

Human Embryo Development and Birth Defects

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In collaboration with the Centers for Disease Control and Prevention's
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Students will research the different stages of human embryo development. Next, the teacher will give a PowerPoint presentation about a category of birth defects known as neural tube defects (NTDs) and the relationship between NTDs and embryo development. Students then work in groups to research other birth defects and create and present a PowerPoint presentation to the class.

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Summary

Students will research the different stages of human embryo development. Next, the teacher will give a PowerPoint presentation about a category of birth defects known as neural tube defects (NTDs) and the relationship between NTDs and embryo development. Students then work in groups to research other birth defects and create and present a PowerPoint presentation to the class.

Learning Outcomes

- Students will identify and describe important developments in each stage of human embryo development.
- Students will explain defects that can occur during different stages of embryo development.
- Students will identify preventative methods available for birth defects

Materials

1. Computers with Internet access
2. PowerPoint

Total Duration

3 hours

Procedures

Teacher Preparation

The teacher should become familiar with embryo development and birth defects at each stage of embryo development (see “Human Embryo Development Stages”, “Birth Defects Listing and Information”, and “NTDs PowerPoint Presentation”). Download, print, and copy all supplemental documents for student use. Download the “NTDs PowerPoint Presentation”. This could also be printed out and used as a guide for students as they develop their own PowerPoint presentation.

Note to teachers: like many health-related topics, it is important to present the information about NTDs in a sensitive manner. Students may have been affected by an NTD or other birth defect or who have a family member or friend with a birth.

Web Resources

Title: The Visible Embryo

URL: www.visembryo.com/baby/index.html

Description: This Web site, supported by the medical community of the University of California Medical Center, shows human development at different stages of pregnancy and describes important areas of development for each stage.

Title: Birth Defects & Genetics: Other Birth Defects

URL: http://www.marchofdimes.com/pnhec/4439_10286.asp

Description: This March of Dimes Web site has a listing of many different birth defects, as well as general information and links to other organizations for each defect.

Supplemental Document

Title: Neural Tube Defects (NTDs)

File Name: NTDs PowerPoint.ppt

Description: This PowerPoint describes the types of NTDs, how an NTD occurs, and the importance of folic acid in the prevention of NTDs.

Introduction

Duration: 15 minutes

As a pre-assessment tool, the teacher will ask the students to brainstorm about birth defects. Students will be allowed five minutes to think of as many birth defects as they can. When time is up, the teacher will ask students to write their results on the board. The teacher will inform students that three percent of all babies born in the United States are affected by a birth defect. In order to understand these defects better, students will need to have a general understanding of how a human embryo develops.

Step 2

Duration: 30 minutes

After students have brainstormed about birth defects, they will become familiar with the different stages of embryo development using the VisEmbryo Web site found in the Web resource list that follows. The teacher will distribute the "Human Embryo Development Stages" worksheet, which will guide students through the Web site. Students should work either individually or in pairs to complete the worksheet. After completion, students should hand in the "Human Embryo Development Stages" worksheet for an assessment grade.

Web Resource

Title: The Visible Embryo

URL: www.visembryo.com/baby/index.html

Description: This Web site, supported by the medical community of the University of California Medical Center, shows human development at different stages of pregnancy and describes important areas of development for each stage.

Supplemental Documents

Title: Human Embryo Development Stages

File Name: Human Embryo Development Stages.doc

Description: This handout guides students through the Visible Embryo Web site. Students answer specific questions about the important developments for each stage.

Title: Human Embryo Development Stages Answer Key

File Name: Human Embryo Development Stages Answer Key.doc

Description: This document provides answers to the "Human Embryo Development Stages" handout.

Step 3**Duration: 25 minutes**

Now that students have a greater understanding of how an embryo develops, the teacher will introduce information on NTDs via a PowerPoint presentation. The presentation discusses the types of NTDs, explains how NTDs occur, and describes prevention methods women can use to decrease their chances of having a baby with an NTD.

Supplemental Document

Title: Neural Tube Defects

File Name: NTDs PowerPoint.ppt

Description: This PowerPoint describes how an NTD occurs, the types of NTDs, and the importance of folic acid in the prevention of NTDs.

Step 4**Duration: 1 hour, 40 minutes**

Following the presentation on NTDs, the students will be instructed to choose and research a birth defect other than NTDs using the Internet. The teacher distributes "Birth Defects PowerPoint Rubric". Working in groups of two or three, students will create a PowerPoint presentation on the birth defect they have chosen that includes all components listed on the rubric. Students could use the March of Dimes Web resource to find a birth defect to research. Students will then take turns presenting their PowerPoint presentations to the entire class. The presentations should be between 5 to 7 minutes in length. The teacher can assess the presentations using the "Birth Defects PowerPoint Rubric".

Web Resources

Title: Birth Defects & Genetics: Other Birth Defects

URL: http://www.marchofdimes.com/pnhec/4439_10286.asp

Description: This March of Dimes Web site has a listing of many different birth defects as well as general information and organizations with Web sites for each defect.

Supplemental Document

Title: Birth Defects PowerPoint Rubric

File Name: Birth Defects PowerPoint Rubric.doc

Description: This document is a detailed rubric about the contents of the students' PowerPoint presentations.

Conclusion**Duration: 10 minutes**

The teacher will then ask the students, "Now that we know about birth defects and when they occur during embryo development, what can we do as a society to increase awareness of these defects and to promote healthy behaviors such as folic acid use for prevention of some of them?" Possible ideas include TV commercials, posters, and word of mouth, etc. The teacher could also ask students to write down a way they will personally help to spread the word about folic acid use and other prevention strategies for birth defects.

Assessment

In step 2, students will be assessed using the “Human Embryo Development” supplemental document. In step 5, students will be assessed based on their PowerPoint and class presentations using the “Birth Defects Power Point Rubric”.

Modifications

Extension

Students could gain additional knowledge about folic acid by researching the pros and cons of fortifying foods with folic acid. Students could then debate fortification of foods with folic acid. Teachers could assign students different roles, such as a researcher who has made discoveries about the effects of folic acid use in prevention of NTDs, a parent of a child with spina bifida who believes that all women should be taking folic acid to prevent NTDs, a manufacturer who has to process fortified foods and believes the fortification will cost more money, or a consumer who believes that certain foods will cost more money now that they will be fortified with folic acid. In addition to these roles, students could use computers with Internet access to further research other opinions people might have regarding the fortification of foods with folic acid.

Education Standards

National Science Education Standards

SCIENCE AS INQUIRY, CONTENT STANDARD A:

As a result of activities in grades 9-12, all students should develop

- **Abilities necessary to do scientific inquiry**
- Understandings about scientific inquiry

LIFE SCIENCE, CONTENT STANDARD C:

As a result of their activities in grades 9-12, all students should develop understanding of

- **The cell**
- Molecular basis of heredity
- Biological evolution
- Interdependence of organisms
- Matter, energy, and organization in living systems
- Behavior of organisms

SCIENCE IN PERSONAL AND SOCIAL PERSPECTIVES, CONTENT STANDARD F:

As a result of activities in grades 9-12, all students should develop understanding of

- **Personal and community health**
- Population growth
- Natural resources
- Environmental quality
- Natural and human-induced hazards
- Science and technology in local, national, and global challenges

Human Embryo Development Stages

Human Embryo Development and Birth Defects
Kelly Day, CDC's 2005 Science Ambassador Program

Using a computer with Internet access, go to <http://visembryo.com/baby/index.html> and answer the following questions.

- 1. In embryo development stage 2, what type of replication are the first cells undergoing? What do you think would happen if a mutation occurred in one of these cells?**
- 2. At about 16 days post-ovulation, what layer will give rise to the hair, nails, and skin?**
- 3. Explain what a neural groove is, and at how many days post-ovulation does this form? What do you think might happen if this neural groove is not formed properly?**
- 4. At what stage does the heart become a four-chambered heart? What do you think might occur if the heart does not completely differentiate into four different chambers?**
- 5. During what stage is gender differentiated? What do you think might occur if the gender does not properly differentiate?**
- 6. Describe two major developments that occur during stage 23.**
- 7. During what week of development does the baby acquire the unique ridges that form fingerprints?**
- 8. During what week of development are the lungs completely capable of breathing air?**

- 9. Why is a fetus's eye color usually blue at Week 32 post-fertilization, regardless of the permanent color?**
- 10. At how many weeks post-fertilization is the baby considered "full term"?**
- 11. Describe why an infant is born with 300 bones, while an adult has 206 bones.**

Human Embryo Development Stages Answer Key

Human Embryo Development and Birth Defects
Kelly Day, CDC's 2005 Science Ambassador Program

Using a computer with Internet access, go to <http://visembryo.com/baby/index.html> and answer the following questions.

1. In embryo development stage 2, what type of replication are the first cells undergoing? What do you think would happen if a mutation occurred in one of these cells?

The cells are undergoing mitotic division. If one cell acquires a mutation, then all subsequent cells will also have the same mutation because during mitosis, every cell replicates from another cell and is the exact same as the cell it came from.

2. At about 16 days post-ovulation, what layer will give rise to the hair, nails, and skin?

The ectoderm.

3. Explain what a neural groove is, and at how many days post-ovulation does this form? What do you think might happen if this neural groove is not formed properly?

The neural groove is the organ that will eventually form the nervous system. This forms between 17 and 19 days post-ovulation. If the neural groove was not formed properly, the baby might have problems with his/her brain or spinal chord.

4. At what stage does the heart become a four-chambered heart? What do you think might occur if the heart does not completely differentiate into four different chambers?

At stage 17, the heart becomes four-chambered. If the heart does not completely differentiate into four chambers properly, the baby might have a congenital heart defect.

5. During what stage is gender differentiated? What do you think might occur if the gender does not properly differentiate?

During stage 20, gender is differentiated. If this did not occur properly, the baby might end up having organs of both sexes or an undistinguishable gender.

6. Describe two major developments that occur during stage 23.

Answers may vary. For example, taste buds begin to form, intestines begin to migrate into the body cavity.

7. During what week of development does the baby acquire the unique ridges that form fingerprints?

During week 16 post-fertilization.

- 8. During what week of development are the lungs completely capable of breathing air?**
During week 26 post-fertilization.
- 9. Why is a fetus's eye color usually blue at week 32 post-fertilization, regardless of the permanent color?**
Eye color is usually blue because pigmentation is not fully developed until the eyes receive light exposure.
- 10. At how many weeks post-fertilization is the baby considered "full term"?**
40 weeks.
- 11. Describe why an infant is born with 300 bones, while an adult has 206 bones?**
As the baby grows, some bones will fuse together.

Birth Defects Power Point Rubric

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| Criteria | 4 | 3 | 2 | 1 |
|--|--|---|--|---|
| How does this birth defect occur? | Presentation includes an understandable and correct explanation of how this birth defect occurs. Also included is when, during the pregnancy, this birth defect could occur. | Presentation includes a somewhat understandable and correct explanation of how this birth defect occurs. Also included is when, during the pregnancy, this birth defect could occur. | Presentation includes a correct explanation of how this birth defect occurs. The explanation is not very clear. Also included is when, during the pregnancy, this birth defect could occur. | Presentation includes an explanation of how this birth defect occurs. The explanation is either not correct, or not understandable at all. The presentation does not include when, during the pregnancy, this birth defect could occur. |
| How can people with NTDs manage their condition? | Presentation clearly explains that there is no cure for this defect and explains some of the methods that doctors use to help people with this defect manage their condition, if any methods are available . | Presentation somewhat clearly explains that there is no cure for this defect and mentions at least one of the methods that doctors use to help people with this defect manage their condition, if any methods are available . | Presentation does not clearly explain that there is no cure for this defect and does not mention at least one of the methods that doctors use to help people with this defect manage their condition, if any methods are available . | Presentation incorrectly states that a cure for this defect exists and does not include at least one of the methods that doctors use to help people with this defect manage their condition, if any methods are available . |
| | Presentation includes clear and understandable information about how the birth defect could be prevented. If no prevention methods are currently | Presentation includes somewhat clear and understandable information about how the birth defect can be prevented. If no prevention methods are | Presentation includes unclear information about how the birth defect can be prevented. If no prevention methods are | Presentation does not include information about how the birth defect can be prevented. If no prevention methods are currently available, |

| | | | | |
|--|--|---|---|--|
| <p>How can this birth defect be prevented?</p> | <p>available, presentation includes clear and understandable information about current research into the birth defect.</p> | <p>currently available, presentation includes somewhat clear and understandable information about current research into the birth defect.</p> | <p>currently available, presentation includes unclear information about current research into the birth defect.</p> | <p>presentation does not include information about current research into the birth defect.</p> |
| <p>Is there a reference slide included at the end of the presentation? Is the presentation within the appropriate time limit of 5-7 minutes? Are all group members involved in the presentation? Is the presentation creative and neat?</p> | <p>All four requirements met.</p> | <p>Three requirements met.</p> | <p>One to two requirements met.</p> | <p>No requirements met.</p> |

Roles for Folic Acid Debate

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1. **Folic acid researcher.** You have been involved with the research of positive effects of folic acid on birth defects. You have also published several papers regarding these effects. What would be your argument for fortifying foods with folic acid?
2. **Parent of a child with spina bifida.** You are a parent who has a child with spina bifida. If foods had been fortified with folic acid, it might have decreased the chance of your child having the birth defect. What would be your argument for fortifying foods with folic acid?
3. **Manufacturer who now has to process fortified foods.** You are a manufacturer who will now have to make sure all the food you process will be fortified with folic acid. What would be your argument for fortifying foods with folic acid?
4. **Doctor.** You are a doctor who has not seen a significant decrease in neural tube birth defects. You may still support the use of folic acid for other reasons. What would be your argument for the fortification of foods?
5. **Congressperson.** You are currently working with a large Hispanic population. The Hispanic population tends to have a greater risk of neural tube defects than other populations. What would your argument be for the fortification of foods with folic acid?
6. **Consumer.** You are concerned about the increase in prices of certain foods. You start to think the government is fabricating the story of how folic acid prevents birth defects. What would your argument be for the fortification of foods with folic acid?
7. **Others.** What are some other people that might have varying opinions about fortification of foods with folic acid? What would their arguments be?