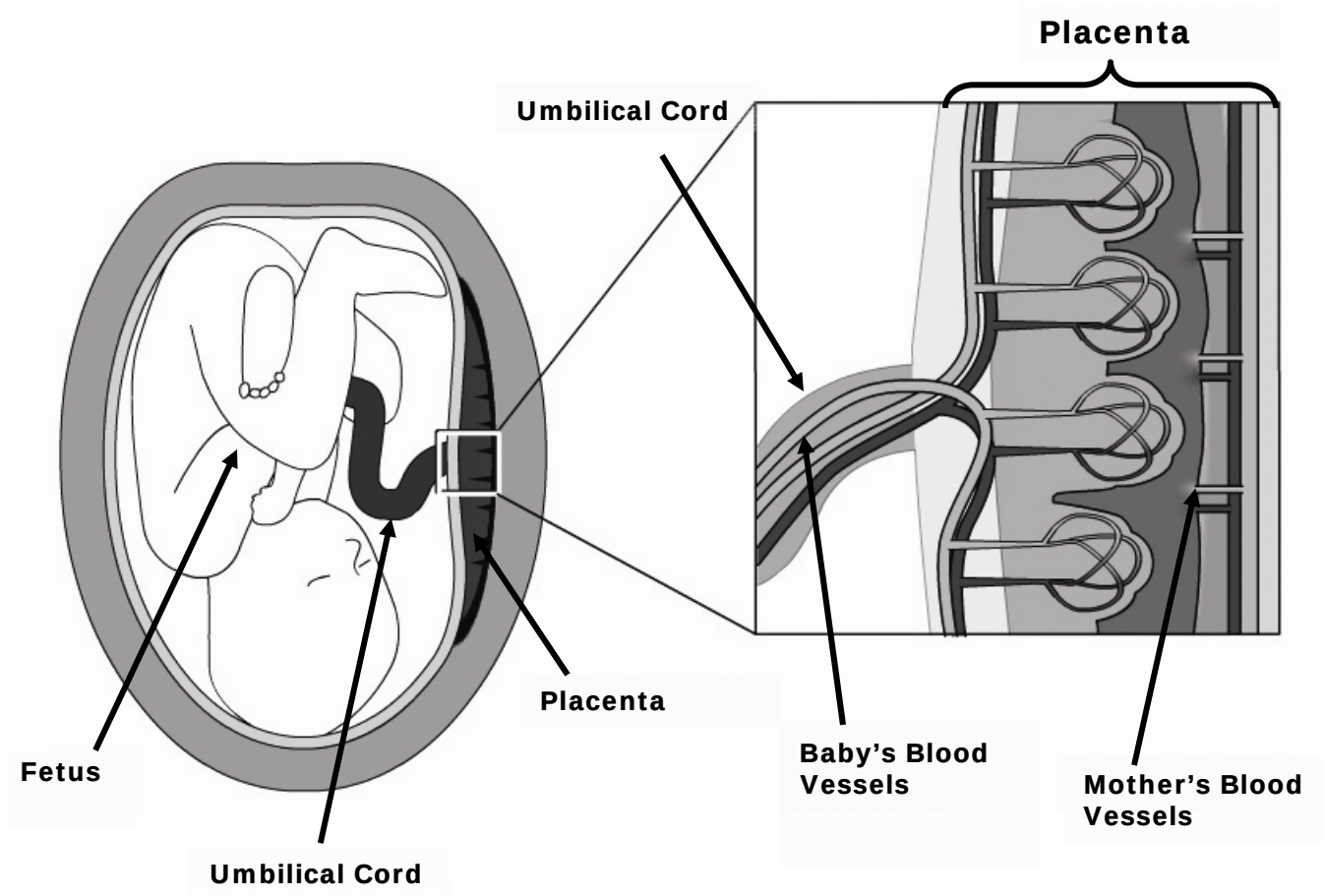
While you wait, go on to answer questions 3 through 6 in Part B. Also, go on to work on Part C.

Base your answers to questions 3 through 6 (on the next page) on the information in the reading and the diagram below, and on your knowledge of biology.

Do drugs diffuse from a mother to her developing baby?

The **placenta** is an organ that supplies a developing baby with oxygen and food, and allows the baby's wastes to be excreted into the mother's bloodstream. In the placenta, the mother's blood vessels come close to but do not connect with the baby's blood vessels. The mother's blood does NOT enter the baby. Instead, in the placenta, small molecules such as food, oxygen, wastes, or harmful substances diffuse from the mother's blood vessels to (or from) the developing baby's blood vessels. Larger substances, such as blood proteins and blood cells, cannot diffuse from the mother's blood to the baby's blood.

Many harmful substances in a mother's bloodstream, such as alcohol, cocaine, and nicotine, can easily enter a developing baby through the placenta and umbilical cord. Prenatal (before birth) exposure to harmful substances can cause the abnormal development or death of a baby.



3. What is meant by the term “prenatal drug exposure”?

   Exposure to drugs that occurs before birth.

4. Does the mother’s blood flow directly into the developing baby? Explain why or why not.

   No, because their blood vessels are not connected to each other.

5. Explain why the placenta is essential for the normal development of the baby.

   The placenta is the organ that supplies the fetus with food and oxygen and allows harmful wastes to leave the fetus.

6. The blood vessels of the mother and baby are not directly connected to each other. Explain how some harmful substances in the blood of a pregnant female can enter a developing baby.

   Harmful substances can diffuse out of the mother’s blood vessels and into the baby’s blood vessels.

7. Use the FLORATRYP Test Strips to test the mother’s blood and the baby’s blood for the presence of drugs.

   - Dip one FLORATRYP Test Strip into the “mother’s blood” in the cup. Is FLORATRYP present in the mother’s blood?

     Yes

   - Dip one FLORATRYP Test Strip into the “baby’s blood” in the dialysis tubing. Is FLORATRYP present in the baby’s blood?

     Yes

   If the FLORATRYP Test Strip turns DARK green or blue, the drug FLORATRYP is present in the blood.

8. In your model, did FLORATRYP diffuse through the placental membrane from the mother’s blood to the developing baby’s blood? Explain how you could tell.

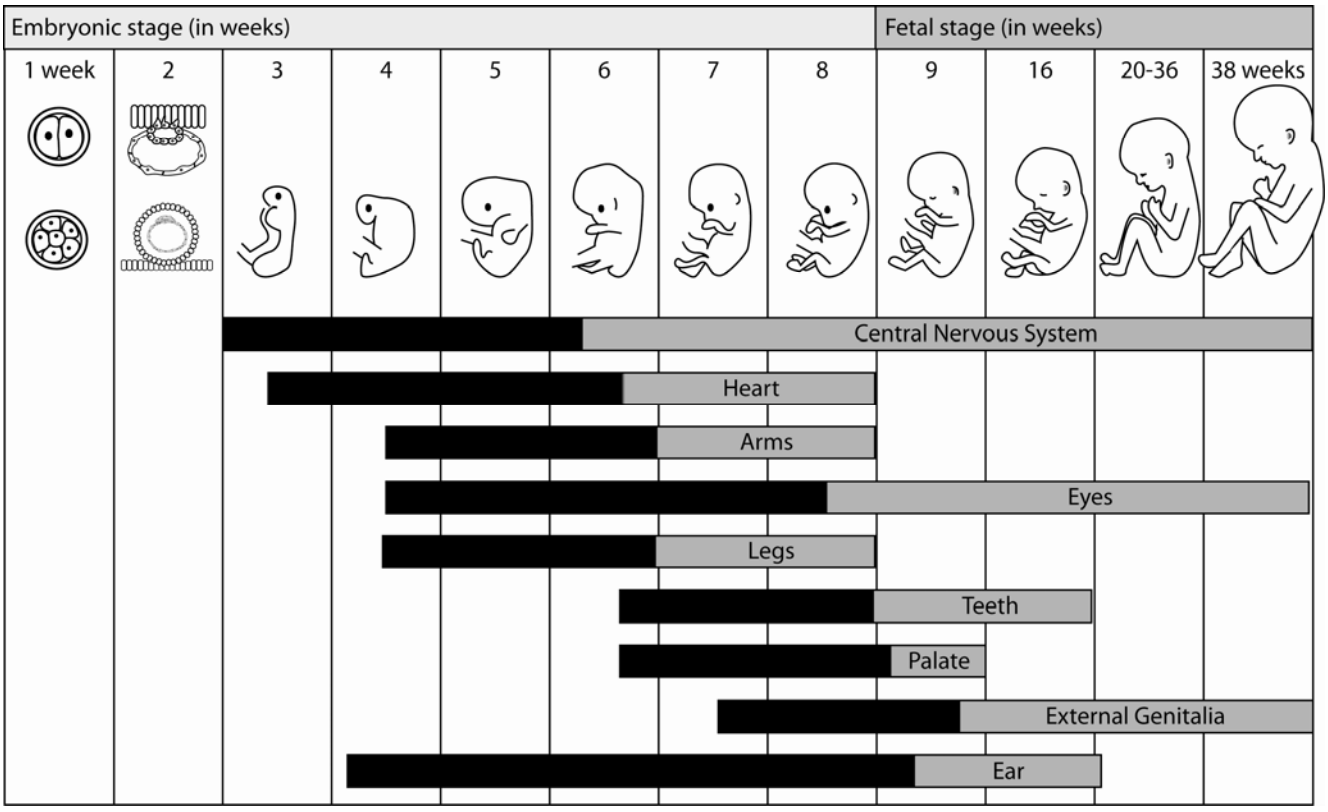
   Yes, the fetus’s blood turned the paper green/blue.

Part C: When do drugs affect a developing baby?

How a drug affects development depends on the type of drug, the embryo or fetus's stage of development, the strength of the drug, and how much and how often the mother took the drug when she was pregnant. Drugs reaching an embryo or fetus may have no effect, or they may cause major (obvious at birth) defects, or minor (subtle but noticed later in life) defects.

The chart below illustrates when developing organs may be affected by harmful substances. The chart will help you think about the effects of the mother's lifestyle on embryonic and fetal development.

- Black bars represent times when harmful substances may cause major structural abnormalities.
- Gray bars represent times when harmful substances may cause physiological (functional) or minor structural abnormalities.



1. An **embryo** is an unborn offspring in whom the major body organs are still forming. Once the major organs have formed, the unborn offspring is called a **fetus.** At the beginning of what week does an embryo become a fetus?

   9 weeks

2. At which stage (the embryo stage or the fetus stage) is exposure to harmful substances, such as alcohol or drugs, most likely to cause major birth defects?

   The embryo stage

3. During which weeks would prenatal exposure to drugs be likely to cause major birth defects that affect the CNS (brain and spinal cord)?

   Weeks 3-6

4. During which weeks might prenatal exposure to drugs be most likely to cause minor structural or physiological (functional) defects that affect the CNS (brain and spinal cord)?

   Weeks 6-38

5. How does prenatal exposure to drugs such as nicotine, alcohol, and cocaine affect developing babies? Do an Internet search using the search terms (shown in parentheses) found below. For each type of drug (tobacco and alcohol) list at least three negative effects that the drug may have on children whose mothers used the drug during pregnancy.

   - "prenatal tobacco exposure" and/or "prenatal nicotine exposure"

     Student answers will vary but may include: decreased birth weight and increased risks of birth defects, premature birth, sudden infant death syndrome, attention deficit disorder, hyperactivity, antisocial behavior, and learning disabilities.

   - "prenatal alcohol exposure"

     Student answers will vary but may include: fetal alcohol syndrome, which is characterized by slowed growth, facial abnormalities, nervous system damage including low IQ, learning disabilities, attention deficit hyperactivity disorders

   - "prenatal cocaine exposure"

     Student answers will vary but may include: decreased birth weight and increased risks of birth defects, premature birth, sudden infant death syndrome, attention deficit disorder, hyperactivity, antisocial behavior, and learning disabilities.

6. Which drug (alcohol, nicotine, or cocaine) has the greatest effect on children born to mothers who used the drug during pregnancy?

   Alcohol

7. When is a mother's use of drugs most likely to harm a developing baby—early in pregnancy or late in pregnancy?

   Early in pregnancy

8. Some people have suggested there should be a law that makes the use of drugs such as alcohol, tobacco, or illegal drugs during pregnancy a criminal offense.

   - Explain one advantage this kind of law.

     This type of law would protect the developing babies from being harmed by drugs.

   - Explain one disadvantage to this kind of law.

     Student answers will vary. Possible answers include: difficult to enforce, may prevent mothers from seeking prenatal care, there are other things that could cause harm to a baby before or after birth.

   - Would you support this kind of law? Explain why or why not.

     Student answers will vary. Accept any answer that is supported with an explanation.