

## Activity 6

### Effects of Prenatal Drug Exposure - Long Term Studies

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*NOTE: This is a 2-part activity (Part A and B)*

#### Part A: Does FLORATRYP affect brain development?

##### Core Concept:

Long-term studies can be used to study the effect of drugs on the brain and child development.

##### Class time required:

Approximately 40-60 minutes.

##### Teacher Provides:

- Copy of student handout entitled “**Effects of prenatal drug exposure: A simulated long-term study**” for each student.
- Access to a calculator for each student team.
- Safety goggles for each student.
- Kit of materials for **Part 1: Testing Mother’s Urine for Drugs** that includes:
  - Optional: Microtube or test tube rack
  - One bag labeled “FLORATRYP Test Strips” that contains at least 10 strips of pH 1-12 paper. Order from [www.microessentiallab.com](http://www.microessentiallab.com), catalog number 4800.
  - 10 2.0ml microtubes (or small test tubes) of simulated urine prepared using the information in the following table. Note: A 10% solution of household ammonia may be substituted for pH 10 buffer.

Label on Tube	Contents of Tube - 1 ml of:
<b>Mother 98</b>	pH 10 buffer + yellow food color to simulate urine
<b>Mother 07</b>	pH 6 buffer + yellow food color to simulate urine
<b>Mother 23</b>	pH 6 buffer + yellow food color to simulate urine
<b>Mother 56</b>	pH 10 buffer + yellow food color to simulate urine
<b>Mother 11</b>	pH 10 buffer + yellow food color to simulate urine
<b>Mother 35</b>	pH 6 buffer + yellow food color to simulate urine
<b>Mother 62</b>	pH 6 buffer + yellow food color to simulate urine
<b>Mother 77</b>	pH 10 buffer + yellow food color to simulate urine
<b>Mother 90</b>	pH 6 buffer + yellow food color to simulate urine
<b>Mother 74</b>	pH 10 buffer + yellow food color to simulate urine

- An envelope containing materials for Part 2 labeled “Mental Development Index Tests.” Fill this envelope with strips of paper with each baby’s mental development index score. To make these slips of paper, cut along the dotted lines. Shuffle the strips of paper before you insert them into the envelope. Consider laminating these strips.

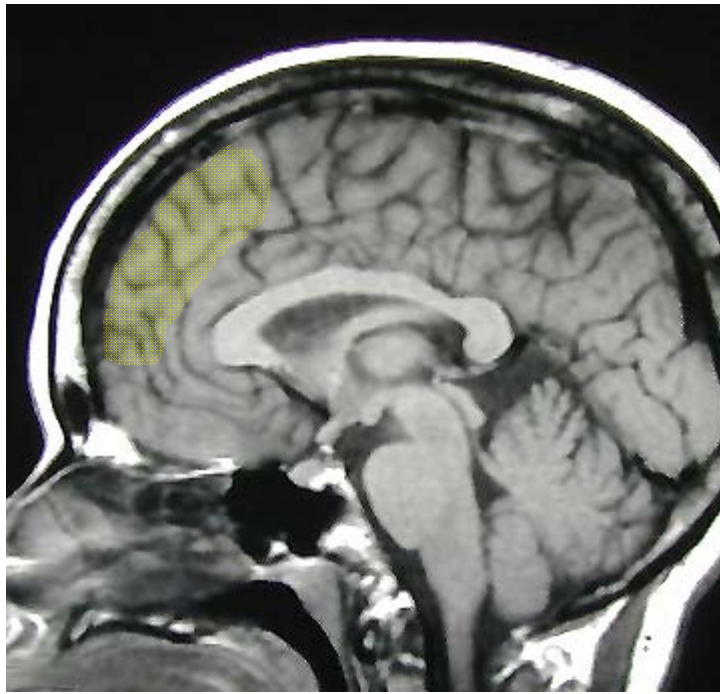
Baby 22	<b>Two Year Mental Development Index Score 94</b>
Baby 34	<b>Two Year Mental Development Index Score 80</b>
Baby 63	<b>Two Year Mental Development Index Score 86</b>
Baby 71	<b>Two Year Mental Development Index Score 83</b>
Baby 85	<b>Two Year Mental Development Index Score 75</b>
Baby 19	<b>Two Year Mental Development Index Score 97</b>
Baby 38	<b>Two Year Mental Development Index Score 88</b>
Baby 76	<b>Two Year Mental Development Index Score 90</b>
Baby 91	<b>Two Year Mental Development Index Score 92</b>
Baby 92	<b>Two Year Mental Development Index Score 70</b>

- An envelope containing materials for Part 3, labeled “Magnetic Resonance Imaging Results.” Duplicate the next 5 pages IN COLOR. Note: if you look closely at the diagrams for babies 22, 71, 85, 76, and 92, each have portions of the cortex that are colored a faint yellow. Cut along the dotted lines on the diagrams on the following five pages. Fill the envelope with diagrams of each baby’s MRI. Shuffle the MRI diagrams before you insert them into the envelope. Consider laminating the MRI’s.

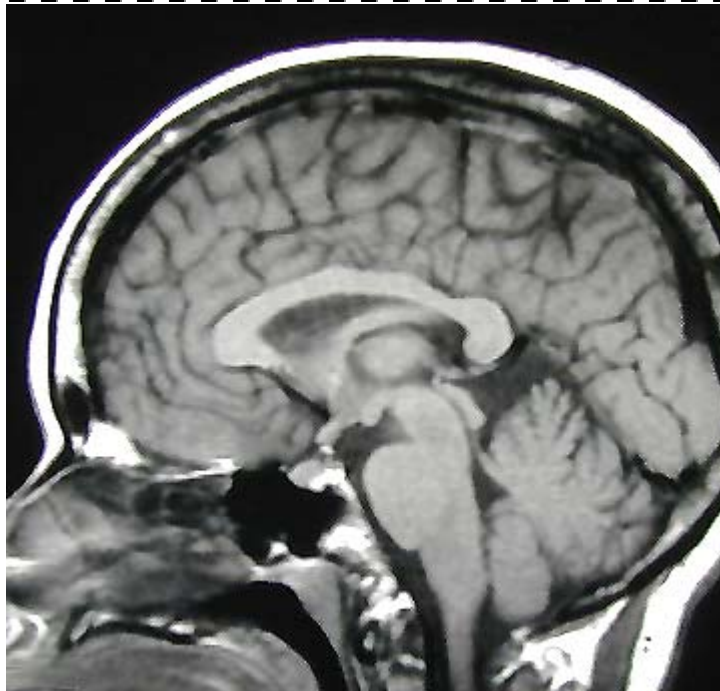
This project was generously funded by Science Education Drug Abuse Partnership Award R25DA021697 from the National Institute on Drug Abuse. The content is solely the responsibility of the authors and does not necessarily represent the official views of the National Institute on Drug Abuse or the National Institutes of Health.

Source for MRI photos: <http://www.siumed.edu/anatomy/images/brainmrisag2.jpg>

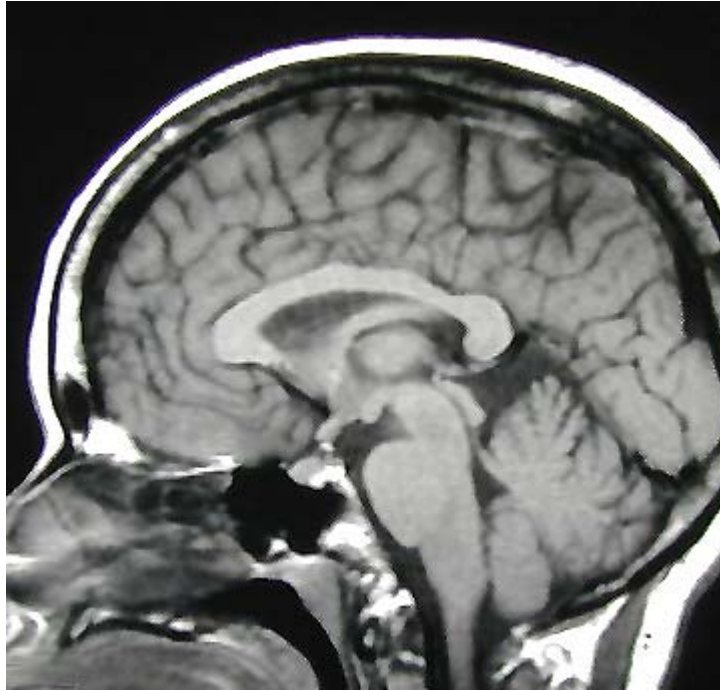
**Baby 22**



**Baby 34**



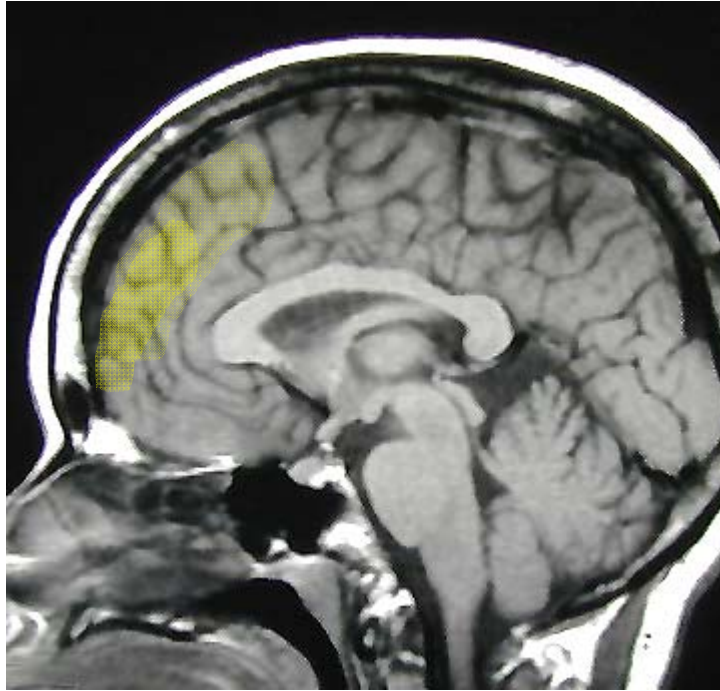
**Baby 63**



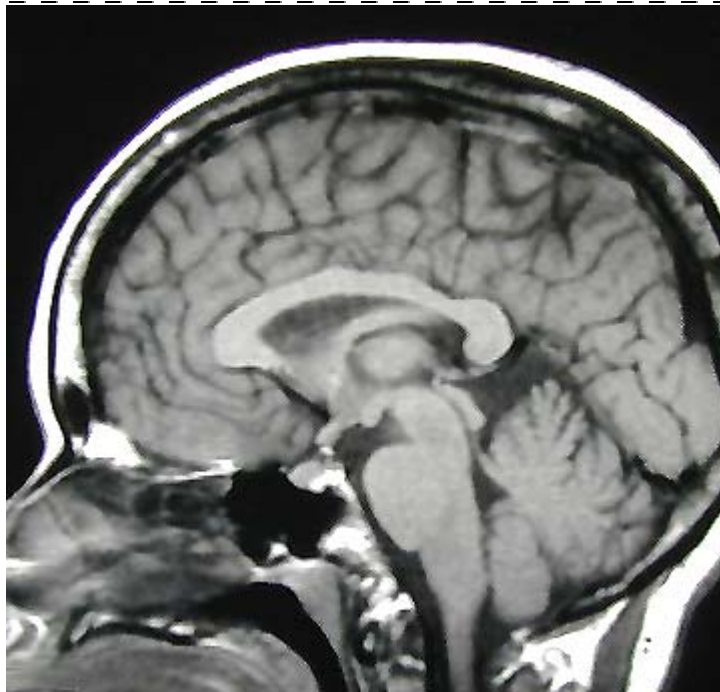
**Baby 71**



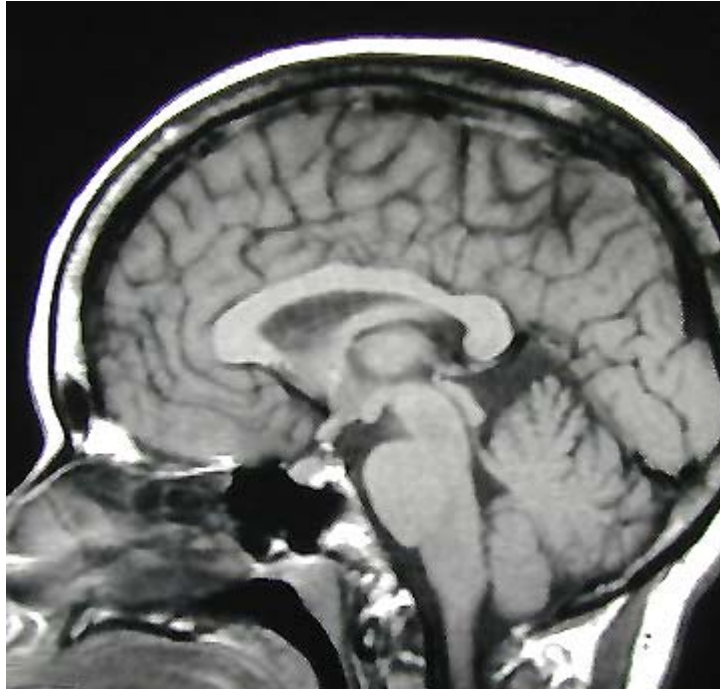
**Baby 85**



**Baby 19**



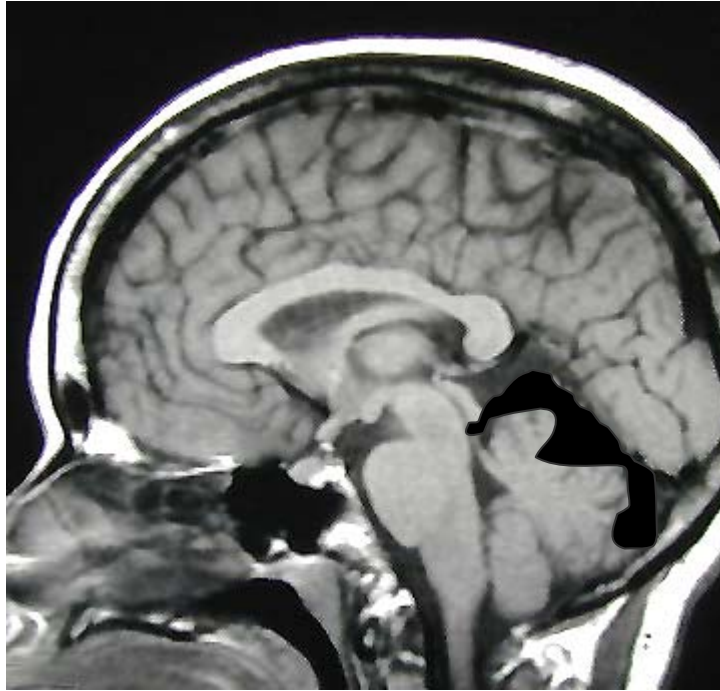
**Baby 38**



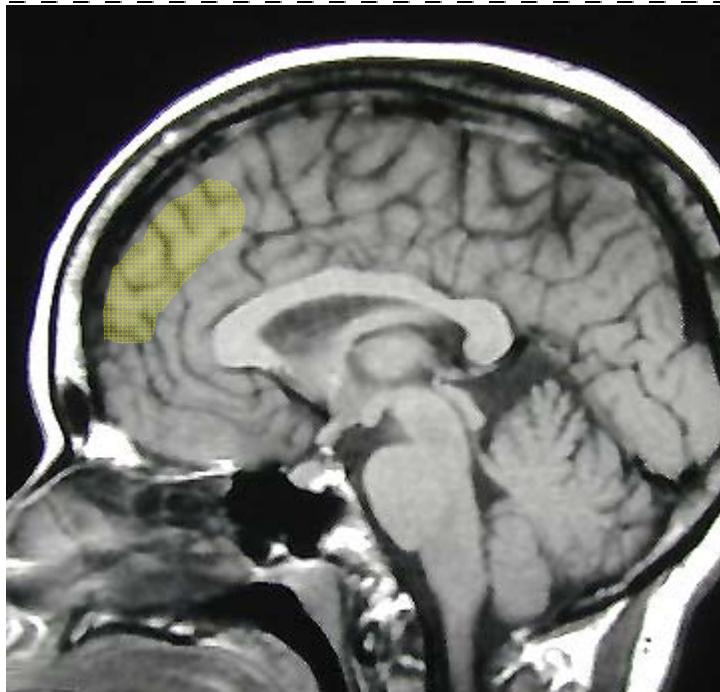
**Baby 76**



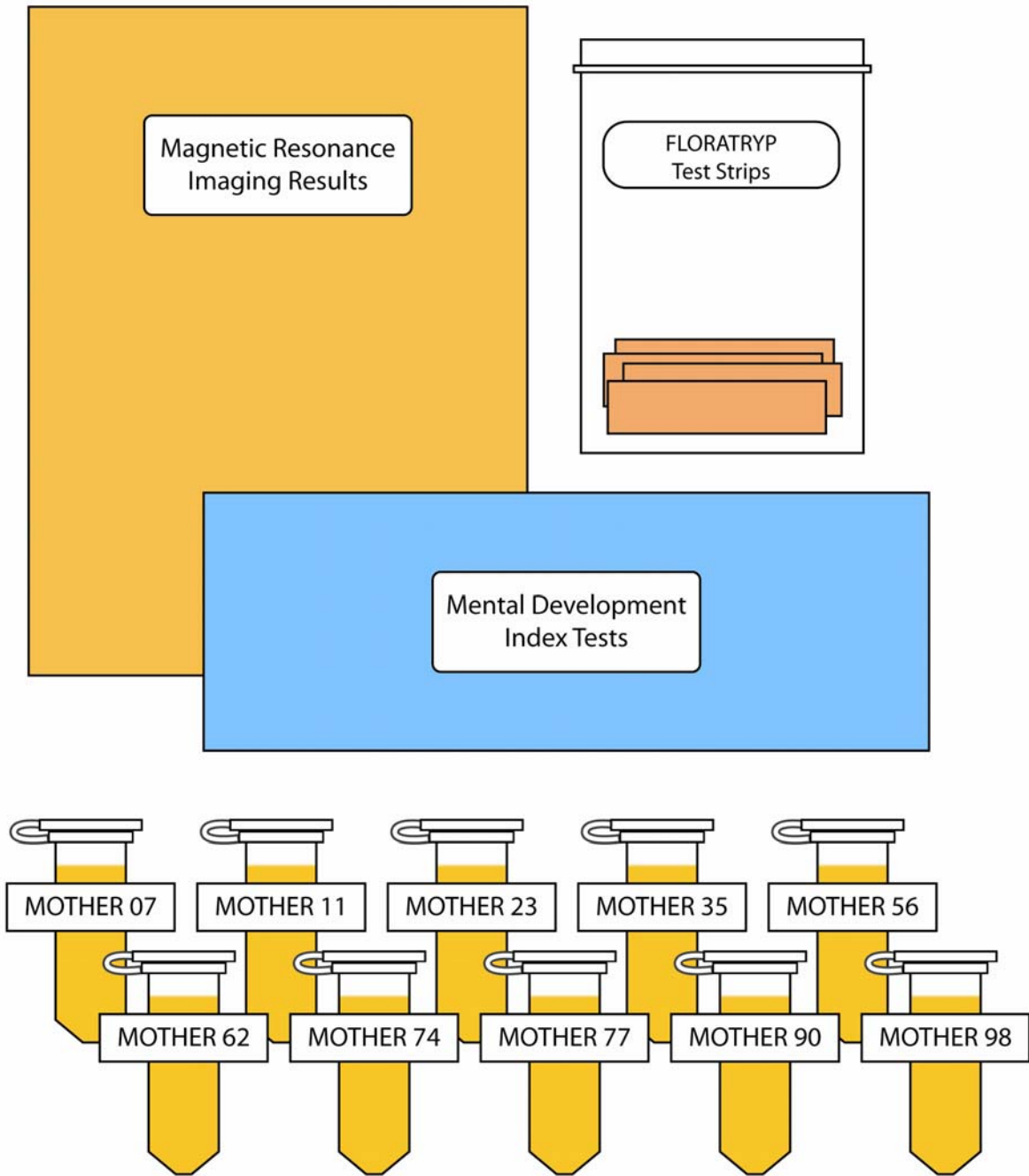
Baby 91



Baby 92



**Quick Guide:**





### **Suggested Class Procedure for Part A:**

1. Distribute copies of the student handout entitled “**Effects of prenatal drug exposure: A simulated long-term study**” to each student.
2. Read the information in the box aloud to the class.
3. Explain that students will be collecting and analyzing the data from the mothers and the children who are participating in this long-term study.
4. Explain that this lab activity does NOT involve real drugs. FLORATRYP is a fictitious drug and the chemicals that have been used to simulate this drug are poisonous.
5. Have students tear off the last page of this handout (Research Data Table), so that they can use this sheet to record the data that they collect.
6. Distribute materials needed for **Part 1: Testing Mothers’ Urine for Drugs** and ask students to complete Part 1.
7. Tell students that when they complete each part of this lab activity, they should return the materials they are using and ask for the materials for the next part.
8. Distribute materials for remaining parts of this activity, when requested by students. You may choose to discuss the results of each test as students complete each part or to discuss the results at the end of the activity.
9. If time permits, have students share and discuss their answers to questions in Part A of the activity.
10. Students may complete Part B in class or for homework. Take time to have students share their ideas for experimental designs with their classmates.

## **Part B: Does prenatal FLORATRYP exposure lead to changes in adolescents or adults?**

### **Core Concept:**

Prenatal drug exposure may have long-term effects extending into adolescence and adulthood.

### **Class time required:**

Approximately 40 minutes.

### **Teacher Provides:**

Copy of student handout entitled “**Does prenatal FLORATRYP exposure lead to changes in adolescents or adults?**” for each student.

### **Suggested Class Procedure for Part B:**

1. Distribute a copy of the student handout entitled “**Does prenatal FLORATRYP exposure lead to changes in adolescents or adults?**” 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 complete the activity.
4. Have students share and peer review their experimental designs.
5. Allow time for discussion of student answers to questions 12 and 13.
6. Also consider discussing the ethical issues associated with this type of study.

## Activity 6

### Effects of Prenatal Drug Exposure - Long Term Studies

#### Part A: Does FLORATRYP affect brain development?

##### Babies at Risk?

##### Effects of Prenatal Exposure: A simulated long-term study

As the use of “FLORATRYP” (a new, illegal drug) increases, scientists are concerned that mothers’ use of FLORATRYP during pregnancy will harm their developing babies. Scientists know that prenatal exposure to drugs like nicotine and alcohol harms developing babies. They are concerned that FLORATRYP use during pregnancy might have similar effects on developing babies.

Scientists are conducting a long-term research study to determine the effects of prenatal exposure to FLORATRYP. Hundreds of women have agreed to participate in this study. Approximately half of the women in this study had used FLORATRYP (but no other drugs) while they were pregnant. The other women in the study had not used FLORATRYP or any other drugs when they were pregnant.

The researchers have asked you to assist with collecting data for a part of this study by:

- **Conducting urine tests on samples from ten women (mothers).**
- **Recording mental development test scores from the children (age 2 years).**
- **Interpreting the brain scan results of the children (age 8 years).**

*Note: To maintain confidentiality, each of these women and their children has been assigned an identification number.*

#### **1. Testing Mothers’ Urine for Drugs**

Samples of each woman’s urine were collected on the day that their baby was born. You will need to test the urine samples to determine which of the mothers have the drug FLORATRYP present in their urine.

1. Your lab kit contains 10 tubes of urine samples that were collected from the mothers who are participating in this study. These tubes are labeled with the mothers’ identification numbers.
2. Dip a different FLORATYRP Test Strip into each of the urine samples. If the test paper turns dark green or blue, FORATRYP is present in the mother’s urine.
3. Record the results of the FLORATRYP tests on the Research Data Table on the last page of this lab activity. You may tear this data table off to make recording of data easier.
4. Use a highlighter or light colored marker to color the entire row for the mothers who had FLORATRYP in their urine.

## **2. Mental Development Tests at Two Years**

When the children were two years old, a psychologist administered a test called the Mental Development Index (MDI) to each of the children. An ideal score on the Mental Development Index is 100.

The envelope labeled “Mental Development Index Tests” contains the psychologist’s reports for each of the children. The psychologists did not know whether the children’s mothers were or were not FLORATRYP abusers.

1. Enter the scores from the Mental Development Index tests into the Research Data Table.
2. Determine the average Mental Development Index test scores for:
  - Babies born to women who used FLORATRYP **82.4 points**
  - Babies born to women who did not use FLORATRYP. **88.6 points**
3. Does the data support the hypothesis that prenatal FLORATRYP exposure interferes with normal mental development? Explain why or why not.

***Yes, there is a difference of 6 points.***

4. What factors, other than prenatal FLORATRYP exposure, could cause decreased scores on the Mental Development Index test?

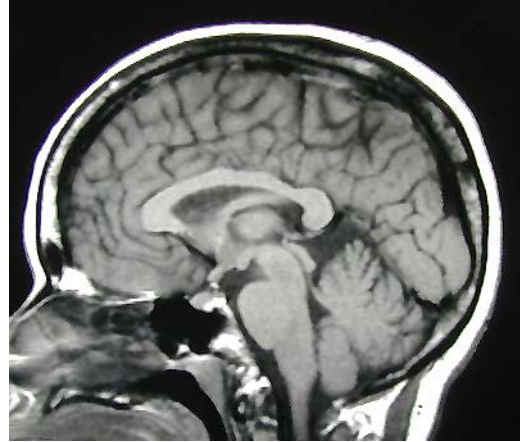
***Use of other drugs (alcohol and nicotine), nutrition, genetics, premature birth, etc.***

### 3. Brain Studies at Eight Years

When the children were eight years old, researchers used magnetic resonance imaging (MRI) to examine the brains of the children. The researchers looked at both the brain structure and the biochemicals present in different brain regions.

1. The envelope labeled “Magnetic Resonance Imaging Results” contains the MRI images of the brains of each of the children. Examine the MRI images for differences in the structure (size and shape, NOT color) of the different parts of the brain.

- If there are no structural differences, record “normal” in the Research Data Table.
- If there are structural differences, write “abnormal” and identify the part of the brain that is abnormal in the Research Data Table.



**Normal Brain Structure**

2. Do the MRI images provide evidence that prenatal FLORATRYP exposure causes structural changes in the brain?

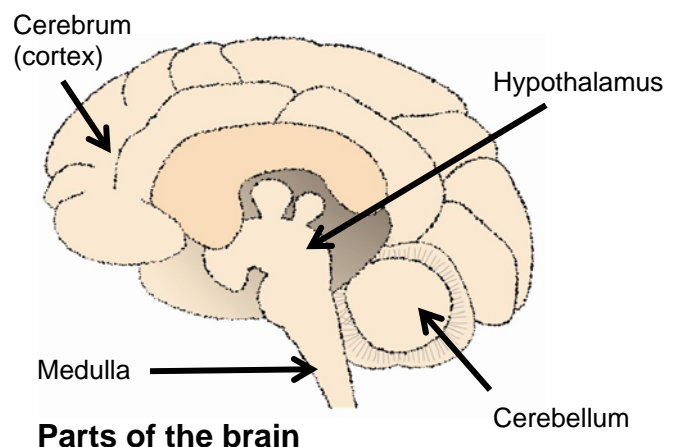
***No, there is only one child with structural differences in his brain and that child’s mother did not have drugs present in her urine test.***

One biochemical measurement included in the MRI scans was creatine level. All brain cells require creatine for normal energy functions. Creatine helps supply energy to tissues. Increased concentrations of creatine can indicate either damage to nerve cells or changes of brain cell function.

3. Look closely at the MRI’s. Some of the MRI’s have yellow areas. Yellow areas indicate that these parts of the brain are producing higher than normal levels of creatine.

4. In the Research Data Table, indicate whether the creatine levels in each of the children’s brains are normal (not yellow) or high (yellow).

5. If the creatine levels are high, also write the part of the brain that shows high creatine levels.



6. Do the MRI creatine tests show that prenatal FLORATRYP exposure interferes with normal brain biochemistry?

***Yes, all of the children who had prenatal exposure to FLORATRYP showed high levels of creatine in the front part of the cerebrum.***

<b><i>Part of Brain</i></b>	<b><i>Function Associated with Part of Brain</i></b>
<b>Cerebrum (cortex)</b>	Higher brain functions such as thought, memory, and action.
<b>Hypothalamus</b>	Sleep and emotions
<b>Cerebellum</b>	Balance and coordination of muscle activity
<b>Medulla</b>	Regulation of breathing and heart rate

7. Explain what problems might be associated with high creatine levels in the cerebrum (cortex).

***High creatine might indicate that the cerebrum has been damaged by FLORATRYP use and this might affect memory, impulse control and attention associated with LD and ADHD.***

8. Based on all the information in your Research Data Table, do you think that prenatal exposure to FLORATRYP causes changes to the brain? Support your answer with evidence from the data table.

***Yes. FLORATRYP can cause changes in mental development and in frontal cortex creatine levels.***

**Part B: Does prenatal FLORATRYP exposure lead to changes in adolescents or adults?**

**Does prenatal FLORATRYP exposure lead to changes in adolescents or adults?**

Some researchers are concerned that the effects of prenatal exposure to FLORATRYP, an illegal drug, may appear or become worse during adolescence or adulthood.

The researchers would like you to design a long-term controlled study to investigate the effects of prenatal FLORATRYP exposure on the behavior or learning of adolescents and adults.

1. List at least three possible effects that prenatal FLORATRYP exposure might have on the behavior or learning of adolescents or adults.

***Student answers will vary but may include ADHD, behavioral problems, risk-taking behavior, drug abuse, depression, etc.***

2. Select one of the potential effects (from your list above) that you would like to investigate in your research study.

***Student answers will vary.***

3. Explain how you could collect data related to this effect.

***Student answers will vary.***

4. What is the hypothesis that you will be testing in your research study? State your hypothesis as an If....., then.....statement.

**Hypothesis:** The prediction that could be tested in an experiment. The hypothesis is stated as an "If ....then....." statement.

***If*** \_\_\_\_\_,

(Independent variable)

***then*** \_\_\_\_\_

(Dependent variable)

***Student answers will vary. For example: If adolescents or adults had prenatal FLORATRYP exposure, then they will be more likely to have ADHD than people who did not have prenatal FLORATRYP exposure.***

5. Describe how the experimental group and the control group in your study should be different.

***The people in the experimental group had prenatal exposure to FLORATRYP. The people in the control group did not have prenatal exposure to FLORATRYP.***

**Control group** does not receive a treatment. The control group serves as a basis for comparison.

**Experimental group** receives the treatment.

6. List five characteristics or factors that must be kept the same in both the experimental group and control group.

***Student answers may vary but may include same: age, nutrition, stress, depression, type of home environment and mothers only used cocaine, had same prenatal care, did not have depression.***

7. What type of data should be collected to support or refute (disprove) the hypothesis.

***Student answers will vary but should be specifically related to their hypothesis. For example, people should be given tests to see if they are diagnosed as having ADHD.***

8. What is the **independent variable** in your study?

***FLORATRYP or no FLORATRYP exposure***

**Independent variable** (or manipulated variable) is the variable (factor) you change on purpose in the experiment.

**Dependent variable** (or responding variable) is the variable that may change as a result of a change in the independent variable. The dependent variable is the data that is observed and measured in a controlled experiment.

9. What is the **dependent variable** in your study?

***Student answers will vary but should be specifically related to their hypothesis. For example, people should be given tests to see if they are diagnosed as having ADHD.***

**Controlled variables** are factors that are kept the same in the control group and the experimental group so that your experiment is a fair test.

10. What are the **controlled variables** in your research study?

***Student answers may vary but may include same: age, nutrition, stress, depression, type of home environment and mothers only used cocaine, had same prenatal care, did not have depression.***



11. Prepare a data table that you could use to organize the data collected for your research study.

***Student answers may vary in their complexity but should at least include information such as shown in the example below:***

<b><i>Prenatal FLORATRYP Exposure (yes or no)</i></b>	<b><i>Has ADHD (yes or no)</i></b>

12. Describe the results of your research study that would lead to the conclusion that your hypothesis was supported.

***If more people who were exposed to cocaine had ADHD (or other dependent variable) than people who were not exposed to drugs.***

13. Explain why it would be important to include a large number of participants in the control group and experimental group for your research study.

***A large number of participants increases the reliability of the results of an experiment.***

14. Explain two reasons why doing this type of research study would be difficult.

***Student answers will vary but may include:***

- ***Keeping results confidential***
- ***Finding subjects for the control group and experimental group that had the same characteristics.***
- ***Finding people in the original study who were willing to participate now that they are adolescents or adults.***

## Research Data Table

Mother's ID Number	Baby's ID Number	FLORATRYP in Mother's Urine? (YES or NO)	Two Year Mental Development Index score	Eight Year Brain Structure	Eight Year Creatine Levels
M 98	B 22	YES	94	Normal	High Cerebral cortex
M 07	B 34	NO	80	Normal	Normal
M 23	B 63	NO	86	Normal	Normal
M 56	B 71	YES	83	Normal	High Cerebral cortex
M 11	B 85	YES	75	Normal	High Cerebral cortex
M 35	B 19	NO	97	Normal	Normal
M 62	B 38	NO	88	Normal	Normal
M 77	B 76	YES	90	Normal	High Cerebral cortex
M 90	B 91	NO	92	Abnormal cerebellum	Normal
M 74	B 92	YES	70	Normal	High Cerebral cortex